Conjugated linoleic acid (CLA), an octadecadienoic fatty acid, is a derivative of linoleic acid with conjugated double bonds which occurs naturally in meat and milk from ruminants. CLA has been shown to benefit health in animal models. Our previous work with lactating dairy cows benefits in animal models. Our previous work with lactating dairy cows

Key Words: conjugated linoleic acid, CLA, fat

Variation of milk fat concentration of conjugated linoleic acid and milk fat percentage is associated with a change in ruminal biohydrogenation. J. M. Griinari1, K. Nurmela1, D. A. Dwyer2, D. M. Barbano1, and D. E. Bauman1, Cornell University, Ithaca, NY USA, 2Valio Ltd., Helsinki, Finland.

Conjugated linoleic acids (CLA) have demonstrated a number of health benefits in animal models. Our previous work with lactating dairy cows has shown that a wide range of milk fat CLA concentrations can be produced (Kelly et al. 1998. J. Nutr.128:881). This study was conducted to produce milk fat with high CLA content. Cows (n=23) were fed a total mixed diet with 30% forage supplemented with sunflower oil
at 5.3% of dietary dry matter. Data presented here are based on milk samples (n=23) obtained on day 11 after the feeding of the sunflower oil supplemented diet was started. A subset of these cows which had the highest milk fat content of CLA (n=10) were sampled again on day 18. Concentration of cis-9, trans-11 CLA in milk fat on day 11 averaged 2.55% of total fatty acids and the individual cows ranged from 0.7 to 4.9%. Unexpectedly, over the next seven days in the high CLA subset, milk fat content of cis-9, trans-11 CLA decreased from an average of 3.49 to 1.95%. Decrease in milk fat cis-9, trans-11 CLA was associated with a decrease in milk fat content of trans-11 C18:1 and with an increase in trans-10 C18:1 suggesting a change in ruminal biohydrogenation. Variation in milk fat concentration of cis-9, trans-11 CLA in the entire data set was closely predicted by concentrations of trans-11 C18:1 in milk fat (y = 0.40x + 0.46; R² = 0.8). Similarly, variation in milk fat concentration of another CLA-isomer, tentatively identified as trans-10, cis-12 CLA, was predicted by concentrations of trans-10 C18:1 in milk fat (y = 0.013x + 0.011; R² = 0.7). Furthermore, variation in milk fat percentage was predicted by concentrations of trans-10, cis-12 CLA in milk fat (y = -0.1x + 3.47; R² = 0.5). These data support the role of trans-11 C18:1 as a precursor of milk fat cis-9, trans-11 CLA over a wide range of trans-11 C18:1 supply. Data also provide additional support for our previous work (Grinari et al. 1998. JDS. 81:1251) indicating an involvement of trans-10 C18:1 and trans-10, cis-12 CLA in milk fat depression.

Key Words: CLA, Milk fat depression, Biohydrogenation

4 Examination of the importance of ∆9-desaturase and endogenous synthesis of CLA in lactating dairy cows. B. A. Corl1, S. H. Lacy1, L. H. Baumgard1, D. A. Dwyer1, J. M. Grinari1, and D. E. Bauman1, 2Cornell University, Ithaca, NY, 2Valo Ltd., Helsinki, Finland. 3 New Crops Research Unit at the National Center for Agricultural Utilization Research, ARS, USDA.

Conjugated linoleic acids (CLA) are geometric and positional isomers of linoleic acid which have been shown to have a number of positive health benefits in animal models. CLA is an intermediate in the biohydrogenation of linoleic acid by rumen bacteria and it was thought this was the sole source of CLA in ruminants. However, we challenged this idea and our recent studies demonstrated that endogenous synthesis of CLA occurs from trans-11 C18:1, another intermediate in rumen biohydrogenation, via the enzyme ∆9-desaturase (Corl et al., J. Dairy Sci. 81 (Suppl. 1):233). Our objective in this study was to examine the importance of ∆9-desaturase and the extent of endogenous synthesis of CLA. To do this, we used sterculic acid, a nineteen carbon fatty acid with a cyclopentene ring structure located between carbons 9 and 10, which specifically inhibits ∆9-desaturase. Sterculic acid was isolated from the seeds of Sterculia foetida. We found the seeds contained 23% oil by mass, and sterculic acid comprised 55% of the fatty acids in the oil. The oil was prepared as an emulsion in water and was abomasally infused into high producing dairy cows. In the preliminary study, 3 cows (140 ± 53 DIM) were abomasally infused for 4 d with the emulsion (10 g/d sterculia oil). Infusion had no effect on dry matter intake or the yield of milk and milk fat. However, milk fat composition was altered. Consistent with an inhibition of ∆9-desaturase, the ratio of stearate to oleate was increased by 181%. Furthermore, the infusion of sterculia oil reduced CLA by 40%. This represents a minimum estimate of the contribution of endogenous synthesis of CLA and studies are in progress to refine this estimate. Nevertheless, it is clear that endogenous synthesis of CLA is a major source of CLA in milk fat.

Key Words: CLA, desaturase


One hundred, forty-four pigs (initially 41 kg BW) were used to determine the interactive effects between fat source and modified tall oil (MTO) on growth performance and carcass characteristics. Pigs were blocked by ancestry and initial weight and randomly allotted to one of the twelve treatments arranged in a 2 X 2 X 3 factorial with main effects of sex (barrows (B) or gilts (G)), MTO (0 or .5% of the diet), and fat source (no added fat (NF), 6% choice white grease (CWG), or 6% poultry fat (PF)). Corn-soybean meal diets were fed from 41 to 66 (1.1% lysine) and 66 to 113 (.75% lysine) kg. Overall, B had greater (P < .0001) ADG and ADFI compared to G. Modified tall oil had no effect (P < .16) on ADG, ADFI, or G/F. Pigs fed diets containing PF had decreased (P < .01) ADFI and increased G/F compared to pigs fed diets containing NF or CWG with pigs fed CWG having intermediate response. A fat source X sex interaction was observed for G/F, with G fed NF having lower (P < .05) G/F than B; however, G fed PF had higher G/F than B. When pigs reached 113 kg, one pig per pen was slaughtered to measure carcass characteristics. Gills were leaner, had increased LMA, lean %, and pH and had firmer bellies compared to B (P < .04). Belly firmness was improved (P < .06) by MTO. Pigs fed PF had increased (P < .002) average backfat thickness compared to pigs fed NF. Pigs fed CWG had firmer (P < .008) loins compared to pigs fed PF, and decreased (P < .04) longissimus drip loss compared to pigs fed NF or PF. Pigs fed NF or CWG had firmer bellies than those fed PF (P < .05). Instrumental color of the longissimus muscle and fat was not affected by MTO or fat source (P < .40). In conclusion, regardless of fat source, MTO improved belly firmness. Added fat decreased ADFI and increased G/F. Pigs fed PF had the highest G/F, but the fattest carcasses and softest loins and bellies.

Key Words: Pigs, Fat, Modified Tall Oil

6 Conjugated linoleic acid (CLA): A ruminant fatty acid with beneficial effects on human health. M. A. McGuire1 and M. K. McGuire1, 2 University of Idaho, Moscow, 2 Washington State University, Pullman.

Diet has a significant impact on human health. Although the human diet contains components which may promote cancer, it also contains components with a potential to prevent cancer. Research shows that ruminant fat contains an anticarcinogenic compound called rumenic acid (RA). This fatty acid is produced when dietary linoleic acid is isomerized by rumen bacteria during biohydrogenation and is one form of a family of fatty acids collectively called CLA. Although commercial sources of CLA contain other forms of CLA, ruminant fat contains primarily RA. Classic models of tumorgenesis in rodents have demonstrated that CLAs inhibit mammary gland growth of transplantable tumors. All studies to date indicate that CLA can be an effective inhibitor of tumor growth at concentrations in the diet less than 1%. The feeding of CLA during only the period of rapid mammary gland development, offers protection for life from mammary cancer. Further, protection from mammary cancer by CLA is independent of the amount or type (saturated or unsaturated) of fat in the diet. Moreover, RA and milk fat rich in RA can act to inhibit mammary tumor growth similar to results when commercial sources of CLA are fed, suggesting that RA is the anticarcinogenic CLA. Humans appear to produce little CLA in their bodies and thus, diet is probably the primary source. We have shown that CLA intake influences CLA content of blood and breast milk. This may be significant, since diets rich in dairy products and beef could supply humans with the level of CLA necessary for protection from cancer. Other evidence suggests that CLA can influence atherosclerosis, growth, immune function and diabetes; reinforcing the important role of ruminant fat in establishing optimal human health. Together, these relatively recent findings concerning the health benefits of CLA (and specifically RA) suggest that ruminant fats remain a significant part of the human diet. One way to accomplish this without increasing energy intake is the use of butter, instead of margarine or other non-dairy substitues.

Key Words: Conjugated Linoleic Acid, Rumenic Acid, Health

7 Effects of modified tall oil on body composition and serum and tissue levels of α-tocopherol, cholesterol, and phospholipids in ovarietomized rats. P. R. O’Quinn*, S. I. Koo, S. K. Noh, J. L. Nelssen, R. D. Goodband, and M. D. Tokach, Kansas State University, Manhattan.

Adult ovarietomized rats (a model for post-menopausal women) were assigned (n = 13/group) by BW (initial) to MTO (1% of the diet) or ad-libitum standard AIN-93G diet containing 8% α-tocopherol (αT)-stripped soybean oil or the same diet containing 1% modified tall oil (MTO) at the expense of soybean oil. Diets were matched in fatty acid profile except for the isomers of conjugated linoleic acid found in MTO. Rats were pair fed (90% of ad-libitum intake) twice daily for the duration of the 6 wk trial. By 3 wk, rats fed MTO had reduced (P < .05) BW; this trend continued for the duration of the trial. Rats fed MTO had higher (P = .05) non-protein respiratory quotient (RQ) and lower (P = .05) heat production
(KJ/hr/BW(kg)) when measured over a 44-hr fast, indicating more efficient utilization of glucose substrates by rats fed MTO. Rats fed MTO also had lower total body fat (P < .001) and more lean tissue (P < .05) measured via dual energy X-ray absorptiometry (DEXA). Serum total cholesterol and phospholipids (PL) did not differ between groups (P > .05), but rats fed MTO had lower αTP levels (P < .005) at 4 and 6 wk. Total cholesterol, PL, and αTP levels in the heart and brain were not affected by diet; rats fed MTO had higher (P < .05) total cholesterol in the liver, kidneys, and abdominal and retroperitoneal fat. Rats fed MTO also had higher (P < .05) liver PL, lower gastrocnemius αTP, and higher abdominal fat lipid content. Rats fed MTO had enhanced (P < .005) abdominal and retroperitoneal fat αTP over control rats (134.11 vs 81.66 nmol/g and 128.51 vs 92.87 nmol/g for rats fed MTO and the soybean oil control diets, respectively). These results suggest that, unlike growing pigs, adult ovariectomized rats fed MTO grow slower due to a decreased efficiency of gain, were leaner, had less total body fat, used glucose substrates more efficiently for fuel during fasting, and preferentially deposited αTP in fat tissues when compared to rats fed a control diet.

Key Words: Modified tall oil, Body composition, α-tocopherol

8 Anti-diabetic effects of dietary conjugated linoleic acid (CLA): Isomer-specific effects on glucose tolerance and skeletal muscle glucose transport. J. Ryder1, D. Bauman2, C. Portocarrero3, X. Song1, M. Yu1, D. Barbano2, J. Zierath1, and K. Houseknecht3, 1Karolinska Institute, 2Cornell University, 3Purdue University.

CLA are geometric and positional isomers of linoleic acid. Although the role of specific isomers has not been established, CLA have anticancer, anti-atherogenic and anti-obesity properties. We have reported that CLA improves glucose tolerance in ZDF rats and activates PPARγ response elements in vitro. It is not known which CLA isoforms are responsible for the anti-diabetic effects. Here, our aim was to elucidate the mechanism(s) by which CLA (2 different isomer mixtures) improves glucose tolerance. Male normoglycemic, prediabetic ZDF rats were fed either control diet (C), CLA oil supplemented diet (1.5% CLA; 50% C9, 50% C11), or one of two isomer-supplemented diets (1.5% CLA; 50% c9, t11 isomer; COIL), high CLA butter supplemented diet (1.5% CLA; 90% C9, t11 isomer; BUTTER) or were pair-fed (P) the C diet to match the intake of COIL rats. Following 11 d of treatment, glucose tolerance tests were performed. After 14 d of treatment, 3-O-methylglucose transport into soleus and EDL muscles was assessed. Insulin (IN)-stimulated PI3-kinase activity was determined in soleus and EDL muscles. COIL rats ate fewer g of food and grew more slowly than C fatty rats (P < .05). BUTTER rats weighed more than all other treatments (P < .05). Although food intake was identical, final body weights were lower for COIL vs. P rats (P < .05). Epidymal fat pad weight was reduced by both COIL and P (P < .01) compared to BUTTER or C. There was no effect of treatment on glycogen in liver or muscle of fed rats. Plasma triglycerides were lower in COIL and BUTTER vs P or C (P < .05). Fed blood glucose and IN were reduced in COIL and P rats compared to C or BUTTER (P < .05). Glucose tolerance was improved by COIL but not BUTTER compared to C (P < .01). Pair-feeding had an intermediate effect on glucose tolerance compared to COIL. Glucose transport into EDL muscle was not improved by any treatment. COIL but not BUTTER or P, increased IN-stimulated glucose transport into soleus muscle compared to C (P < .01). PI3-kinase activity in EDL and soleus was not affected by treatment. Thus the anti-diabetic effects of CLA appear to be specific for the C10,12 isomer. Furthermore, the improved glucose tolerance in COIL rats is due, at least in part, to increased IN-stimulated glucose transport into soleus muscle, and cannot be explained simply by reduced food intake.

Key Words: Fatty acid, Insulin, CLA

9 Feeding conjugated linoleic acids (CLA) decreases lipogenesis and alters insulin responsiveness in porcine adipose tissue explants. M. L. Heckert*, J. M. Eggert, A. P. Schinkel, S. E. Mills, and S. S. Donkin, Purdue University, West Lafayette, IN.

Dietary conjugated linoleic acids (CLA) have profound effects on body composition and glucose homeostasis in several species. The addition of CLA to diets for swine may be a strategy to alter glucose utilization for lipogenesis in favor of energy partitioning towards lean growth. Thirty pigs from each of two genetic populations characterized by high or average carcass lean percentage (54 vs 52% fat-free lean) were fed a corn and soybean meal diet with the addition of 0 or 0.6% conjugated linoleic acids (CLA) in a 2 x 2 factorial arrangement of treatments. Pigs were serially slaughtered at 23, 46, 68, 91, 114 and 136 kg body weight to obtain subcutaneous adipose tissue. The effect of insulin (0, 100 nM) on lipogenesis (μmol glucose incorporated into total lipids · h-1 · mg tissue -1) from 5.5 mM U-[14C]glucose was determined during a 2 h incubation period. Basal lipogenesis was not different between the two genotypes (8.6 vs 9.1; high lean vs low lean). There were no interaction effects (P > .05) for CLA × genotype × body weight × insulin, or CLA × insulin × body weight, or genotype × CLA, or body weight × CLA. There was a genotype × insulin effect (P < .05) which indicated insulin was more effective in lean pigs. There was no CLA × genotype × body weight effect (P > .05). Basal lipogenesis was decreased (P < .05) in adipose tissue from pigs fed CLA (6.3 vs 11.3; CLA vs. control) as was lipogenesis in the presence of 100 nM insulin (15.1 vs 24.3; CLA vs. control) characterized by a CLA × insulin effect (P < .05). The basal rate of lipogenesis was depressed by 54% and the direct effects of insulin to stimulate lipogenesis were dampened with the addition of CLA to diets of growing pigs. These data support weight- and genotype-independent effects of CLA to reduce lipogenesis in growing pigs.

Key Words: Lipogenesis, CLA, insulin


Cytotoxic T cells constitute the main subset of T lymphocytes expressing, along with suppressor T lymphocytes, CD8 co-receptors on their membrane. CLA, a mixture of positional and geometric isomers of linoleic acid, induces changes in the proportions of recirculating T lymphocytes in early-weaned pigs. To further understand the effects of CLA on cell-mediated immune response, T lymphocyte subsets were measured by flow cytometry. A factorial (2x4) arrangement within a split-plot design with four pigs from the same litter as the experimental unit for the environment, pig as the experimental unit for the CLA treatment, and day 0 as a covariate were used in data analysis. Management schemes were used to create two (dirty and clean) microbiological environments. A total of 32 (5.3 ± 3.0 kg) pigs were individually penned in each environment. Experimental diets were formulated to contain increasing amounts of CLA-60 (0, .67, 1.33 or 2%). Diets were formulated to exceed NRC (1988) nutrient recommendations for swine and were self-fed for 7 wk in three phases. Within phases, diets were isocaloric and isonitrogenous. Pigs were bled on d 0, 14, 28 and 42. On d 14, as dietary CLA increased, CD4 T lymphocytes increased linearly (24.9, 26.8, 31.0, and 34.1%; P < .001), CD8 T lymphocytes were linearly reduced (31.2, 27.5, 25.8, and 22.7%; P < .001), and a CLA × interaction (P < .05) was described in CD4CD8 double positive T lymphocytes. On day 42, dietary CLA produced both a linear increase of CD8 T lymphocytes (21.7, 22.3, 22.0 and 20.7%; P < .05) which indicated insulin was more effective in low lean pigs. There was no CLA × body weight × genotype interaction (P > .05). The basal rate of lipogenesis was decreased (P < .05) in adipose tissue from pigs fed CLA (6.0 vs 11.0; CLA vs. control) as was lipogenesis in the presence of 100 nM insulin (15.1 vs 24.3; CLA vs. control) characterized by a CLA × insulin effect (P < .05). The basal rate of lipogenesis was depressed by 54% and the direct effects of insulin to stimulate lipogenesis were dampened with the addition of CLA to diets of growing pigs. These data support weight- and genotype-independent effects of CLA to reduce lipogenesis in growing pigs.

Key Words: Conjugated linoleic acid, T lymphocytes, pig

The first protein of a group of proteins now identified as belonging to the calpain system was purified in 1976. The calpain system presently is known to be constituted of three well-characterized proteins; several lesser studied proteins that have been isolated from invertebrates; and 10 mRNAs that encode polypeptides, which based on sequence homology, belong to the calpain family. The three well-characterized proteins include two calcium-dependent proteolytic enzymes, µ-calpain and m-calpain, and a protein, calpastatin, that has no known activity other than to inhibit the two calpains. A substantial amount of experimental evidence accumulated during the past 25 years has shown that the calpain system has an important role both in rate of skeletal muscle growth and in extent of postmortem tenderization. Calpastatin seems to be the most variable component of the calpain system, and skeletal muscle calpastatin activity is highly related to rate of muscle protein turnover and rate of postmortem tenderization. The current paradigm is that high calpastatin activity: 1) decreases rate of muscle protein turnover and hence is associated with increased rate of skeletal muscle growth; and 2) decreases calpain activity in postmortem muscle and hence is associated with a lower rate of tenderization. The properties of the calpain system will be reviewed and regulation of its activity in living and postmortem muscle will be discussed.

Key Words: Calpain, Calpastatin, Muscle-specific calpain

12 Molecular features of striated muscle calpastatin. S. Lonergan*, Iowa State University, Ames, IA.

Calpains are ubiquitously distributed intracellular calcium-dependent cysteine proteinases that are thought to contribute to diverse processes such as myoblast differentiation/fusion and myofibrillar protein turnover. Calpastatin, the endogenous proteinaceous inhibitor of the calpain enzymes, has been found in all the tissues that contain calpains and is hypothesized to play a major role in the regulation of calpain proteolytic activity. Calpastatin binds to calpain domains IV and VI (the calcium binding domains) in the presence of calcium and inhibits calpain activity. The interaction of calpastatin with the calpains is reversible with both molecules retaining activity following dissociation of the calpain/calpastatin complex. Striated muscle calpastatin from mammalian and avian species examined to date exhibits a structure of four repeats of mutuually homologous sequences at an interval of about 140 amino acids. An alkaline N-terminal region is referred to as domain L, and the repetitive acidic domains are known as domains 1, 2, 3, and 4. Three highly conserved regions within domains 1, 2, 3, and 4 are apparently responsible for calpain inhibition. A previously undefined N-terminal region containing 68 amino acids (“XL” region) has recently been characterized as a potential site for phosphorylation of newly synthesized calpastatin by cAMP-dependent protein kinase. The bovine calpastatin promoter appears to be up-regulated by dibutyryl cAMP. Consequently, the calpastatin promoter and protein appear to be at least partially regulated by cAMP-dependent protein kinase pathways. A broad range of molecular weights has been reported for purified tissue calpastatins (from 24-172 kDa). Alternative splicing, different translation initiation sites, and proteolytic processing may explain a portion of this variation. Intuitively, variation in calpastatin structure or phosphorylation may influence cellular localization or binding and inhibition of calpains. However, the physiological significance of these documented variations in calpastatin is not clear. Definition of molecular structure, function and diversity of calpastatin will aid in developing an understanding of regulation of calpain mediated processes in striated muscle.

Key Words: Calpastatin, Striated Muscle, Proteinase Inhibitors


The objective of this presentation is to review the potential roles of the calpain proteolytic system in prenatal and postnatal muscle growth and development. The involvement of the calcium-dependent proteases, the calpains, and their specific inhibitor, calpastatin, in muscle growth and differentiation is well documented. The expression of calpains and calpastatin during prenatal muscle growth and development is well described, as well as the requirement of m-calpain for myoblast fusion. The involvement of skeletal muscle-specific calpain (skm-calpain) in muscle physiology, however, is poorly characterized. An important role in muscle growth and development is anticipated, since it is expressed primarily in skeletal muscle at an early stage of development and throughout adulthood. The expression of srm-calpain in myoblasts mirrors that of m-calpain during fusion and differentiation. Skm-calpain is more stable in muscle than previously thought; its autolysis proceeds more slowly in situ than it does in vitro which may allow us to elucidate its regulation in situ. Also, mutations in the skm-calpain gene in humans leads to a limb-girdle muscular dystrophy (type 2A), and skm-calpain antisense treatment of myotubes results in myofibrillar disorganization. Mutations of other calpains or calpastatin have not yet been described, suggesting that these would be lethal. In postnatal muscle, the calpain system serves as a major regulator of protein turnover. The nature of this regulation has been described experimentally through beta-agonist or glucocorticoid administration, and a genetic model, the callipyge lamb. Finally, calpains are also actively involved in muscle (and other tissues) atrophy in concert with caspases; however, it is not clear if their role is permissive, consequential, or active in this process.

Key Words: Calpain, calpastatin, muscle tenderness

14 Possible role and regulation of the calpain/calpastatin system in meat quality. E. Huff-Lonergan*, Iowa State University, Ames, IA.

Postmortem processes that govern meat quality are highly complex. This is due, in part, to the myriad of changes occurring in the tissue as living muscle is converted to meat. Additionally, factors inherent in muscle may vary between individual animals at the time of slaughter and also contribute to variations in meat quality. One important quality attribute that can differ widely is tenderness. As meat is held for a period of time postmortem it becomes more tender. This tenderization is associated with the degradation of myofibrillar/cytoskeletal proteins. The protease mu-calpain is implicated as a major causative agent of myofibrillar/cytoskeletal protein degradation. Calpastatin has been hypothesized to regulate the postmortem degradation of myofibrillar/cytoskeletal proteins by calpain. The precise factors regulating the interaction between calpain and its inhibitor, calpastatin or between calpain and its substrates have not been definitively identified. Mu-calpain is a member of a family of calcium-dependent cysteine proteinases that depend on reducing conditions to be active. Therefore, one factor that may dramatically impact postmortem calpain activity and postmortem protein degradation is the sub-cellular environment. For example, the ability of postmortem tissue to maintain reducing conditions is compromised. Since mu-calpain is sensitive to oxidizing conditions, the redox capacity of the tissue may impact myofibrillar/cytoskeletal protein proteolysis by mu-calpain. In addition, as muscle is converted into meat, the environment changes within the tissue to create conditions of low pH and relatively high ion strength. These conditions may alter protein conformation and protein interactions. Information regarding the effect of postmortem conditions on the activity of mu-calpain, the interaction between mu-calpain, its inhibitor and its substrates can yield important clues regarding the regulation of postmortem meat tenderization and the development of meat quality attributes.

Key Words: Calpain, calpastatin, meat tenderness
The term experimental unit (EU) is defined as the unit to which one application of a treatment is applied, and the effects of that treatment are measured on the sampling unit. Frequently, the sampling unit is defined as the pasture containing animals, not animals, resulting in a conservative definition of EU. Statistical evaluations of experiments are made to determine the reliability of biological results, and the associated levels of confidence for inferences regarding the extension of that information to populations under study. Due to financial and logistical constraints, the number of animals and paddocks are generally limited in grazing experiments. Generally, the biological impact of treatments on cattle are of major interests due to financial considerations. Estimates are that pasture variation has a CV of about 5%, compared to 10-30% for animals. The importance of the effects of treatments causing variances in animals creates a compelling reason to utilize animals as the EU in studies where possible. Because animals vary (higher CV) more than pastures, using animals as the EU may result in more difficulty in reporting treatment differences. Combining animals and paddocks as the error term when possible, after sequential tests for both, can give a conservative and appropriate test for significance. Several studies have shown large variances within groups treated, so animals as the EU may be appropriate. Studies have shown problems associated with group feeding and/or the impact of varying levels of individual animal intake within a group on performance; reasons to be aware of group dynamics in treatment effects. The group dynamics are best measured, in many cases, where the EU is the animal.

Key Words: Experimental unit, Statistical methods

PHARMACOLOGY AND TOXICOLOGY SYMPOSIUM

17 Medicines from plant poisons: biomedical applications, L. F. James1, W. Gaffield2, K. E. Panter1, B. L. Stegelmeier1, R. J. Molyneux2, and D. R. Gardner1, 1USDA-ARS-Poisonous Plant Research Laboratory, Logan, Utah, USA, 2USDA-ARS—Western Regional Research Center, Albany, California, USA.

Certain plants biosynthesize and accumulate chemical compounds that have adverse effects on various biological systems of the body when consumed by animals. It is therefore not unreasonable to suppose that by changing the dose expected outcome maybe altered and that these bioactive constituents could be manipulated to yield more positive results. Moreover the information gained from research on poisoning of livestock by plants has yielded valuable information in relation to veterinary medicine and human health and disease. One such example is the cyclopian-type malformation occurring in lambs born from ewes that graze Veratrum californicum on the 14th day of gestation. The causative agent, cyclopaamine, has been shown to regulate genes involved in development and this information is now being used to study facial birth defects and other health problems in man. Another example arises from certain lupines (Lupinus species), poison hemlock (Conium maculatum) and other plants that produce structurally related alkaloids. When cows graze these plants on days 40-70 of gestation skeletal malformations and cleft palates are produced in the calves. These results have been extended to goats fed the alkaloids during gestation and the prenatal kids with cleft palates thus produced are currently being used as a model to study the etiology of cleft palates and their surgical repair in utero. Some species of Astragalus and Oxytropis, known as locoweeds, when grazed by livestock induce abnormal behavior in the animal, wasting, habituation and skeletal birth defects, as well as congestive heart failure when grazed at high elevations. The toxin, an indolizidine alkaloid named swainsonine, inhibits certain enzymes, (mannosidases), essential for the correct processing of glycoproteins which are involved in structural and metabolic processes of mammalian cells. The study of this problem has led to the identification of many other glycosidase inhibitors in plants and a better understanding of the way in which glycoproteins influence the proper functioning of cells and cellular recognition. This information has stimulated research on the control of metastasis in the management of cancer.

Key Words: Poisonous plants, Biomedical applications, Livestock
as the proportion of apoptotic granulosa cells increases. In contrast, theca function was maintained in atretic follicles with progesterone production and expression of theca 3β-hydroxysteroid dehydrogenase positively correlated with apoptosis. During the mid-luteal phase of the estrous cycle the incidence of atresia averaged 50%; the incidence of atretic follicles among gilts ranged from 12 to 78%. The level of atresia was not correlated with plasma FSH concentrations during the last 42 hr before slaughter. This is in contrast to the massive loss of non-ovulatory follicles that is accompanied by decreased plasma FSH during the follicular phase of the cycle. Exogenous FSH also increased follicle number in prepupal and altemogest-treated gilts, but did not cause growth of large follicles or induce aromatase activity. To investigate FSH and other factors that regulate follicle growth and apoptosis, granulosa cells were incubated for 24 hr in their presence. Either FSH or IGF-I attenuated spontaneous apoptosis by 50%. Their effects were not additive, supporting a mediating role for IGF-I. No evidence was found to support the hypothesis that androstenedione alone or in the presence of FSH was atretogenic in pigs. Protease inhibitors attenuated apoptosis showing that members of the interleukin-1 beta-converting enzyme family were active during apoptosis in cultured porcine granulosa cells.

Key Words: Follicle atresia, Granulosa cell apoptosis, Swine


Nutrient intake and body energy reserves are major regulators of reproductive performance of beef cows. Reduced body weight causes cessation of estrous cycles, and inadequate body energy stores at parturition lengthens the postpartum anestrous interval. The objective of this presentation is to evaluate the ovarian response to restricted nutrient intake. Nutritionally induced reduction in follicular growth is a result of decreased secretion of GnRH and LH. Potentially metabolic signals controlling gonadotropin secretion are IGF-I and NEFA. During anestrus, ovarian follicular waves are recurrent but inadequate estradiol is secreted by the dominant follicle to cause estrus and ovulation. Realimentation of nutritionally induced anovulatory cows results in ovulation when adequate body energy stores are achieved, and the first ovulation is followed by an interovulatory interval of 10.5 ± 0.9 d. Increased follicular growth rate is associated with increased concentrations of LH, estradiol and IGF-I in plasma. When nutritionally induced anovulatory cows are realimentated, a transient increase in plasma progesterone occurs, usually without estrus, before the first normal estrous cycle. The number of times an estrous cow is mounted before the first normal luteal phase after anestrus is less (P < .05) then before the second luteal phase. We conclude that prolonged restriction of nutrient intake reduces secretion of LH, estradiol and progesterone. Potential metabolic signals that may affect follicular waves include time, nutritional status, and adaptation of the hypothalamic-pituitary-ovarian axis. Hormonal and nutritional factors may interact to control follicular waves and affect reproduction in cattle. Key Words: Nutrient, Ovulation, Beef Cow

20 Changes in gene expression associated with ovarian follicular development: A review. H. A. Garverick*, University of Missouri, Columbia.

Ovarian follicles in most domestic species can grow to the antral stage with little or no gonadotropic support. From this stage, a cohort of follicles of a size is recruited to grow towards ovulation by a transient rise in circulating FSH. From the recruited follicles, one or some (species dependent) are selected for continued growth and become dominant. A few follicles achieve ovulation; the fate of the others is atresia. Changes in mRNA expression of the gonadotropin receptors (FSHR and LHR), folliculostatin, enzymes (P450c17, P450scc, P450aro), and steroidogenic enzymes (P450arom, P450c17, P450aro, 3β-hydroxysteroid dehydrogenase (3β-HSD)), steroidal acute regulatory protein (StAR), growth factors (IGF-I and IGF-II) and their binding proteins (IGFBP) have been associated with growth, development and atresia of bovine ovarian follicles. Recruited follicles have been associated with initiation of mRNA expression of P450c17 and P450aro in granulosa cells. Selection has been associated with initiation of expression of mRNA for LH and 3β-HSD in granulosa cells. In general, changes in mRNA expression of the gonadotropin receptors (FSHR in granulosa and LHR in theca and granulosa), steroidogenic enzymes (P450c17 in theca, P450aro in granulosa, 3β-HSD in theca and granulosa), and StAR in theca increase with follicular development. Expression of the above mentioned mRNAs in follicles decreases prior to morphological signs of atresia at any stage of development. Expression of mRNAs for gonadotropin receptors, steroidogenic enzymes, StAR and growth factors is usually non-detectable in late stages of atresia.

Key Words: Ovary, Follicle, Gene Expression

21 Endocrinology of increased ovarian folliculogenesis in cattle selected for twin births. S. E. Echternkamp*, USDA, ARS, RLH, Clay Center, NE.

Three generations of genetic selection in cattle using an index of ovulation and twinning rate (Twinner) has increased the frequency of twin births to >50% and enhanced ovarian follicular development beginning at the secondary preantral stage. Ovaries of Twinner females contain a twofold greater number of secondary preantral follicles, exhibit 50% more small (≤5 mm) and medium (6-12 mm) antral follicles, and have a >70% frequency of twin or multiple dominant (ovulatory) follicles within a follicular wave compared to unselected (Control) females; numbers of primordial and primary follicles do not differ between populations. Evaluation of circulating FSH and LH concentrations during proestrus and estrus and after GnRH treatment or follicle ablation revealed no difference in FSH secretion between populations but LH release to GnRH was increased in twiners, which was likely related to the higher systemic estradiol concentrations. Ablation of all follicles >5 mm in Twinner and Control cyclic cows on d 7 or 8 (estrus=d0) initiated a transient increase in FSH (but not LH) followed by enhanced recruitment of growing follicles and subsequent selection of multiple dominant follicles in Twinner vs Controls, without population differences in FSH or LH. Circulating concentrations of insulin and cholesterol also do not differ between populations. Conversely, circulating IGF-I concentrations are elevated 50-100% in Twinner cows. Follicular follicles of Twinner also have higher follicular fluid IGF-I concentrations than Controls, but follicular fluid estradiol and progesterone concentrations do not differ between populations. Results suggest that the increased follicular recruitment and selection in Twinner cows are not related to level of gonadotropin secretion, but the enhanced preantral and antral folliculogenesis is likely associated with increased circulating estrogen and/or systemic IGF-I production. Preliminary results are suggestive of a QTL for ovulation rate on chromosomes 5 and 7.

Key Words: Ovarian Folliculogenesis, Twin Births, Cattle

22 Influence of size of the dominant follicle, serum estradiol, and exogenous GnRH on luteal sensitivity to prostaglandin F2α in beef heifers. S. W. Williams*, 1 M. Amstalden1, R. L. Stank1, 2, D. L. Vallejo1, and G. L. Williams1, 1 Texas A&M University Agricultural Research Station, Beeville, 2 Texas A&M University-Kingsville.

The efficacy of exogenous prostaglandin F2α (PGF) to induce luteal regression in beef cattle is variable and dependent on the stage of die- strous during which PGF is given. Our objectives were to investigate the effects of size of the dominant follicle, circulating concentrations of estradiol, and exogenous luteotropic antagonism on PGF-mediated regression of the bovine corpus luteum (CL). Thirty-five Brahman x Hereford (BxH) heifers were randomized to 1) 40% of heifers were treated on d 6, 10 or 14 of the estrous cycle. Within each day of the cycle, heifers (n = 11 or 12/group) received 2 treatments in a Latin square arrangement. Treatments were: 1) PGF (25 mg Lutalyse® i.m. plus a sham implant placed s.c. in the ear); 2) PGF (25 mg Lutalyse® plus simultaneous administration of an Alzet osmotic minipump, placed s.c. in the ear, delivering 2.5 µg GnRH/h). Alzet pumps or sham implants remained in place for 1 h after pump or sham implant insertion to monitor changes in circulating LH. PGF treatment increased (trt x time, P < .10) serum LH during the first 11 h. Regardless of treatment, the percentage of heifers exhibiting luteal regression was greater (P < .01) on d 14 (91.7%) than on d 6 (54.2% or 10 (63.6%). Proportion of CL’s regressing did not differ (P > .05) between PGF and PGF on any
Day of the cycle. Mean diameter of the largest follicle on d 6 (10.7 ± .3 mm) differed (P < .01) from mean diameters observed on d 10 and 14 (6.3 ± .4 and 6.5 ± .5 mm, respectively). Similarly, mean concentrations of estradiol-17β in serum were greater on d 6 (7.1 ± 2 pg/ml) than on d 10 and 14 (5.4 ± .3 and 5.5 ± .1 pg/ml, respectively). Mean concentrations of estradiol did not differ (P > .05) between periods in which luteal regression occurred vs those in which it did not occur. Luteal sensitivity to PGF is dependent upon stage of diestrus, but this dependence does not appear to be influenced by size of the dominant follicle, circulating estradiol, or level of gonadotrophic support.

Key Words: Luteal regression, dominant follicle, estradiol

23 Early increases in estradiol in follicular fluid from cattle with low peripheral concentrations of provagotropin. R. Taft*, B. Sayre, and E. K. Inskesp, West Virginia University, Morgantown.

Butcher and Pope (BOI 21:49, 1979) showed congenital anomalies as well as embryonic and fetal deaths after aging of rat oocytes were due to long precollationary exposure to estrogen (E2). Synchronization of estrus in cattle with low doses of progesterogens can result in persistency of follicles, higher peripheral estrogen and low fertility. Concentrations of E2 in follicular fluid (FF) of the largest first wave follicles (LF1) were comparable in cows with normal luteal function (n=12) and cows with low progesterone (P4) to determine if oocytes were exposed to increased estrogen soon after the initiation of treatment. Cows on low P4 (LP, n=12) received used intravaginal progesterone releasing devices (CIDR) on d 4 after estrus, followed by two injections of PGF2α (25 mg, i.m.) 12 h apart on d 6. Beginning on d 4, ovaries were examined by ultrasonography on d 14 after calving then on d 21-28, 35-42, and at weekly intervals until estrus and on d 7 (E7) and d 10 (E10) postpartum. Cows were bled on d 1, 3, 5, 7, 14 after calving and at weekly intervals until estrus and on d 7 (E7) and d 10 (E10) postpartum. Cows were bled on d 1, 3, 5, 7, 14 after calving and at weekly intervals until estrus and on d 7 (E7) and d 10 (E10) postpartum.

Key Words: Estradiol, or level of gonadotrophic support.

25 Effect of estradiol benzoate (E2) and (or) prostaglandin F2α (PG) on corpus luteum function in beef heifers. D. F. Hentges*, F. N. Kojima, B. E. Salfen, J. F. Bader, T. J. Safranski, and M. F. Smith, University of Missouri-Columbia.

The corpus luteum (CL) is not responsive to a luteolytic dose of PG prior to d 5 of the estrous cycle. This study was designed to determine the effect of E2 administration on CL responsiveness to PG injection on d 4 of the estrous cycle. Estrus was synchronized in normally cycling heifers following two injections of PG 14 days apart. Heifers were randomly assigned at estrus to a 2 x 2 factorial arrangement of treatments [E2 ± PG (n=24); SO ± PG (n=24)]. Heifers received either E2 (11 mg) or sesame oil (om) on d 1 and PG or no injection on d 4 post-estrus. Daily transrectal ultrasonography was performed from the second injection of PG to the second estrus to characterize follicular and CL development. Blood samples were collected every 12 h beginning d 1 until the next estrus, and analyzed for concentrations of progesterone (P4). PG did not induce luteolysis in the E2 group. The first follicular wave emergence was later (P < .01) in E2 vs non-E2 treated heifers (4.4 ± .3 and 1.4 ± .3 d, respectively). Although E2 delayed emergence of the first follicular wave, the estrous cycle length was similar (P > .08) among treatment groups. Mean diameter of CL was larger (P < .02) in the E2 (19.9 ± 5.5 mm) compared with PG and Control groups (17.8 ± .5 and 18.1 ± 5.5 mm, respectively), but similar to the PG group (19.1 ± 5.5 mm). There was an E2 by time interaction (P < .0001) on concentrations of P4 (d 0 through estrus). Concentrations of P4 in the E2 and PG + PG groups were similar from d 0 to d 16.0, but higher (P < .03) from d 16.5 to d 21 post-estrus compared to the Control and PG groups. In summary, E2 administration did not result in PG-induced luteolysis on d 4; however, E2 delayed emergence of the first follicular wave.

Key Words: Estradiol, Prostaglandin F2α, Beef Heifers

26 Effects of parity status on postpartum follicular development and endocrine profiles in the Brahman. S. M. Webb, D. A. Neuendorff*, A. W. Lewis, and R. D. Randle, Texas Agricultural Experiment Station, Overton.

Eight multiparous and six primiparous Brahman cows suckling male calves with body condition scores (BCS) of 6.4 ± 1.7 and 6.2 ± 4.4, respectively, and weighing 504 ± 36 kg and 463 ± 28 kg, respectively, were used to evaluate the influence of parity on postpartum follicular development and endocrine profiles leading to the resumption of estrus. All animals grazed coastal bermudagrass overseeded with rye-ryegrass with free choice hay and water and were supplemented with 4.17 kgxhd⁻¹ of 41:1 cornsoybean meal. BW and BCS of cows and BW of calves were recorded at 14 d intervals from d 1 after calving through first estrus and at weaning. Cows were bled on d 1, 3, 5, 7, 14 after calving and at weekly intervals until estrus and on d 7 (E7) and d 10 (E10) post estrus. Ovarian follicular populations were monitored by transrectal ultrasonography on d 14 after calving then on d 21-28, 35-42, and continued on an 8 day examination and 6 day rest schedule through detection of estrus. Plasma PGFM and progesterone (P4) concentrations were quantified using RIA. At d 7 PGFM concentrations tended (P < .10) to higher in the primiparous group. Plasma P4 concentrations on E7 and E10 and changes in BW and BCS through d 42 and at estrus were not affected (P > .10) by parity status. From d 1 to weaning, ADG was greater (P < .04) for the primiparous group. Calif performance was not influenced (P > .10) by parity status. The number of medium size follicles (4.1-6 mm) through d 49 was greater (P < .01) in the multiparous group. Interval to resumption of follicular waves (P < .04) estrus (P < .03), and to development of an 8mm or 10mm follicle (P < .01) was
greater in the primiparous group. Follicular development and waves began later after calving in primiparous cows, but the interval from these events to estrus were similar to multiparous cows.

**Key Words:** Primiparous, Multiparous, Follicles

27 **Identification of the optimal dose of estradiol benzoate in combination with a progesterin to program follicular turnover in cyclic cattle.** V. L. Bogacz*, J. E. Huston, D. E. Grum, and M. L. Day, The Ohio State University, Columbus.

An experiment was designed to determine the optimal dose of estradiol benzoate (EB) used in conjunction with an intra-vaginal progesterone insert (CIDR-B®) to program follicular wave turnover in cyclic cows. Estrus was synchronized in twenty-five cyclic cows with day of estrus designated as d 0 of the experiment. On d 14, all cows received an i.m. injection of PGF2α and a CIDR-B with either 0 (0EB; n=5), 0.5 (.5EB; n=7), 1 (1EB; n=6) or 2 (2EB; n=7) mg of EB/500 kg bodyweight. Transrectal ultrasonography was used to monitor ovarian follicular dynamics from d 7 through the subsequent ovulation. Observations for estrus were made twice daily from CIDR-B removal on d 21 until ovulation. The second wave of follicular growth for the synchronized estrous cycle emerged on d 10.4 ± 0.25 and the dominant follicle of this wave ovulated following CIDR-B removal in 4/5 cows in the 0EB treatment. Atresia of the dominant follicle of the second wave, emergence of a third wave of follicles, and ovulation of the dominant follicle of the third wave were induced in 4/7, 6/6 and 6/7 cows in the .5EB, 1EB and 2EB treatments, respectively. Day of emergence of the third wave was later in the 2EB (P < 0.05) than in the 1EB treatment (18.2 ± 0.31 vs. 16.7 ± 0.33, respectively). Day of ovulation (24.8 ± 0.11) and diameter of the ovulatory follicle (16.3 ± 0.58) did not differ among treatments. However, across treatments, cows with only 2 follicle waves ovulated a larger follicle (P < 0.05) approximately 1 d earlier (P < 0.05) compared to cows with 3 waves of follicle growth. Both the 1EB and 2EB treatments induced turnover of follicular waves. Since the interval to new wave emergence is prolonged with higher doses of EB, it is suggested that the 1 mg dose would be optimal for use in an estrus control system in cyclic beef cows.

**Key Words:** Estradiol Benzoate, Progesterin, Follicular Turnover

> ROCHE-ASAS FOUNDATION BEEF SYMPOSIUM

**Beef Carcass Quality and Yield**

28 **The importance of beef carcass quality and yield: Cattle performance, carcass-based pricing, and consumer issues.** H. G. Dolezal*, Oklahoma State University.

Merit based marketing programs have gained popularity in the U.S. beef industry with increasing opportunities for vertical cooperation. In addition to input costs, numerous factors (gain, feed efficiency, and animal health) impact profitability as well as ultimate carcass quality and yield grade. Commodity marketing rewards volume production and encourages maximizing tonnage produced, harvested, and fabricated to dilute fixed costs, despite consumer preferences for cut sizes originating from carcasses weighing less than 363 kg. Grid and formula based carcass pricing shifts many risks to producers compared with live weight based sales; hence, non-conformers (excessive finish, dark cutters, extremes in weight, inadequate quality) must be minimized. Over the past three years, the spread between U.S. Choice and U.S. Select has averaged $8.49/45.4 kg for closely-trimmed boxed beef with seasonal spreads of $4.32 (first quarter) to $15.44/45.4 kg (fourth quarter). Consumer preferences for taste and consistency have strengthened demand for branded or premium Choice programs and U.S. Prime. Red meat yield, measured as U.S. yield grade should contribute as much as $5.00 per head for a mere .1 change. Objective value determination should originate with predominantly boneless, closely-trimmed boxed beef subprimals. These may be classified as middle meats, end meats, thin meats, and lean trim, comprising approximately 17.1, 43.3, 17.6, and 22.0% of total weight as carcass value, respectively, over the past three years. By-product value has accounted for approximately 13.3% of total harvest animal value during the same period. Models to predict carcass value and value per 45.4 kg will be developed. If cattle are fed to a common rib fat endpoint, and within the range of rates of winter and summer gains reported herein, we conclude that backgrounding program has little or no effect on marbling or carcass grade. Carcass yields and meat quality relationships within 54 published trials were examined statistically. Carcass measurements will be discussed first followed by meat quality factors. Although lean darkens as cattle age, color can be restored partially by feeding concentrate diets. Feed components (lower iron availability; vitamin E supplements) also may lighten beef color. Fat color varies with breed and carotenoid content of the diet while melting point varies with breed and saturation of dietary fat. Marbling scores vary with breed, animal age, rate of gain, and days on feed. Higher marbling scores were related positively to beef tenderness, juiciness, flavor intensity, and overall desirability. Shear force increased with fat thickness, opposite the direction one would expect from added fat attenuating carcass cooling. Indeed, the only carcass measurement related significantly albeit weakly (R² = .04) to tenderness was marbling score. Juiciness and flavor intensity both decreased as dressing percentage increased, while both flavor desirability and intensity decreased as ribeye area increased. Overall beef desirability for sensory panels increased with marbling score and decreased with fat thickness (R² = .24). Amazingly, each individual component of meat quality could be predicted more precisely from animal and production

> 30 **Effects of nutrition on beef carcass quality and yield.** F. N. Owens* and B. Gardner*, 1Optimum Quality Grains, L.L.C., Des Moines, IA, 2Oklahoma State University, Stillwater, OK.

Carcass yields and meat quality relationships within 54 published trials were examined statistically. Carcass measurements will be discussed first followed by meat quality factors. Although lean darkens as cattle age, color can be restored partially by feeding concentrate diets. Feed components (lower iron availability; vitamin E supplements) also may lighten beef color. Fat color varies with breed and carotenoid content of the diet while melting point varies with breed and saturation of dietary fat. Marbling scores vary with breed, animal age, rate of gain, and days on feed. Higher marbling scores were related positively to beef tenderness, juiciness, flavor intensity, and overall desirability. Shear force increased with fat thickness, opposite the direction one would expect from added fat attenuating carcass cooling. Indeed, the only carcass measurement related significantly albeit weakly (R² = .04) to tenderness was marbling score. Juiciness and flavor intensity both decreased as dressing percentage increased, while both flavor desirability and intensity decreased as ribeye area increased. Overall beef desirability for sensory panels increased with marbling score and decreased with fat thickness (R² = .24). Amazingly, each individual component of meat quality could be predicted more precisely from animal and production
system factors than by carcass measurements ($R^2 = .29$ to .95). Tenderness, juiciness, flavor desirability, flavor intensity, and overall desirability all were adversely affected increased weight per day of age; fast growing, young cattle did not have optimum meat quality. Nevertheless, tenderness was improved by faster daily gains during the finishing period. However, final weights decreased beef tenderness and flavor intensity, while longer feeding periods (pasture plus feedlot days) decreased juiciness and flavor intensity. Higher concentrate diets improved flavor desirability. For optimum meat quality, the ideal animal appears to be one that is older and has gained rapidly but is not excessively heavy at harvest.

Key Words: Carcass quality, Beef, Tenderness

31 A beef quality synopsis: what we know and where we need to go. J. B. Morgan*, and D. N. Vargas, Oklahoma State University, Stillwater, OK USA 74078.

Today’s domestic and international consumers are demanding more in terms of beef quality than ever in the past. Beef consumers quality equation now contains additive factors such as safety, nutrition and convenience as well as dependability. These relentless demands have prompted the beef industry to find new and innovative ways to produce high-quality beef products which always clear the quality hurdle. Recent research has focused on the use of vitamins to improve beef quality. Studies have shown the efficacy of supplementing vitamin E in extending the retail shelf-life of beef. By decreasing the rate of lipid oxidation and lean discoloration, a $4.00 investment of supplemental vitamin E ensures that fewer beef cuts are discounted or discarded due to premature browning, resulting in a $30.00 to $35.00 saving per carcass marketed through commercial retail outlets. Secondly, it appears that supplementing cattle with high-doses of vitamin D3 enhances meat tenderness; preliminary results demonstrate that supplementing 5 million IU/hd/d of vitamin D3 for the final 6 d prior to harvest decreases (P < .05) shear force values of steaks aged for 7 d. Vitamin D3 increases calcium levels in muscle which is associated with accelerated postmortem tenderization. Increasing the rate of tenderization in this fashion should facilitate the shipment of consistently tender beef to retail outlets even under feature sale conditions. Case-ready products are leading the beef industry into a new era of marketing. In order for beef to remain competitive at the retail counter one must continue to develop "consumer-friendly" items that can be prepared with minimal time and effort. Another factor critical to the beef industry’s future is the advent of on-line tenderness characterization systems. Predicted carcass tenderness should facilitate trend-based marketing and allow producers to select the product quality of their choice. Understanding factors which contribute to beef quality and consistency and more importantly, learning how to control these factors, will save the industry millions of dollars annually. As the 21st century arrives, beef producers, processors and retailers must strive to provide consumers with a consistent, high-quality product if beef is to maintain its viability as a protein supplier.

Key Words: Beef, Quality, Overview

RUMINANT NUTRITION/PASTURES AND FORAGES SYMPOSIUM
Designing Supplements for Grazing Beef Cattle

32 Designing supplementation programs for beef cattle forage based diets. W. E. Kunkle*, 1University of Florida.

Supplements are offered to cattle fed forage based diets to improve performance and economic return. This review will focus on identifying the limiting nutrients, sources of carbohydrates in energy supplements, feed additives and feeding systems. The first step in designing a supplement is to determine nutrients (protein, vitamins and minerals) that limit intake, digestibility and utilization of the forage energy. Although this seems simplistic, grazing cattle select their diet and nutrient composition of consumed forage often is unknown. Blood urea nitrogen and fecal analysis offer point-in-time indicators of protein-energy balance of the diet. Energy supplements (balanced with protein, vitamins and minerals) are often needed to meet desired performance. Several experiments indicate that when the sum of starch plus sugars in supplements are offered above .4% of body weight, forage intake and digestibility are reduced. In this situation, choosing a highly digestible supplement low in starch such as soybean hulls compared to a supplement high in starch such as corn gives 15 to 30% better performance per unit of supplemental TDN. Several antibiotics increase gain and efficiency of growing cattle fed forage diets. Supplementing approved levels of ionophores or bacitracin has improved gains .07 to .11 kg/day at a cost (wholesale) of 2 to 3 cents/day. These antibiotics increase gains of growing cattle similar to feeding an additional .45 kg of TDN/day. Adding these antibiotics to supplements formulated for growing cattle usually improves net return. Other antibiotics and feed additives that control diseases, bloat, and parasites may increase net returns in selected situations. Formulating self-fed supplements that are consumed at desired amounts reduces feeding costs but challenges for the nutritionist include variation in consumption across situations, variation in consumption amount and frequency within the herd, and availability of reasonable cost intake limiters that do not cause management or disease problems. Hand-fed supplements offered at 1.5 kg/day or less usually give similar improvements in performance when fed on alternate days compared to daily feeding but less frequent feeding may result in reduced performance.

Key Words: Supplement, Antibiotics, Cattle

33 Designing mineral supplements for beef cattle. L. W. Greene*, Texas A&M University System.

Mineral supplementation programs in the cow/calf/stocker industry range from nothing or plain salt/sulfur blocks to highly formulated free-choice mineral supplements containing organic and inorganic sources of minerals. The primary question is, “Which of these will generate the greatest return on investment by optimizing production efficiency and maintaining cattle health?” Many variables must be considered when attempting to answer this question. In most cases, every production system is different due to environment, forage type, animal genetics, physiological state of production, etc., making it difficult to “fine tune” mineral supplements for the generic production system. However, to prevent tremendous complexity in managing mineral supplementation programs, average environments, forage mineral supplies, animal characteristics and production levels must be used as a starting point. In unique situations, formulations can be altered to account for variances from the norm. However, care must be taken to avoid critical negative mineral to mineral interactions that are known to exist. It is not uncommon to create a completely new problem when changing a mineral supplement program to fix an old problem. Choice of supplement ingredients is also critical to ensure adequate mineral availability and supplement weather-ability. In addition, the mineral supplement providing the best mixture of mineral salts to meet production needs is of little value if consumption is not adequate. These issues and others will be discussed with respect to current literature on mineral supplementation programs for beef cattle.

Key Words: Mineral supplement, Beef cattle

34 Designing protein supplements. M. K. Petersen*, C. R. Krebsiel, J. Sawyer, and R. Waterman, New Mexico State University, Las Cruces, NM USA.

Protein supplementation of grazing livestock is used to complement the nutrient content of grazed vegetation. When effectively implemented, economic improvements in gain and reproduction can be realized. Timing of supplement availability (within day, within week, or within season) can influence the outcome. The source and quantity of protein can also modify the response by the animal. Nitrogen, protein, and/or amino acids may be included into supplements to achieve various results. The objectives may include an enhanced supply of ammonia or nitrogen containing growth factors to ruminal microbes, satisfying a protein requirement of the animal, or to manipulate metabolism (metabolic hormones or supply of intermediates). These goals must be met within the context of management effective delivery systems and highly palatable formulas. Protein supplements are designed first by the quantity of feed which is acceptable to management. The quantity of ruminally degradable intake protein is considered next to optimize ruminal function and intake. Then, depending upon vegetation type, quantity, and animal
physiological state, the purpose of appropriate ruminally undegradable intake protein (UIP) is considered. After the UIP sources and quantity are determined, the carrier/energy sources are selected to achieve the required amount of feedstuffs to serve as dilution agent, binder, and space filler. The form of the supplement (e.g., small, standard, or large pellets, blocks, molasses liquid or solidified and loose) will be dependant upon feeding management intensity and the physical characteristics of the selected feeds. Protein supplements should be designed with a specific purpose. This goal will dictate the amount and type of protein used and the form supplied. Feeding management will determine the frequency and timing of supplementation. The overall aim is to supply the most biologically potent mix of nutrients that will allow for the provision of the least amount of supplement at the lowest cost while successfully achieving production goals.

**Key Words:** protein supplementation, grazing ruminants

### 35 Dietary fats as reproductive nutraceuticals in cattle

G. L. Williams* and R. L. Stanko. *Texas A&M University Agricultural Research Station, Beeville, TX, U. S. A.

Inadequate dietary energy intake and poor body condition are two of the most pervasive factors influencing reproductive efficiency in cattle production systems. Therefore, an important goal has been to discover novel methods for enhancing reproductive performance in cattle that are exposed to these conditions, often repeatedly. This review will examine dietary fat as a reproductive "nutraceutical", including the roles of fatty acid content and minimum effective intake. Although the consumption of lipids by ruminants is limited under natural conditions, their addition to formulated diets to increase caloric content or to positively modify diet physical characteristics is a long-standing practice. Recently, fat supplements have been used in attempts to influence specific metabolic pathways, and ultimately, hormones that directly modulate reproductive processes. The basis for this approach lies within an array of digestive, metabolic, and reproductive sequelae that occur when cattle consume significant quantities of fat, particularly fermentable fat. Evidence suggests that the consumption of polyunsaturated plant oils can positively influence ovarian follicular growth, luteal function, and postpartum reproductive performance, independent of caloric effects. Mechanistically, these effects have been attributed to a cascade of events that change rumen fermentation patterns, heighten lipoprotein-cholesterol synthesis, increase secretion of ovarian steroids, modify circulating concentrations of insulin and growth hormone (GH), and enhance the synthesis or accumulation of insulin-like growth factor-1 (IGF-1) within the ovarian follicle. Both natural and manufactured products that can be used to exploit these physiological concepts are available commercially.

**Key Words:** Dietary Fat, Cattle, Reproduction

### 36 Potential for hair sheep in the U.S.

D. Notter*. Virginia Polytechnic Institute and State University, Blacksburg.

The U.S. sheep industry must improve its competitiveness relative to other meat and fiber sources within the U.S. and internationally. Current opportunities to develop innovative programs include funding from the National Sheep Industry Improvement Center and 4 yr of protection from imports by the International Trade Commission. It is essential that the sheep industry seize these opportunities to build a secure base for future development. Production characteristics that currently limit expansion of the sheep industry include high labor requirements, susceptibility to internal parasites, and low wool prices. These problems could be reduced by development of "easy-care", wool-free sheep breeds with greater parasite resistance, so long as these breeds were also able to maintain satisfactory growth, reproduction, maternal ability, and carcass yield and quality. Hair sheep have many characteristics that are desired in easy-care sheep types, including high fertility and prolificacy, excellent lamb vigor, and substantial resistance to internal parasites. Meat quality appears to range from very acceptable to excellent. These animals are small, however; associated growth rates and optimal slaughter weights are low relative to those of other U.S. breeds. Little has been reported about herding characteristics of hair sheep, and genetic control of fiber type (wool versus hair) is not well understood. Purebred hair sheep may be useful in hairdressing and specialty markets, but use of hair sheep genetics in traditional markets will likely involve composite breeds with 50 to 75% hair sheep genetics. Existing composite breeds such as the Katahdin and Dorper may fill this role, but development and evaluation of new composite types using other sources of hair sheep genetics should also be considered. Potential for hair sheep is greatest in the southeastern U.S. and the southern Corn Belt. Low cold tolerance may limit their usefulness in colder regions, where hair sheep crosses, which often have a partial wool coat in winter that is shed in summer, may be preferred.

**Key Words:** Hair sheep, Composite breeds, Disease resistance

### 37 East Friesian germplasm: effect on milk production, lamb growth, and lamb survival


The East Friesian (EF) breed originated in the Friesland area of Germany. It generally is regarded as the highest milk-producing breed of dairy sheep in the world. Average milk yields as high as 550 to 650 liters have been reported in northern Europe. It is medium to large in body size with rams weighing 90 to 120 kg and ewes weighing 65 to 75 kg. The face and legs are white and free of wool, and a distinguishing characteristic is a long, thin tail that is free of wool - a "rat" tail. They have a high prolificacy; generally over 2.0 lambs per ewe. The first importation of EF genetics into the U.S. was in 1993 by the University of Wisconsin-Madison (UW), the University of Minnesota, and a few private producers. It consisted of F1 EF ram lambs from B.C., Canada sired by one Swiss EF ram. There were later importations into the U.S. of crossbred and purebred rams and ewes, embryos, and semen from Canada and Europe, so EF genetics are now readily available. Early studies at UW compared the performance of progeny sired by EF crossbred (1/2, 3/4 and 7/8 EF) and purebred Dorset (D) rams. EF-cross lambs had greater birth, weaning, and postweaning weights than D-cross lambs. When lambing at one and two years of age, EF-cross ewes gave birth to and reared more lambs per ewe mated, had longer lactation lengths, produced more milk, fat and protein, and had a lower percentage of milk fat and protein than D-cross ewes. With the low levels of EF genetics evaluated in this early study (mostly 25%, some 50%), it appears that EF-cross sheep are superior to D-cross sheep for lamb and milk production in northern Wisconsin. The same may not hold true for EF-cross sheep of over 50% EF genetics. Some studies conducted in the Mediterranean region found that sheep containing more than 50% EF breeding had lower survival, lower lamb production, and, in some cases, lower milk production than local breeds. It appeared that the EF was not adapted to the high environmental temperatures of the region and was more susceptible to some diseases; most notably, pneumonia. Evaluations of high percentage and purebred EF sheep are needed in North America.

**Key Words:** East Friesian, Dairy sheep

### 38 Evidence of quantitative trait loci affecting growth and carcass composition traits in cattle segregating the muscle hypertrophy locus


The locus causing muscle hypertrophy (mh) on chromosome 2 has been previously assessed for growth and carcass traits. The objective was to identify other quantitative trait loci (QTL) in two families segregating the mh allele. Two half-sib families were developed from a Belgian Blue

This study evaluated effects of four beef carcass electrical stimulation (ES) treatments on carcass grade factors, muscle color, and subprimal purge loss as well as cooked steak tenderness and weight loss. One side per beef carcass was subjected to ES using one of four treatments: low voltage - medium duration (LVMD), high voltage - medium duration (HVMD) or high voltage - long duration (HVLV) and compared with the non-ES control side. Electrical stimulation was achieved by inserting a positive electrode between the latissimus dorsi adjacent to the second and third rib and a negative electrode into the biceps femoris adjacent to the sacrum of beef sides. One 2.54 cm thick longissimus steak was fabricated from each of 120 treated and 120 control matched carcass sides such that samples from 10 subgroups, adjusted WBS values for Select beef were improved (P<.002) from those for control sides within ES treatment subclasses. Mean marbling scores for stimulated sides did not differ (P>.05) from those for control sides within ES treatment class. Mean values for CIE L*, a* and b* of lean color were higher (P<.05) for HVLD treated sides than for control sides. When Warner-Bratzler shear force (WBS) values for steaks were adjusted to a common degree of doneness, WBS values were lower (P<.05) for HVLD treated sides than for control sides. When Warner-Bratzler shear force (WBS) values for steaks were adjusted to a common degree of doneness, WBS values were lower (P<.05) for HVLD treated sides than for control sides in all four treatment classes. Within quality grade subgroups, adjusted WBS values for Select beef were improved (P<.05) only when the HVMD and HVLD treatments were utilized. When adjusted WBS values for steaks from control carcass sides were greater than 4.5 kg, treatment of matching carcass sides with LVMD, LVLD, HVMD or HVLD reduced WBS to below 4.5 kg 88, 60 and 75% of the time, respectively. Mean values for cooked steak weight loss, adjusted to a common degree of doneness, did not differ by treatment and mean purge loss in inside rounds only differed (P<.05) only when the LVMD treatment was applied.

Key Words: Electrical Stimulation, Shear Force, Purge

40 Use of sperm rich or entire ejaculates for breeding sows. J. D. McDonald1, T. J. Safranski2, and S. L. Terlouw3.

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The bulk of reproduction research has focused on the female. Increased value of individual boars and use of artificial insemination have heightened the need to fine tune semen collection and processing procedures. This study was designed to determine whether the total fluid ejaculate (TE) or sperm rich fraction only (SR) should be collected for maximum reproductive performance. Semen collected from 425 individual terminal boars was used to mate to hybrid maternal sows with Landrace, Large White and Duroc genetic background. Each boar was used randomly for each treatment. Semen was evaluated and extended to a minimum of 3.2×10^6 viable cells per 85 mL in BTS, and was used within 48 hours of collection. Semen was sent to 34 separate sow units. Every-other-week, the treatments that were sent to the farms were alternated, and only sows mated Monday through Friday were included in the data set. Three matings were performed at either 24 hour intervals (AM/AM/AM) or 24 and eight hour intervals (AM/AM/PM) depending on day of estrus post-weaning from June 18 through August 20, 1998. The number of matings for the TE and SR were 7,856 and 7,577, respectively. A model including sow unit, treatment, week, sow unit x week (error term), parity and previous lactation length was used to compare whether or not sows farrowed (FARO), total number born (TNB), born alive (NBA), stillborn (NSB) and mummies (MUMB). FARO varied among sow units and parity, but there was no significant treatment effect. Parity, previous lactation length and sow unit each had significant effects on TNB and NBA, but again there were no treatment differences (10.95±.07α vs 10.90±.073 for TNB, P=.38 and 10.22±.067 vs 10.19±.067 for NBA, P=.54 for TE and SR, respectively). Similar relationships were seen for NSB and MUMB, except that previous lactation length was no longer significant. Use of either TE or SR resulted in similar sow reproductive performance in this study. There may be an advantage to one type of collection if semen is stored for longer periods of time prior to use.

Key Words: Semen fractions, Boar, Fertility

41 Absence of virus in pig embryos recovered from gilts vaccinated with a modified-live PRRS vaccine. B. A. Didion1, M. T. Finn1, M. Eisenhardt2, and J. Christopher-Hennings3.

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Porcine reproductive and respiratory syndrome virus (PRRSV) is a pathogen threat to the swine industry. Porence embryo transfer has merit for reducing disease transmission risks (i.e. PRRSV) associated with transportation of live animals. The objective of this study was to examine the efficacy of surgical recovery of pig embryos from PRRSV infected gilts towards generating a source of PRRSF-free germplasm. Seven serologically PRRSV-negative prepuberal line gilts (180 days of age) were relocated to an off-site facility and estrus was induced using P.G. 600 (Day=0). Also on Day 0, gilts were bled and samples submitted for PRRSV testing via reverse transcription polymerase chain reaction (RT-PCR). On Day 4, all gilts were artificially inseminated intramuscularly with a single dose of PrimeParc (Schering Plough). On Day 8, all gilts underwent mid-ventral laparotomies. Serum, uterine fluids and embryos were collected from each gilt for PRRSV testing via RT-PCR. Uterine flushings from each horn were kept separate (14 samples collected) and tested for PRRSV via RT-PCR. Embryos isolated from each horn were divided into two treatment groups towards testing for PRRSV via RT-PCR: Group I embryos were washed with trypsin and Group II embryos were washed without trypsin (control). The RT-PCR results for serum collected on Day 0 was negative for all seven gilts. All semen samples tested negative for PRRSV. Day 8 serum samples were collected on six of the seven gilts. Four of the six gilts tested positive for PRRSV in serum. There was 1 of 14 uterine flush samples testing positive for PRRSV. No embryos from Group I or II tested positive for PRRSV. Results suggest that pig embryo recovery and transfer may be a viable option for transporting germplasm with reduced health risks.

Key Words: Porcine, PRRSV, Embryo transfer

42 Estrous cycles in gilts with or without PG-600 and boar exposure. D. F. Hentges and T. J. Safranski

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A commercially available product, PG-600 (Intervet), containing PMSG and hCG is available to stimulate puberty in gilts. Our objectives were to determine whether the best induction and maintenance of estrous cycles came from PG-600 alone or in conjugation with other stimuli. In July, 109 gilts housed 16 to 21 per pasture lot were randomly allocated to treatments in a 2 × 2 factorial arrangement. Treatments were presence (or absence) of PG-600 and boar exposure (BE) beginning at 165 d of age. Blood samples were collected weekly, starting the week prior to initiation of treatments. Serum was assayed for progesterone (P4) to
determine whether ovulation had occurred. Forty-seven gilts with initial P4 concentrations above two ng/ml and two injured gilts were removed. The BE gilts were exposed to a mature boar 15 min daily with all gilts receiving daily BE beginning 18 days after initial treatment. During the 56 d study 54 gilts were observed in estrus. Three gilts from each of the BE and control treatments did not exhibit estrus and were not included in the estrus data. Mean days to first estrus were reduced (P < .006) with PG-600 vs no PG-600 (5.09 ± 1.01 and 9.42 ± 1.13, respectively). Days to first estrus were no different (P > .05) for BE vs no BE (6.96 ± 1.09 and 7.54 ± 1.96, respectively). The BE x PG-600 interaction was not significant. PG-600 increased (P < .01) the number of gilts expressing estrus within six days of treatment. A second estrus was seen within 18 to 23 days in 31 gilts that responded to initial treatments. There were no significant differences among treatments; however, the BE x PG-600 interaction approached significance (P < .05). Ninety-two percent of gilts receiving only PG-600 had a normal estrus cycle; whereas, only 67% of gilts receiving both PG-600 and BE had a normal estrus cycle. In experiment 1 BE had no menses effect on synchronizing estrus when used alone. Future research is needed to optimize timing for PG-600 and to confirm the effects of additional stimuli.

Key Words: Puberty, Gilt, PG-600

43 Boar sperm acrosomal status relative to fertility. S. T. Finn* and B. A. Didion, DEKALB Swine Breeders, Inc., DeKalb IL/USA.

Little information exists on the correlation between acrosome status and boar fertility. The objective of this research was to evaluate the effect of acrosomal integrity of boar spermatozoa on fertility. Twenty-seven boars with varying levels of fertility were used in this study. Fertility was measured as the percentage of sows bred (via artificial insemination) by each boar that farrowed. The mean farrow rate percentage was 72%. Two semen samples were collected from each boar with at least a seven-day interval between collections. Motility (measured microscopically) and acrosome integrity were evaluated for each boar. For acrosome staining, semen was diluted 1:1 with a sodium citrate solution (29g/l). A smeared slide was made for each collection. The slides were treated with methanol and allowed to air dry. The slides were treated with FITC-labeled PSA (50 micrograms/ml) for 45 minutes. They were then rinsed with dH2O for 10 minutes and air-dried. The slides were then examined at 400x magnification using an Olympus BH2 UV microscope fitted with a FITC filter set. A total of 200 sperm were categorized as acrosome-intact or acrosome-loss for each sample. Acrosome-intact sperm fluoresced more intensely than acrosome-loss sperm. The mean percent motility and mean percent acrosome-intact sperm was 92.8% and 98%, respectively. The range of percent acrosome-intact sperm was 92% to 100%. No functional relationship existed (r=-0.2) between boar fertility and acrosome status.

Key Words: Boar, Fertility, Acrosome

44 Factors associated with incidence of PG600 intervention in weaned sows. C. J. Bracken*, W. R. Lamberson, and T. J. Safranski, University of Missouri, Columbia, MO, USA.

During September of 1998, sows in a commercial herd were studied to determine factors affecting time of ovulation after weaning (n = 146). This group included a sub-population (n=31) that did not exhibit signs of estrus by d 7 post weaning and received PG600 intramuscularly. The first objective of this study was to identify factors associated with delayed estrus or PG600 intervention with PG600. A second objective was to characterize factors contributing to variation in the estrus to ovulation interval (EOI). The number and diameter of follicles present on both ovaries of each sow at d 3 post weaning, and of each sow receiving PG600 on the day of injection, were determined via transrectal ultrasound. Beginning 36 hours after the initial ultrasound (4.5 d after weaning), ovaries were examined at 07:00 and 16:00 h until ovulation was observed or d 6 post injection. Time of ovulation was defined as the midpoint between the last observation of a complete cohort of preovulatory follicles and the first observation of the absence of ovarian follicles. Estrous detection was conducted once daily using fence line boar contact. Parity, number of pigs weaned, lactation length, predominant follicle size (small, 3-4 mm; medium, 5-6 mm; or large, ≥7 mm), total d 3 follicular volume, back fat, and loin eye area were used as independent variables in analyses of PG600 intervention. Increased parity (P<.05), backfat (P<.05), and d 3 follicular volume (P<.001) reduced the likelihood of PG600 intervention. Only 9 of 90 sows with predominantly large follicles at d 3 post-weaning received PG600, while 17 of 26 sows with predominantly medium and 3 of 6 sows with predominantly small follicles received the drug (P<.001). Sows that received PG600 on average ovulated 15.82 h before expressing estrus whereas sows not receiving PG600 expressed estrus 30.03 h before ovulation (P<.001). Using PG600 intervention may affect EOI thus, influencing the appropriate time of insemination.

Key Words: PG600, estrus, ovulation


Storage of swine waste is associated with the production of a variety of odorous compounds, including ammonia, organic acids and alcohols, and sulfides. These odorous compounds can contribute to health problems for swine facility workers and animals, as well as affect local populations. Although the generation of these chemicals is the result of microbiological activity, little is known about the types of microorganisms responsible for their production. Microbial populations of pig and waste storage pits were analyzed by conventional microbiological analyses and 16S rDNA sequence analyses. DNA was extracted from fecal samples collected from a local swine production facility. For pit samples, total colony counts on media containing clarified swine slurry were 2-20 times higher than those obtained on rumen fluid medium. In contrast, the highest counts for fecal samples were obtained on rumen fluid containing medium. Samples were also plated onto media containing tetra-cycline, erythromycin, or tylosin, and antibiotic resistant bacteria enumerated. Antibiotic resistant organisms were found in all samples, and the level of resistance ranged from 4% erythromycin resistance in 6 ft pit samples to 32% tylosin resistance in 3 ft pit samples. Randomly selected colonies from the highest dilutions were isolated. Similarity analyses of 16S rDNA sequences derived from the bacteria indicated the presence of primarily low G+C Gram-positive bacteria, such as Clostridium sp., Streptococcus sp., and Lactobacillus sp. Total DNA was also isolated from the fecal and pit samples. DNA sequence analyses of PCR amplified 16S rDNA genes were carried out to identify predominant bacteria. Similarity analyses of the 16S sequences indicated the presence of primarily low G+C Gram-positive bacteria, such as Clostridium sp., Streptococcus sp., and Lactobacillus sp. in both ecosystems. Many of the sequences were of unidentified microorganisms. A variety of methanogenic archeabacteria were identified from the pit DNA. A large number of unidentified sequences were also found. These results indicate that the primary eubacteria identified in swine feces and waste pits are low G+C, Gram-positive bacteria.

Key Words: swine, waste, bacteria

46 Mucosal competitive exclusion to reduce salmonella in swine. D. E. Reeves*, P. J. Fedorka-Cray2, J. S. Bailey2, N. J. Stern2, N. A. Cox2, S. R. Ladely2, and W. Pullen1, 1University of Georgia, College of Veterinary Medicine, 2USDA-ARS, Russell Research Center.

In two separate trials, a mucosal competitive exclusion culture (MCES) was studied for its effectiveness in reducing Salmonella in suckling pigs. The MCES culture was derived from the cecum of a 6 week-old pig known to be free of Salmonella. MCES was produced in large scale, adjusted to approximately 10^8 CFU/ml, and frozen at -70°C until use. In trial one (T1), pigs were given 5ml MCES by oral gavage within 6 hours post-farrowing (PF) and again at 24 hours PF. Control pigs were given 5 ml sterile PBS by oral gavage at same time interval. At 48 hours PF, pigs were inoculated intranasally with 1 ml of S. choleraesuis (10^3 CFU/ml). In trial two (T2), all treatments were the same as T1, except that the challenge dose of S. choleraesuis was increased to 10^6 CFU/ml. Pigs in each treatment were housed in separate pens at weekly intervals prior to farrowing and from farrowing and from suckling pigs and sows at daily intervals after farrowing for culture. At day 7 PF necropsy samples of tonsil, lung and lymph nodes, liver, spleen, colon, cecum and ileocecal junction were obtained aseptically from each pig and qualitatively cultured. A cecal fecal sample was quantitatively cultured. No clinical signs of salmonellosis were apparent in either trial nor was S. choleraesuis recovered from fecal samples in either trial. In T1, 9.5% of the tissues were positive from the MCES treated pigs versus 21% positive tissues from the control pigs.
In T2, 28% of the tissues were positive from the MCES treated pigs versus 51% from the control pigs. A slight (≤1 log) quantitative difference in total numbers per cecum between treated and control groups was observed. The increase in the number of positive tissues between trials was attributed to the higher challenge dose given in T2. These data confirm previous findings in which a 25% reduction in positive tissues between treated and control pigs was observed. The continued observation in reduction of numbers of positive tissues indicates that the use of MCES may be a practical solution for control of Salmonella. Additional studies to determine the optimal time of administration and duration of protection is warranted.

Key Words: competitive exclusion, salmonella, swine

47 Development of electronic nose technology as a diagnostic tool in detection and differentiation of Escherichia coli O157:H7. S. M. Younts1, E. C. Alocia1, W. N. Osburn1, S. Marque1, and D. L. Grooms1, 1Michigan State University, 2Large Animal Clinical Sciences, Michigan State University.

Cattle have been identified as a primary reservoir for Escherichia coli O157:H7. Pre-harvest detection of pathogens using electronic nose technology would enhance efforts to reduce the risk of human exposure. The objective of this research was to develop a neural network-based gas sensing electronic nose to differentiate E. coli O157:H7 from non-O157:H7 strains. In phase 1, computer controlled gas sensors were used to monitor gas emissions from four isolates of E. coli O157:H7 and four non-O157:H7 E. coli isolates. A standard concentration of each isolate was grown in 10ml of nutrient broth at 37°C for 16 hours with gas sampling conducted every five minutes. Readings were continuously plotted to generate gas signatures. Gas chromatography/mass spectrometry analysis was used to validate the gas signatures and verify the gas composition. Standard growth curves were established through viable plate counts to demonstrate the relationship between bacteria growth and gas emissions. Detectable differences were observed between the gas patterns of the E. coli O157:H7 and the non-O157:H7 isolates. Phase 2 involved the training and testing of the artificial neural network (ANN) for identifying the gas signatures. Five signature vectors from each isolate (n=40) were used as training vectors for the ANN. In the training process the ANN was configured for pattern recognition, data classification, and forecasting. A second data set was used in testing the ANN for rapid identification and classification output. Analyzing the response of the ANN, the sensitivity, specificity, and predictive value of the electronic nose for detecting E. coli O157:H7 was calculated. Based on the ability to detect differences in the gas patterns, this technology has a broad scope of potential applications with promise as a diagnostic tool for pre-harvest pathogen detection in cattle intended for human consumption.

Key Words: E. coli O157:H7, Electronic nose, Food Safety

48 Modeling the relation between energy intake and protein and lipid deposition in growing pigs. J. van Milgen*, N. Quiniou, and J. Noblet, INRA, Saint-Gilles, France.

A data analysis model is proposed where, for an animal of given BW and genotype, the relation between protein deposition (PD) and ME intake above maintenance (MEp) is curvilinear, so that PD intersects the orine and reaches its maximum at the maximum protein deposition rate (PDmax). An increase of MEp beyond that required to attain PDmax would not change PD. The MEp not used for protein synthesis can be used for lipid deposition (LD). The relation between PD and LD on the one hand and ME on the other hand can then be described as a function of the maintenance energy requirement (MEm), PDmax, the level of ME required to attain PDmax (F; as a multiple of MEm), and the energetic efficiencies of PD (kPD) and LD (kLD). Of these statistics, only kPD and kLD were assumed to be independent of BW and genotype. Variation in PDmax was described as a Gompertz function (of age) whereas variation in F was assumed to be a linear function of BW. Maintenance energy requirements were expressed as lower function of BW. To verify the model, 345 nitrogen and energy (indirect calorimetry) balances were obtained from 3 types of pigs (Large White castrates (LWc) and Large White x Pietrain castrates (LPc) and males (LPm)) ranging in BW between 45 and 100 kg and housed under thermoneutral conditions. Animals were allotted to one of four energy levels ranging from 70 to 100% of ad libitum intake. The MEm was not different between genotypes (850 kJ/kg BW;40) whereas the kPD and kLD were .56 and .75, respectively. The maximum values for PD were 174, 179, and 192 g/d for LWc (54 kg BW; 103 d), LPc (37 kg BW, 83 d) and LPm (77 kg BW; 109 d), respectively. In most ad libitum fed animals, PD was limited by MEp and not by PDmax. In LPm, the difference between PD and PDmax was small (less than 8%). In LWc and LPc, PDmax started limiting PD at approximately 130 d of age (80 kg). The F did not change with BW for LPm (2.8 x MEm). For the other genotypes, it decreased linearly from 4.6 at 40 kg to 2.0 at 100 kg of BW. Because PDmax was a function of age, even some restrictively fed LWc were limited by PDmax and not by energy intake. At a same BW, these animals are older and therefore have a lower PDmax. Due to its nature, the model allows estimation of PDmax even when energy is restricting PD.

Key Words: Growing Pigs, Energy, Model


Two trials with finishing pigs (PIC line 355 x Camborough 22) were conducted to evaluate the effects of vitamin, trace mineral (VMT) deletions on performance, economics, carcass quality, and tissue nutrient levels. In trial 1, a 3 x 2 factorial (three VMT regimens, two stress regimens) was conducted for 12 weeks with 252 pigs (mixed sex). Average initial BW was 55 kg. The VMT regimens consisted of control (adequate level of VMT throughout trial), VMT deleted for final 6 weeks of trial and VMT deleted for entire 12 weeks of trial. The stress regimen consisted of leaving half the treatments in their original location or moving the other half of the treatments to a new pen location every seven days. There were three replications per treatment with 14 pigs per pen (.80 m2). Each treatment was replicated with 12 pens. Overall, there were no significant differences for ADG, ADFI, G/F, cost per kg of gain, loin eye area, and last rib backfat. However, there was a significant decrease (greater than 75%) in vitamin E content (loin muscle) from deleting vitamins for 6 and 12 weeks. In trial 2, a 3 x 2 factorial (three VMT regimens, sex) was conducted for 12 weeks with 306 pigs. Average initial weight was 58 kg. The VMT regimens were identical to those used in trial 1. Each treatment consisted of three replications of 17 pigs per pen (.66 m2) and all diets were unmedicated. Overall, pigs fed diets without VMT for 12 weeks had reduced (P ≤.06) ADG and lower (P ≤.10) ADFI than those fed the control diets. Compared to barrows, gilts had significantly lower ADFI and improved (P ≤.05) G/F and fat-free lean index. Vitamin E content (ham muscle) was markedly (P ≤ .05) reduced (greater than 50%) when pigs were fed diets without VMT for 6 and 12 weeks compared to those fed the control. Levels of copper in ham muscle were reduced (P ≤.05) in barrows but not in gilts fed diets without VMT. These data suggest that deleting VMT during the finishing stage reduces performance and markedly lowers the nutritional quality (vitamin content) of pork.

Key Words: Pigs, Vitamins, Pork quality

50 Efficacy of acidified sodium chloride as a decontamination treatment for pork tongues. H. N. Zerby1, K. E. Belk1, J. N. Sofos1, G. R. Schmidt2, N. Kotrolo2, M. L. Aldrich2, and G. C. Smith1, 1Colorado State University, Fort Collins, CO, 2Alcide Corporation, Redmond, WA.

This study was conducted to evaluate decontamination on pork tongues after they were treated with an acidified sodium chloride, lactic acid or trisodium phosphate solution. Acidified sodium chloride (ASC) consist of a combination of acid and sodium chloride in an aqueous solution (in this study acetic acid and 1200 ppm of sodium chloride were used). Individual pork tongues (n = 25) were immersed in solutions of ASC (22°C), 2% lactic acid (LA; 50°C), or 12% trisodium phosphate solution (TSP; 50°C) for 10 sec. Other pork tongues were sprayed with a solution of 2% LA (50°C) on each side for 10 sec at 35 psi. The effectiveness of the treatment regimens was determined by analyzing pork tongue samples for aerobic plate counts (APC), total coliform counts (TCC) and Escherichia coli counts (ECC). The APC, TCC and ECC from all treatments were compared with counts obtained from untreated controls. The controls had mean values (log CFU/g) for APC, TCC and ECC of 4.8 ± 4 ± 2.6 ± 1.0 and 2.5 ± 1.1, respectively. All decontamination treatments were successful in reducing (P ≤.05) APC, TCC and ECC by a minimum of 68, 98 and 98% of the absolute counts associated with the controls, respectively. Spraying or immersing pork tongues in a 2% LA solution
resulted in a 92% reduction in APC CFU/g compared to the controls, which was more effective (P < .05) than was immersing pork tongues in a 12% TSP which resulted in a 68% reduction. Reductions in mean APC CFU/g due to immersion in ASC solution were similar to reductions obtained with LA. For TCC and ECC, all treatments were equally (P > .05) effective, reducing counts by a minimum of 1.9 and 1.8 mean log CFU/g, respectively. Overall, the results indicated that immersion of pork tongues in an ASC, LA and TSP or spraying the pork tongues with LA were similarly effective in reducing microbial counts. Therefore, all three treatments can be considered as an effective decontamination intervention for reducing microbiological counts on pork tongues.

Key Words: Pork, Safety, Bacteria
on data recorded on progeny of five CLPG mating types (CC x CN, CN x CN, CN x NN, NC x NN, and NN x CN, with the sire genotype given first). We used a complete 4 x 4 mating design of CLPG genotypes to evaluate the paternal polar overdominance model of gene action. Data were recorded on 287 F3 lambs produced by 8 F2 sires and 152 F2 dams of Dorenet-Romanov origin. Genotypic data from eight markers flanking the previously determined CLPG interval were used to calculate CLPG genotypic probabilities in the four-generation pedigree. Lambs were slaughtered and leg muscling scores assigned to carcasses. Lambs with scores less than 13 (13 = low prime) were considered of normal phenotype, whereas lambs with scores greater than 13 were classified as callipyge phenotype. Phenotypic classification was regressed on CN probability to test the hypothesis of paternal polar overdominance. The model accounted for 78% of the variation in phenotypic classification (P < .0001). Residual analysis identified 15 observations associated with 96% of the error sum-of-squares. CN probabilities were intermediate for 7 lambs due to recombinations between flanking markers or lack of flanking marker information. Leg scores of 12 were assigned to 7 lambs with CN probabilities greater than .997 and the remaining lamb received probability to test the hypothesis of paternal polar overdominance. The were slaughtered and leg muscling scores assigned to carcasses. Lambs of Dorset-Romanov origin. Genotypic data from eight markers flanking the previously determined CLPG locus.

Key Words: Callipyge, Sheep, Imprinting


To evaluate the use of genetic markers in breeding value prediction, breeding values for heifer ovulation rate calculated using BLUP with or without fixed covariates for expected inheritance of founding animal alleles at selected positions in the genome (FACOV) were compared to subsequent measurements of ovulation rate. Expected inheritance of founding animal alleles was determined from a multi-locus peeling algorithm using marker genotypes. Averages of six ovulation rate measurements made from 12 to 18 months of age were calculated for 426 heifers born in four calving seasons. Sixteen FACOV were selected for the final analysis based on preliminary analyses using data collected prior to the comparison data. These sixteen covariates consisted of five founding animal alleles at one location on one chromosome, six at another distant location on the same chromosome, and five on a second chromosome. Including the 16 FACOV reduced the estimate of polygenic variance by 13%. Predictions were updated for the four calving groups using only information collected prior to each calving group. The regressions of observed ovulation rate on predicted breeding value were not substantially or significantly different from the expected value of 1.0 either with (.93±.19) or without (.92±.21) FACOV. The proportion of observed variation in ovulation accounted for by prediction was .052 with FACOV and .043 without FACOV. Without FACOV, predicted breeding values of heifers were based only on the averages of their sire and dam breeding values. Predicted breeding values using FACOV were partitioned into parental average and deviation from parental average. The deviation from parental average results from Mendel sampling of the selected founding animal alleles and accounted for 28% of the variance accounted for by prediction with FACOV. Using marker information to track a small number of founding animal alleles increased the accuracy of predicted breeding values by accounting for some within family segregation.

Key Words: Marker Assisted Selection, Genetic Prediction, Cattle


A candidate gene approach was used to identify loci that influence ovulation rate (OR). Two selection lines (IOL and COL) and a control line (C) were used. IOL was obtained from a line previously selected on ovulation rate and embryonic survival for 8 generations. COL and C were derived from the previously randomly selected control line. Both IOL and COL have undergone 8 additional generations of selection in which stage 1 included all gilts from 50% of litters with greatest number of fully formed pigs (FF), and stage 2 included 50% of these gilts with the greatest OR. Line C continued to be randomly selected. IOL and COL differ in mean EBV by 6.1 ova and 4.1 FF, whereas COL and C differ by 2.2 ova and 2.2 FF. Animals from generation 7 were genotyped for retinol binding protein 4 (RBP4, n=190) and epidermal growth factor (EGF, n=189). Animals from generations 7 and 8 were genotyped for estrogen receptor (ESR, n=523), prolactin receptor (PRLR, n=491), follicle stimulating hormone beta subunit (FSHb, n=272), and prostaglandin-endoperoxide synthase 2 (PTGS2, n= 513). Chi square analysis for homogeneity of genotypic frequencies across lines was conducted in 3 X 3 contingency tables. Distributions for EGF, ESR, and RBP4 were not significant. Genotype frequencies for PRLR, FSHb, and PTGS2 were different among the lines (P<0.005). Changes in gene frequencies (s.e. adjusted for genetic drift) between IOL verses C and COL verses C are: .33 ± .29 and .15 ± .27 for PRLR, .30 ± .28 and .1 ± .26 for FSHb, and .16 ± .22 and .09 ± .21 for PTGS2. The average effect of gene substitution for PRLR, FSHb, and PTGS2 on OR were calculated using the MTDFREML program with model fixed effects and number of favorable alleles in the genotype (0, 1, or 2) as the covariate. The favorable allele was defined as the one with the highest frequency in the selection lines. Estimates of were .12 ± .46 (PRLR), .35 ± .76 (FSHb), and .37 ± .68 (PTGS2). Selecting for PRLR, PTGS2 and FSHb may benefit genetic improvement for litter size; however, additional studies to verify these results are needed.

Key Words: Candidate Gene, Ovulation Rate, Swine


An association between the estrogen receptor (ESR) gene and reproductive components in swine has been evaluated. Two hundred twelve litter records from females genotyped at the ESR locus were analyzed using a model that included the effects of ESR genotype of dam, parity, farrowing month, dam breed, sire breed, and significant two-way interactions. Some litter traits displayed favorable, but not statistically significant trends with respect to ESR genotype: litter weight born alive, litter weight at weaning, number of stillborn pigs, number of pigs at weaning, and total litter weight at weaning. Reproductive tract data were also analyzed for associations with ESR genotype. The ESR genotype of 36 Yorkshire, 28 Large White, and 42 crossbred females was determined to be either AA (n=21), AB (n=69), or BB (n=16). Females of parities 1 (n=46), 2 (n=41), and ≥3 (n=19) were included. All females were mated to Hampshire boars and slaughtered at d 75 of gestation. Measured reproductive tract traits were: ovulation rate, horn length, number of fetuses, fetal weight, uterine weight, number of mummies, fetal sex, fetal placement, fetal survival, and fetal sex. Data were analyzed using a model that included ESR genotype, breed, parity, and significant two-way interactions. Uterine horn was also included in some analyses. Fetal sex and fetal number per horn were not significantly different between animals of AA (58±3.84, 5.11±3.30), AB (54.9±1.94, 5.57±1.16), and BB (52±5.47, 5.84±.34) genotype. Fetal sex and number of fetuses per horn were significantly (P=0.01, P=0.03) different between animals of parity 1 (61.6±2.66, 5.21±2.21), and parity ≥3 (45.6±5.84, 5.97±.32). Some traits displayed favorable, but not statistically significant trends with respect to ESR genotype: fetal survival, total uterine length, total fetal weight, total number of mummies, fetuses per horn, horn length, and fetal sex. The ESR gene is positively associated with several litter and reproductive tract traits.

Key Words: Swine, Genetic Marker, Reproductive Traits

59 Evidence of QTL affecting reproduction in pigs. J. P. Cassady*, R. K. Johnson1, D. Pomp, L. D. Van Vleck2, E. K. Spiegel1, K. G. Arness, and O. Rohrer1, 1University of Nebraska, Lincoln, 2USDA, ARS, USMARC, Lincoln, NE., 3USDA, ARS, USMARC, Clay Center, NE.

The objective was to identify chromosomes regions containing QTL affecting reproduction in pigs. A three-generation resource population was developed by crossing low index animals from a randomly selected control line with high index animals from a line selected for increased index of ovulation rate and embryonic survival (I). Differences between lines I and C at Generation 10 were 6.7 ova and 3.3 fetuses at 50
Genetic and phenotypic correlations among and between bull and heifer reproductive traits in a multibreed beef cattle population. P. B. Kowana1, R. A. Kemp1, D. H. Crews Jr.1, J. P. Kastelic1, D. R. C. Bailey2, and G. H. Coulter1. 1Agriculture And Agri-Food Canada, Lethbridge Research Centre, 2Lacombe Research Centre.

Genetic and phenotypic correlations among and between bull and heifer reproductive traits in a multibreed (25 Charolais, 25 Simmental, 44 Hereford/Angus, 06 Limousin) beef cattle population were estimated. At about one year of age (365±44 d) yearling scrotal circumference (YSC), tomscore meter reading (YTON) and weight (YWWT) measurements were collected on 1547 bulls born from 1983 to 1994. Data on age at puberty (AGEPH), estimated weight at puberty (ESTWT), Julian birth date (JBD), birth weight (BWT), weaning weight (YWWT), pre-weaning (ADG1) and post-weaning daily gain (ADG2) on 1883 heifers born between 1987 and 1994 (inclusive) from Brandon (Manitoba) and Manyberries (Alberta) were also available. All traits were analyzed using a multi-trait animal model with age at time of measurement included as a covariate for YSC, YWWT and YTON. Means and standard errors were 32±3 cm, 381±50 kg, and 21±2 for YSC, YWWT and YTON, respectively. Heifer average BWT, WWT and YWWT were 37±5 kg, 225±28 kg and 341±33 kg, respectively and their ADG1 and ADG2 were 0.95±0.13 and 0.68±0.15 kg, respectively. On average heifers reached puberty at 297±47 d weighing 293±42 kg. Direct heritabilities were 0.65, 0.35 and 0.17 for YSC, YWWT and YTON, respectively and 0.06, 0.36 and 0.27 for JBD, ESTWT and AGEPH, respectively. YSC had a negative genetic correlation (rg=−0.47) with YTON indicating that large YSC was associated with lower YTON. YTON may aid in setting the lower and upper bounds of desirable scrotal size in beef cattle. Of all heifer traits studied, only JBD and ESTWT were significantly (P<.05) related to AGEPH, with rg=−0.24 and rg=0.72, respectively. YSC showed a favorable genetic relationship (rg=−0.28) with AGEPH suggesting that improvement in AGEPH can be achieved as a correlated response to selection of bulls with above average YSC. The genetic and phenotypic correlations between YTON and AGEPH were not different from zero (P>.05) suggesting that YTON was not associated with age at first estrus.

Key Words: Scrotal circumference, Age at puberty, Reproduction

Analysis of litter size and piglet mortality using a multivariate model with direct and maternal effects. M. S. Lund1, P. Luttinen2, L. Rydham3, M. Henryon4, and J. Jensen5. 1Danish Institute of Animal Sciences, 2Finnish Animal Breeding Association, 3Sweden University of Agricultural Sciences.

The objective of this study is to estimate (co)variances for direct and maternal genetic effects in the litter size of pigs and mortality of piglets. Only single-trait analyses have been reported in the literature for these traits, though they are likely to be genetically correlated. Therefore, to obtain a thorough understanding of the components involved in the number of piglets weaned, multi-trait analyses will be carried out which includes the total number of piglets born, mortality of piglets until birth, and mortality of piglets from birth until three weeks of age. The analysis will be performed on large purebred populations from Finnish herds, with complete pedigree information. The dataset consists of records on 114,343 female pigs and 82,471 Yorkshire sires with sires from AI-stations. The model will fit direct and maternal genetic effects for each of the traits in the analysis.

Key Words: Litter size, Piglet mortality

Crossbreeding parameter estimates for growth and litter traits in commercial rabbits. M. F. Medellin and S. D. Lukefahr*. Texas A&M University-Kingsville.

Postweaning fryer and litter production traits were measured in 1,111 weanling rabbits from 185 litters born in 1997 in sub-tropical, semi-arid south Texas. Genetic groups evaluated were Altec (A; a new commercial sire breed) and New Zealand White (NZW; a traditional commercial breed) purebreds and A×NZW and NZW×A reciprocal crosses. Traits were individual weaning (28-d; WW) and market (70-d; MW) weights and ADG. Litter traits were size weaned (LSW), 28 to 70 d total feed intake (LFI), feed efficiency (LFE), and survival rate (SR), and within-litter uniformity for MW (CV). The least-squares model consisted of fixed effects of sire breed, dam breed, season, and two- and three-way interactions, and random effects of sire/breed, dam/dam breed, litter/sire breed x dam breed (only for individual growth traits), and residual error. In favor of A sires, breed additive estimates were 37.3±2.0 (P<.10) and 140±7.3 g (P<.001) and 2.5±0.6 g/d (P<.001) for WW, MW, and ADG, respectively. The maternal breed effect (obtained from NZW minus A performance of dams) did not influence WW (49.4±3.4 g), but tended to affect (P<.10) MW and ADG (112±6.3 g and 1.59±1.9 g/d). Individual heterosis was not important for WW (15.4±19 g/d).
g), but was significant for MW and ADG (81:34 g and 1.59±5.5 g/d). Crossbreeding parameters were not significant for all litter traits investigated. However, when LF1 and LFE were adjusted linearly for LSW (added to the above model), heterosis exhibited in crossbred litters significantly increased LFI by 2,470 g, while the breed additive contribution of a Sire x Breeder interaction was by 26 units. Least squares were similar for A and NZW does (mean LSW was 61±1.3 kits). Season affected (P<0.05) all traits except CV. There was no relationship between breed-type of fryer and season of weaning for SR (P>0.05; overall postweaning mortality was only 3.2%). A doe breed x season interaction was detected for MW (P<0.05). Fryers reared by A compared to NZW does were heavier by 176 g (P<0.05) in the summer, whereas no differences existed between doe breeds in the other seasons. Experimental results recommend crossing of A bucks to NZW does to improve breeding efficiency in the meat rabbit industry.

Key Words: Rabbits, Breeds, Heterosis

64 Comparison of carcass traits of Bos taurus × Bos indicus and Bos taurus × Bos indicus, A. P. Márquez1, C. C. Vásquez2, A. C. Coorea3, H. C. Hernández2, and H. G. González1, 1Universidad Autónoma de Baja California, Instituto de Ciencias Agrícolas, 2Universidad Industrial de Santander, Colombia, 3Universidad Autónoma de Baja California Sur.

Evaluations of 511 carcasses of steers and heifers progeny from crosses involving Charolais, Brahman, Brangus, Hereford and Angus inheritance are presented. Traits evaluated included final weight, percentage of carcass yield chill, yield grade, dressing percentage and marbling score. Separate analyses for each trait was analyzed by using SAS. The analytical model included fixed main effects of sire breed, sex, slaughter group, dam breed and interaction of sire breed x dam. Random nested components of sires within sire breed and dams within dam breed and residual. A series of linear contrasts was used to test averages between specific breed combinations. Charolais crosses were the heaviest (P<0.05) (average of all Charolais crosses = 508.33 kg) for final weight compared with progeny of other sire breed. Sex effects were highly significant (P<0.01) for all traits. Sex effects were significant for final weight, yield grade and dressing percentage. Sires nested as a random components within sire breed were significant for final weight, cold carcass percentage and yield grade. Dam breed effects were highly significant (P<0.01) for all traits. Dam breed effects nested within dam breed were significant (P<0.01) for cold carcass percentage, yield grade and dressing percentage. Sire x dam interaction was highly significant (P<0.01) for final weight, cold carcass percentage and marbling score.

Key Words: Beef cattle, Carcass traits, Breed crosses

65 Breed, muscle quality and sensory characteristics of pigs classified as high or low for glycolytic potential of the loin muscle. R. S. Emmett*, S. J. Moeller, D. L. Meeker, K. M. Irvin, and R. N. Goodwin2, 1The Ohio State University, 2National Pork Producers Council.

The effect of Glycolytic Potential (GP) on pork quality traits was analyzed for a population of 576 longissimus dorsi samples collected from pigs entered in the 1998 National Barrow Show Progeny Test. Berkshire (N=184), Chester White (N=99), Duroc (N=77), Hampshire (N=22), Landrace (N=55), Poland China (N=24), Spot (N=15), Yorkshire (N=69), Hampshire crossbred (N=16), Poland x Duroc F1 crossbred (N=8), and Tamworth x Hampshire crossbred (N=7) were represented in the test. Animals were classified as high glycolytic potential (N=26) or low glycolytic potential (N=550) based on a GP threshold of 160 μmoles lactate equivalents per gram for the population bimodal distribution. Muscle quality and sensory traits were analyzed in a mixed model analysis of SAS with fixed effects of day off test, breed and GP status and a random sire(breed) effect. Partial correlation coefficients were calculated among quality traits using the MANOVA statement in SAS. Objective muscle quality traits measured included loin pH (pH), water holding capacity (WHC) measured as the weight (mg) of exudate absorbed on a filter paper, Instron tenderness (INS), percent cooking loss (CL), and Minolta color (MIN). Sensory scores evaluated included tenderness (TEN) and juiciness (JUC). The least squares means for high and low GP pigs were 182.0 and 112.5 μmoles/g, respectively. High GP pigs had significantly lower pH (5.38 vs 5.56), WHC (.054 vs .038) and greater CL (23.6 vs 19.2) than low GP pigs. No statistical differences were found between low and high GP pigs for INS, MIN, JUC or TEN. Breed was a significant source of variation for all traits evaluated. Berkshire and Chester White breeds exhibited significantly lower GP values than all other breeds. Residual correlations between GP and pH, INS, WHC, CL, and MIN were -.54, .12, .22, .25, and .29, respectively. The results of this study agree with previous research indicating that high GP values are associated with poorer WHC, lower pH and higher CL. The breed differences in GP warrant future studies to determine the relationship of GP with muscle quality and sensory traits.

Key Words: Swine, Muscle Quality, Glycolytic Potential

66 Estimation of genetic parameters for growth traits in a dog guide population. S. K. Helmink1, S. L. Rodríguez-Zas1, R. D. Shanks1, and E. A. Leightoh2, 1University of Illinois, Urbana, 2The Seeing Eye, Inc., Morristown, NJ.

An optimum-sized dog guide weighs 18 to 32 kilograms and stands 53 to 64 centimeters at the withers when mature body size is attained. Heritabilities and genetic correlations were estimated for birth weight, 42-day weight, mature weight, and mature height for 2334 German Shepherd Dogs (GSD) and 2028 Labrador Retrievers (LR) raised by The Seeing Eye, Inc., Morristown, NJ from 1979 to 1997. Data included 5006 observations for GSD from 114 dams and 34 sires, and 4123 observations for LR from 90 dams and 30 sires. Derivative free REML software was used to estimate (co)variance components with an animal model incorporating all pedigree information available and fixed effects for sex and birth year. Maternal effect and covariate of age when measurement was taken were also considered. Heritabilities ranged from 0.16 ±0.07 to 0.51 ±0.11 for GSD and 0.31 ±0.11 to 0.44 ±0.08 for LR. The maternal component was higher than the additive component for heritability of birth weight. Heritability of mature weight was estimated as 0.49 ±0.07 for GSD and 0.44 ±0.08 for LR. Mature height heritability was estimated as 0.31 ±0.08 for GSD and 0.44 ±0.08 for LR. Mature height was most highly correlated with mature weight. Selection for lighter dogs at maturity will yield a decrease in height at maturity, and selection for taller dogs at maturity will yield an increase in mature weight. The estimated genetic parameters will aid in the development of breeding strategies to increase the probability of dogs attaining optimum mature size.

Key Words: Body Weight, Height, Heritability

67 Differences in fresh and cooked ham muscles due to breed and sex. R. N. Goodwin1, R. K. Miller2, and E. P. Berg3, 1National Pork Producers Council, 2Texas A & M University, 3University of Missouri.

Purebred barrows and gilts (787) representing the pure breeds of Berkshire, Chester White, Duroc, Hampshire, Landrace, Poland China, Spot, and Yorkshire were evaluated. These pigs represented 103 sire families. Pigs were entries in the 1996-1997 National Barrow Show Sire Progeny Tests and slaughtered at the Quality Pork Processors commercial packing plant in Austin, MN. One ham per carcass was collected from the plant fabrication line, packaged individually, and transported to the Texas A&M University Meat Lab at College Station, TX. Hams were separated into skin, bone, seam fat, subcutaneous fat, OUTSIDE ham (biceps femoris and semitendinous), KNUCKLE (quadriiceps group), INSIDE (semimembranous), and other lean. Measures of ultimate ph (CPH), Minolta reflectance (RHUNT, L*), and Hunter color (RHunter, L*, a*, b*, C, and E) were taken from the fresh INSIDE, KNUCKLE, and OUTSIDE. The INSIDE, KNUCKLE, and OUTSIDE were injected up to 20% of green weight using a brine containing water, salt, sodium tripolyphosphate, dextrose, sodium erythorbate, and sodium nitrite. Ham muscles were tumbled for one hour after injection and allowed 12 hours at 4°C to equilibrate. Ham muscles were cooked to an internal temperature of 71°C. Measures of pH (CPH), Minolta reflectance (CIELAB), Hunter color (CHROMA*), cooking loss (COORYLD, %), and slicing yield (SLICEYLD, %) were taken on cooked muscles. Fresh ham measures were evaluated with a mixed linear model including fixed effects of BREED, SEX, BREED*SEX and slaughter date. Random effects were SIRE within BREED and DAM within BREED. Cooked ham measures were evaluated using the fresh ham model with the additional effect of brine injection amount. A REML algorithm was used to estimate sire variances. Heritabilities were calculated as four times the sire variance divided by total variance. BREED differences were found for...
68 The genetic relationship of ovine milk score with range lamb weaning weight. G. D. Snowder*1, A. D. Knight1, C. M. Bromley2, and L. D. Van Vleck3* 1USDA, ARS, U.S. Sheep Experiment Station, 2University of Nebraska, Lincoln, 3USDA, ARS, MARC, Lincoln.

Range ewes are commonly evaluated for milking ability by producers as to the ewe’s ability to rear lamb(s) under range conditions. The U.S. Sheep Experiment Station has been subjectively scoring a ewe’s milking ability (low, average, high) within 24 hrs of lambing for many years. The objective of this study was to determine factors influencing milk score and estimate genetic parameters between milk score and litter weight weaned. Lambing records of Columbia (n=1731), Polypay (n=1129), Rambouillet (n=1704), and Targhee (n=1638) individual ewes were evaluated. Only 1 to 10% of first parity ewes were scored as high milking ability. However, 29 to 40% of second or greater parity ewes were evaluated as high milking ability. Some positive association may exist between body size (kg) and milk score especially at third parity or later in all breeds. Ewes with high milk scores gave birth to significantly heavier lambs in all breeds while ewes with low milk scores weaned the lambs with significantly higher lamb death losses at birth. Heritability of milk score and the genetic correlation of milk score with litter weight weaned were determined by MTDFREML analyses within each breed. Heritability estimates were moderate and similar among breeds (Columbia, .21; Polypay, .26; Rambouillet, .21; Targhee, .25). The genetic correlations between milk score and litter weight weaned were also moderate and within a general range (Columbia, .51; Polypay, .44; Rambouillet, .46; Targhee, .38). Conclusions include first parity milking performance may not be a good indicator of future potential milking ability, milk score may be a good selection trait for improving maternal ability, and it appears useful under commercial range conditions weaning at older ages (120 d).

Key Words: Ewe, Milk, Heritability

69 Genetic comparison of top Holstein bulls and their progeny in Hungary. A. Janosa*1, B. Baranyai2, and J. Dohy3, 1Goddlo University of Agricultural Sciences, 2Agricultural Biotechnology Center, Godollo.

Progeny-tested Hungarian Holstein-friesian sires have been examined. The Hungarian Total Production Index (TPI) of 44 sires were compared to their 282 sons’ TPI (i.e. 6.4 sons/sire) and to 16,435 granddaughters’ milk fat and protein production performance. The goal of the present work was to determine if there were correlations between (1) the sires’ TPI and their sons’ TPI and also (2) granddaughters’ fat and protein production performance. The Hungarian Total Production Index was counted as follows: TPI=6.6*PTA Fat(kg)+14.0*PTA Protein (kg)+8.0*PTA Final Score+7.0*PTA Udder Score. Rank correlation between the indices was calculated by the method of Spearman. After the analysis for rank-correlation (r), a weak correlation was found between the sires’ TPI and the sons’ TPI (r=0.42); the sires’ TPI and granddaughters’ fat (r=0.32) and protein (r=0.34) production performance. It can be concluded that however modern the selection of the best sires is (BLUP), the weak correlations between TPI of sires and the fat and protein production performance of their granddaughters show that progeny-testing of sires’ sons is indispensable. The application of TPI does not improve production directly, but prevents the constitutional degradation of the animals. Our other results of correlation between sires’ TPI and granddaughters’ type final score, udder score and feet composit made with similar method, also reinforce this conclusion. The correlations found are strong or middle strong and they are .651,.568 and .579, respectively.

Key Words: Genetic Comparison, Production Index, Progeny-testing

70 Consequences of selection on mothering ability and vitality on underlying mortality traits in pigs. E. F. Knol*, Institute for Pig Genetics, The Netherlands.

In The Dalland genetic improvement program selection against piglet mortality is based on EBV’s for mothering ability and piglet vitality. In two data sets the consequences of this approach were checked. Data 1 consists of around 10,000 litters of commercial offspring with a full pedigree. Correlations of pedigree index of mothering ability with live and still-born and with the occurrence of aggression, overlaying and splay legs were non-significant, while correlations with no. weaned were 0.04 (P=0.0001) and mothering ability 0.03 (P=0.0002). Pedigree index for piglet vitality correlated in the expected directions with still-born -0.03 (P=0.0017), no. weaned 0.04 (P=0.0002), mothering ability 0.04 (P=0.0001), overlaying -0.03 (P=0.0016) and the occurrence of splay legs -0.03 (P=0.0068). Correlations with live born and aggression were non-significant. Gestation length in pigs is highly heritable and correlated with aggression -0.03 (P=0.0001), overlaying -0.04 (P=0.0001) and splay legs -0.07 (P=0.0001). In data 2 some 25,000 litters of pure line sows were analysed, registration of piglet traits is more precise and includes birth weight. Heritability estimates for mothering ability, aggression, overlaying and occurrence of splay legs are resp. 0.07, 0.08, 0.04 and 0.08. Permanent environment estimates resp. 0.05, 0.31, 0.05 and 0.09. Genetic correlations (std) of mothering ability with aggression, overlaying and splay legs are resp. -0.13 (0.22), -0.33 (0.25) and -0.54 (0.18). It is concluded that selection on mothering ability and piglet vitality will not necessarily reduce aggression, but will reduce piglet mortality in general and more specific overlaying and the occurrence of splay legs in both pure lines and the commercial hybrid.

Key Words: Piglet Mortality, Aggression, Splay Legs
enzyme and electrophoresed on a 1% agarose gel. Six different restriction enzymes were evaluated for polymorphisms with the AMHR probe. Allelic variation was identified using the restriction enzyme Hind III. Two animals from each of seven different genetic lines were evaluated for allelic variation. Two alleles were detected using the AMHR probe in three of the seven genetic lines. Allele A was approximately 10 kilobases in size, while allele B was approximately 7 kilobases in size. Next, a single sire, two dams and the resulting two litters of offspring were evaluated for this polymorphism in one genetic line. The same two alleles described above exhibited Mendelian inheritance. Further research is required to identify the chromosomal location of the porcine AMHR gene.

Key Words: Porcine, Anti-mullerian hormone receptor, Polymorphism


The porcine heart fatty acid-binding protein (H-FABP) gene has been sequenced and localized to swine chromosome 6 and may have an association with production traits such as intramuscular fat and backfat (Gerbens et al., 1997; 1998). The objective of this project was to determine allelic frequencies for three PCR-RFLPs of the H-FABP locus in two genetic lines of pigs. The PCR-RFLPs were detected in random selected Pietrain (N=220) and Duroc (N=69) genetic lines using two primer sets for H-FABP (FAB1 and FAB2). The FAB1 primer set yielded an 816 base pair (bp) PCR product. This product was digested with HaeIII and MspI in two separate restriction enzyme reactions. The FAB3 primer set yielded a 376 bp PCR product that was restriction enzyme digested with HindI. Each H-FABP polymorphism exhibited two alleles. The digestion products were electrophoresed on a 3% agarose gel for HaeIII and HindI. The digestion products of the MspI site were electrophoresed on a 2% agarose gel. The HaeIII alleles comprised a 256 bp product (allele h) and a 197/59 bp product (allele H). The HindI alleles comprised a 256 bp product (allele A) and 260/64 bp product (allele a). The MspI alleles comprised a 814 bp product (allele A) and a 703/111 bp product (allele a). These data are presented in Table 1. The data provide evidence to suggest that pituitary responsiveness to GnRH may be useful in predicting reproductive traits in bulls and that this response could be influenced by a sire.

Key Words: Porcine, Anti-mullerian hormone receptor, Polymorphism

74 Preliminary evaluation of pituitary responsive-ness to GnRH as a tool to predict reproductive traits in bulls. M. G. Thomas*, R. A. Winder*, D. M. Halford1, 1New Mexico State University, Las Cruces, NM, 2University of Arizona, Tucson, AZ, 3Texas Agricultural Experiment Stations, Beeville, Kingville and Overton, TX, 4University of Chihuahua, Chihuahua, Mexico.

Development of physiological methodologies that can be incorporated into current sire evaluation techniques could increase the accuracy of sire selection. In this study, Forty-five Noble Line Composite bulls (1/3 Angus, 1/3 Brahman, 1/3 Gelbvieh) from 10 sires and reared in two locations were used to evaluate the use of pituitary responsiveness to GnRH as a tool to predict reproductive traits. Bulls averaging 232 ± 3.5 d of age received a 60 μg i.v. injection of hGnRH to stimulate pituitary secretion of LH. Blood was collected from each bull prior to GnRH injection and thereafter at 30-min intervals for 90 min. Reproductive traits such as scrotal circumference were measured every 28 d and age for scrotal circumference to equal 32 cm (AGE32) were determined during a 112-d performance test. Pituitary responsiveness to GnRH was evaluated for use in predicting reproductive traits using generalized least-squares procedures. In the initial model, sire(location) was used to predict reproductive traits with pituitary response to GnRH used as co-variants. A tendency (P < .10) was observed for sire(location) to be a significant source of variation within the model when predicting AGE32 (307 ± 5.7 d, r² = .35). The model did not appear to be effective for predicting scrotal circumference (r² < .3) even though a correlation was detected between the LH response at 60 min (10.2 ± 4 ng/ml) and scrotal circumference at d 56 of the test (30.5 ± 5.6 cm; r = .31, P < .04). Sire(location) appeared to be a significant (P < .05) source of variation when the data were used to predict serum concentration of LH above baseline 30 min after GnRH injection (9.4 ± 4 ng/ml, r² = .38). These data provide evidence to suggest that pituitary responsiveness to GnRH may be useful in predicting reproductive traits in bulls and that this response could be influenced by a sire.

Key Words: bulls, GnRH, sire

75 Reproductive performance of beef cows with divergent genetic merit for milk production. D. S. Buchanan*, O. Cobanoglu, R. P. Wettmann, J. Minick, and S. Rupert, Oklahoma Agricultural Experiment Station, Stillwater, OK.

Milk production is an important component of calf weaning weight and contributes to efficiency of production in cow-calf enterprises. It is obtained at a cost to body condition which may affect cow reproduction. The objective of this study was to evaluate the extent to which differences in genetic merit for milk production affects reproductive efficiency in beef cattle. Crossbred cows sired by high and low Milk EPD sires from Angus and Hereford (mean Milk EPD (kg) for High Angus (HA), Low Angus (LA), High Hereford (HH) and Low Hereford (LH) were 8.7, -6.1, 7.4, and -3.9, respectively) were compared in spring and fall calving seasons for calving interval, calving day and days to luteal activity. Interval and date were evaluated over a seven year period with 1669 opportunities to calve in cows ranging in age at calving from two to eight years. Cows that failed to calve during a calving season were switched to the other season. Consecutive failures to calve caused the cow to be removed from the herd. Days to luteal activity (determined as days after calving until two consecutive weekly progesterone concentrations exceeded 1ng/ml) was evaluated on 227 cows (ages four to eight years) during a single year. The lowest square model included breed, milk EPD level, year, season, sex of calf, cow age and two factor interactions. Least squares means for HA, LA, HH and LH for calving interval (with observed significance level for group differences) were: 418.5, 416.4, 436.6 and 452.7 days, respectively (P < .01). Similar results were obtained when the initiation of the calving season was included in the model (mean = 322.2, 27.9, 26.9 and 29.5 days, respectively (P > .2). In the same manner, means for days to luteal activity were 56.2, 57.5, 57.6 and 55.5 days, respectively (P > .2). These results provide little evidence that genetic differences in milk production contribute to a loss in reproductive efficiency in this environment (native range, body condition at calving app. 5.5 on a 1-9 scale). Cattle producers should be able to use Milk EPDs to affect calf performance without major concerns about the subsequent effect on reproduction.

Key Words: Beef cattle, Milk production, Reproduction

76 Allelic frequencies for a lepton Sau3AI RFLP in biologically diverse breeds of cattle in the southern United States and Mexico. C. C. Rasor*, M. G. Thomas, H. C. Salazar, R. M. Enns, H. M. Zhang, R. L. Ax, G. L. Williams, R. D. Randal, R. L. Stanko, and J. Rios, 1New Mexico State University, Las Cruces, NM, 2University of Arizona, Tucson, AZ, 3Texas Agricultural Experiment Stations, Beeville, Kingville and Overton, TX, 4University of Chihuahua, Chihuahua, Mexico.

Leptin is a hormone that influences appetite and increases with adiposity in rodents and humans. In 1997, Pompong and coworkers (J. Anim. Sci. 75:1427) identified a RFLP within PCR amplification products of the bovine leptin gene using the restriction enzyme Sau3AI. Three genotypes (i.e., AA, AB, BB) were reported in unrelated animals of various breeds. High frequencies of the A allele were found in Bos taurus breeds; however, this allele was absent in the Brahman cattle that were evaluated (n=4). These data led us to hypothesize that RFLPs within the lepton gene may be indicators of metabolic or feed efficiency differences observed in biologically diverse breeds of cattle. Frequencies of the Sau3AI RFLP within PCR products of the lepton gene were then determined in eight populations of beef cattle located in the southern United States and northern Mexico. Frequencies of the A allele were .88 in Angus (n = 25), .93 in Brahman (n = 7), .76 in Brangus (n = 44), 1.0 in Criollo (n = 11), .97 in F1 Brahford (n = 18), 1.0 in MASHona (n = 6), .94 in Santa Crius (n = 33), .96 in Santa Gertrudis (n = 25). Frequencies for the AA, AB, and BB genotypes across these breeds of cattle were .82, .16, and .02, respectively. The Brahman, Criollo, and Mashona cattle
evaluated were unrelated. Angus and Brangus cattle were progeny from 4 and 3 sires, respectively. Santa Gertrudis and Santa Cruz cattle were each the progeny of 10 sires. These San3AI RFLP data do not support the hypothesis that RFLPs within the leptin gene may be indicators of metabolic or feed efficiency differences observed in biologically diverse breeds of cattle.

**Key Words:** cattle, lepjin, San3AI

### 77 Estimation of variance components for teat number in swine using REML and Gibbs sampler. C. Lee* and C. D. Wang, Hallym University, Chuncheon, Korea.

Variance components were estimated for teat number in a swine population (N=16322). The data contained a variety of breeds: Landrace (L, N=9898), Yorkshire (Y, N=1748), crossbred of Landrace and Yorkshire (LY, N=1924), crossbred of Landrace, Yorkshire, and Chinese Indigenous Min (LYM, N=2685), and Min pig (N=67). Analytical model included breed and sex as fixed effects and additive genetic effect as random effect. The restricted maximum likelihood (REML) and Gibbs sampling were used for parameter estimation. The results indicated that REML estimates of genetic and environmental variances were 1.03 and 0.54. The heritability was 0.66. The maximum likelihood (ML) estimates of breed effects were 13.82 (L), 14.42 (Y), 14.50 (LY), 14.52 (LYM), and 14.61 (M). Using Gibbs sampling, the posterior mean estimate (1.06) of expected genetic variances was larger than that with REML, but that (0.51) of the environmental variance was smaller. However, the posterior mean estimates for breed and sex effects did not differ from those using ML. Bayesian analyses were also performed with flat prior for variance. The posterior mean estimates for variance components as well as for fixed effects were not different from those with (RE)ML. While flat prior is theoretically improper for variance components, empirically it can be closely corresponding to REML estimates. Thus a prior close to the flat prior is recommended for variance components in Bayesian analyses.

**Key Words:** Teat Number, Genetic Parameters, Bayesian inference

### 78 Effects of recipient breed on birth and weaning weight and wool follicle numbers of Merino lambs born by embryo transfer. T. Wuliji*1, K. G. Dodds 2, R. N. Andrews 2, J. Aspinga2, and T. Harison 2, 1 E (Kika) de la Garza Institute For Goat Research, Langston University, Langston, OK 73050, 2 AgResearch, Private Bag 50034, Mosgiel, New Zealand.

One hundred and eighty three embryos were collected from 29 donor Merino (M), crossbred of Merino (CR), Coopworth (C), and Romney (RR) recipient dams. A total of 130 lambs were weaned from these implants. A control group (MN) of 24 naturally conceived single and twin lambs were included for progeny comparisons. Data were analyzed by GLM procedures. Birth weight was 4.2, 4.4, 4.4, and 4.0 kg (SED 0.2) for MN, MR, CR, and RR, respectively. Weaning weight was 25.6, 30.4, 27.6, and 28.9 kg (SED 1.1) respectively. Wool fiber diameter of 16 mm at birth was measured 256, 243, 256, and 253 m2 (SED 12) for MN, MR, CR, and RR birth, and 218, 203, 216, and 207 m2 (SED 16) at weaning, respectively. Follicle fiber diameter at birth was 16.7, 17.2, 17.7, and 17.6 mm (SED .4) for MN, MR, CR, and RR, while fiber diameter of wool samples at birth was similar for all groups (16.5 SED .3 mm). The range in wool fiber diameter was less at weaning (19.8 to 21.7%) than at birth (24.7 to 26%). Fiber curvature of MN at birth was 107, which was greater (P < 0.01) than for other groups (95 for MR, 96 for CR, and 96 for RR, respectively; SED 3.2). Follicle density was 121, 122, 118 and 114 (SED 10) per mm2 for MN, CR, RR and RR groups at birth, and 107, 114, 116, and 109 (SED 8) per mm2 at weaning, respectively; both variables were similar among treatments. Follicle fiber diameter at weaning were 16.5, 15.9, 16.3, and 16.1 (SED .6) for MN, MR, CR, and RR, respectively, while corresponding wool fiber diameter at weaning was 16.3, 16.1, 16.0, and 16.0 (SED .4) at weaning. Lambs of RR and CR were significantly heavier (P < 0.05) at weaning than those of Merino (recipient or naturally bred) dams. These results suggest that crossbred dams improve weaning weight of lambs born to embryo transfer but do not effect wool follicle characteristics of Merinos.

**Key Words:** Merino, Embryo transfer, Follicle density

### 79 Live weight, reproductive performance, and wool characteristics in mixed age Romney ewes selected for a single trait of fleece weight. T. Wuliji*1, K. G. Dodds 2, R. N. Andrews 2, P. R. Turner 2, and R. Wheeler 2, 1 E (Kika) de la Garza Institute For Goat Research, Langston University, Langston, OK 73050, 2 AgResearch, Private Bag 50034, Mosgiel, New Zealand.

Data were collected from 3525 mixed age Romney ewes over 11 years of production, either fleece weight-selected (HF) or control (RC). Data were statistically analyzed using ANOVA. The model included year, flock and age of ewe, with older age classes (6 and above) combined. The HF ewes were (P < .001) heavier than RC for autumn, winter, and spring weights. Greasy fleece weight and yield, clean fleece weight and fiber diameter were 4.91 kg (SE .09), 79.2% (SE .3), 3.62 kg (SE .04), and 40.5 m (SE .2) for HF compared with 4.18 kg (SE .10), 77% (SE .3), 3.05 kg (SE .06), and 39.7 m (SE .3) for RC ewes. These differentials were highly significant (P < .001) except for yield. There was no difference in wool brightness (Y:61.3 vs 61.6; SED .2), but yellowness (Y:Z: 5.4 vs 4.5; SED .2) was greater (P < .001) for HF ewes. Significant (P < .01) differences existed between flocks in ovulation rate (1.6 v 1.5; SED .03), number of lambs born per ewe joined (1.8 vs 1.7; SED .02), number of multiple births per ewe lamb (73 vs 67; SED .02) and number of lambs weaned per lamb born (1.15 vs 1.12; SED .01). These results indicate that a selection for fleece weight as a single trait enhances fleece weight, live weight, ovulation rate, fiber diameter, and fleece yellowness.

**Key Words:** Romney, Wool, Ovulation


Straightbred- and Brahman composites-sired progeny were evaluated for feedlot performance and carcass traits. Angus (A), Brangus (BA), Gelbvieh (GB), and Gelbray (Gb) bulls were randomly mated to first-cross Brahman-Herford cows to produce spring- and fall-born steer calves over two yr. Percent Brahman inheritance was 25% in A (n=30) and G- (n=23) sired steers and 44% in BA- (n=39) and GB- (n=25) sired steers. Following weaning and a stocker program, steers were shipped to a commercial feedlot and evaluated for feedlot and carcass performance. Steers were group fed and slaughtered at an average fat thickness (FT) of 10 mm. Analysis included sire breed and season as fixed effects and random effects of year, year x sire breed, and sire (sire breed) using PROC MIXED of SAS. Sire breed did not influence (P > .25) feedlot gain (FADG), slaughter weight (SWT), hot carcass weight (CWT), or Warner-Bratzler shear force (SF). Sire breed affected (P < .05) carcass marbling score (MS), and yield grade (YG). Overall least squares means for FADG, SWT, CWT, REA, FT, MS, YG, and SF were 1.61 kg, 553 kg, 353 kg, 82 cm, 10.3 mm, 484 (slight +), 2.80, and 4.94 kg, respectively. Angus-sired steers had smaller (P < .05) REA and higher (P < .01) FT, MS, and YG than G-sired steers. Brangus-sired steers had higher (P < .03) MS compared to GB-sired steers. Steers with 25% Brahman inheritance had larger (P < .01) REA than steers with 44% Brahman breeding. Though not significant (P = .25), SF for A- and BA-sired steers were numerically lower (.44 kg) compared to G- and GB-sired steers. These data suggest that superior carcass quality was achieved with the use of Angus sires and improved carcass cutability resulted with 25% Brahman inheritance as well as with the use of Gelbvieh sires.

**Key Words:** Brahman, Feedlot, Carcass

### 81 Estimation of litter environmental and maternal effects for performance test traits of Large White swine. Z. B. Johnson*1, J. J. Chewning*, and R. A. Nugent, II, 1 University of Arkansas, Fayetteville, 2 The Pork Group, Rogers, AR.

The objective of this study was to investigate the importance of litter environmental effects, maternal genetic effects and the covariance between additive genetic effects of the animal and maternal genetic effects for performance test traits for a population of purebred Large White swine. Boars were individually penned at approximately 100 d of age and were fed a corn-soybean meal diet that was 11.4% (w/w) protein and 3.34 kcal/kg ME for approximately 77 d. Boars were weighed at the beginning and end of the test and feed intake recorded. Backfat
Comparison of performance of pigs from three breed terminal and rotational crossbreeding systems: Growth and survival rates. K. Nadarajah*, D. L. Kuhlers, S. B. Jungst, M. R. Duffle, and J. A. Little, Auburn University, Auburn, AL.

Growth performance and survival rates of pigs from a terminal and rotational crossbreeding system involving Duroc (DD), Landrace (LL), and Yorkshire (YY) breeds were evaluated at the Lower Coastal Experimental Station, Camden, AL. Terminal crossbred pigs were sired by five DD boars selected from the top 20% of the Terminal Sire Index (TSI). Rotational crossbred pigs were sired by ten boars (DD=4, LL=3 and YY=3) selected from the top 20% of the Maternal Line Index (MLI). Matings involved 151 dams that produced a total of 3876 pigs of four crossbred types namely, DD x YY, YY x LL, DD x LL, and YY x YLD. Growth performance and survival traits of BF, FCR, and W in the 6th generation were -.71 cm, -.23, and 5.4 kg, respectively. All barrows from the base through the 5th generation were slaughtered to obtain carcass length (LEN), 10th rib backfat thickness (BF10), loin eye area (LEA), and subjective color (COLOR) of MARB. A line selected on an index of ultrasound backfat thickness slaughtered to obtain carcass LEA, LEAN, and BF10, but undesirable changes in poids of range beef cows. This study was designed to evaluate the effect of milk EPDs of Angus and Hereford sires on milk production of crossbred daughters. Bulls (n=35) were chosen from each.

Key Words: Pigs, Maternal Effects, Litter Effects

82 Comparison of performance of pigs from three breed terminal and rotational crossbreeding systems: Growth and survival rates. K. Nadarajah*, D. L. Kuhlers, S. B. Jungst, M. R. Duffle, and J. A. Little, Auburn University, Auburn, AL.

Evaluation of carcass traits of Duroc pigs from a line selected on an index of ultrasound backfat thickness and predicted feed conversion. D. L. Kuhlers*, K. Nadarajah, S. B. Jungst, B. L. Anderson, and B. E. Gamble, Auburn University, AL.

Production of lean meat at minimum feed cost is the goal of swine producers. However, feed intake (FI) and feed conversion ratio (FCR) used to compare models. Common litter environmental effects were important (P < .05) for all traits measured and explained from 13 to 27% of the phenotypic variation. The maternal genetic value was important (P < .05) for LEA, but had little effect on the estimation of heritability. The correlation between m and d was a significant source of variation (P < .05) for BF with an estimated correlation of .50. In summary, the common litter environmental effect was important for all traits in this study and should probably be included in any estimation of genetic parameters; however, both maternal effects and the correlation between maternal and direct effects could be ignored for ADG, DFI, and FG.

Key Words: Beef Cattle, Milk EPD, Growth

83 Milk production of crossbred daughters of high and low milk EPD Angus and Hereford bulls. J. A. Minick*, D. S. Buchanan, and S. D. Rupert, Oklahoma Agricultural Experiment Station, Stillwater.

Milk production is a major factor in the weaning weight of calves which, in turn, affects profitability of cow-calf enterprises. The objective of this study was to determine how well milk EPD of Angus and Hereford sires predicted milk production of crossbred daughters and subsequent calf performance. Bulls were chosen from each breed sire to represent high or low milk EPDs. Mean EPDs in kg for high Angus (HA), low Angus (LA), high Hereford (HH), and low Hereford (LH) were +8.7, -6.1, +7.4, and -4.9. Cows (n=273) calved Prange or fall from 1992-97 for a total of 660 records. Twenty-four hour milk production of the cows was estimated by two weigh-suckle-weigh measurements at monthly intervals. Cow weight and body condition score (BCS, 1-9) were obtained at weaning. The least squares model included breeds, breed, and overall success of any cow-calf enterprise. This study was designed to evaluate the effect of milk EPDs of Angus and Hereford sires on milk production of crossbred daughters. Bulls (n=35) were chosen from each.
breed to represent high or low milk EPDs. Mean EPDs in kg for high Angus (HA), low Angus (LA), high Hereford (HH), and low Hereford (LH) were +8.7, -6.1, +7.4, and -3.9 respectively. The daughters were between 5 and 9 years old during this study. Milk production of cows (n=105) was evaluated via the weigh-suckle-weigh (WSW) method. A sample of these cows (n=48) were mechanically (MM) during the same lactation. Both techniques were used to generate 24 h milk production estimates. Least squares means were generated for the four Breed x Level interactions and the two Levels for each of seven WSW and four MM procedures that were equally spaced throughout the lactation. Least squares means, in kg, from MM for HA, LA, HH, and LH with p values for high versus low were: period 1) 5.76, 4.36, 6.01, and 3.94 (p<.01); period 2) 3.72, 3.22, 3.91, and 3.01 (p>.05); period 3) 3.97, 3.35, 4.19, and 2.46 (p<.01); period 4) 1.27, 1.18, 1.69, and 0.63 (p<.05). Likewise, least squares means, in kg, from WSW for HA, LA, HH, and LH with p values for high versus low were: period 1) 3.70, 3.49, 3.66, and 3.09 (p=.13); period 2) 2.96, 1.97, 2.48, and 1.66 (p<.01); period 3) 3.16, 2.15, 2.55, and 2.66 (p=.08); period 4) 2.41, 1.71, 1.95, and 1.98 (p=.36); period 5) 2.24, 1.76, 1.78, and 1.29 (p=.09); period 6) 1.78, 1.41, 2.65, and 0.92 (p=.01); period 7) 1.89, 2.0, 0.74, and 1.21 (p=.44). In addition, WSW and MM totals were highly correlated (r=.82). These results demonstrate that high milk EPD bulls sired daughters that produced more milk. The high correlation between WSW and MM should increase the confidence of that conclusion. Milk EPDs can be used with confidence to influence milk production.

**Key Words:** Beef Cattle, Milk EPD, Milk Production

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**86 Sire variation for carcass traits of purebred Brahman steers.** T. Smith1, D. E. Franke1, T. D. Bidner1, G. Whipple-VanPatter2, and H. D. Chapman1. 1Louisiana State University Agricultural Center, Baton Rouge, LA. 2Nebraska Central Community College, Hastings, NE.

Purebred Brahman steers (n=169) sired by 25 Gray and 7 Red Brahman bulls were evaluated for postweaning growth and carcass traits. Spring-born paternal half-sib male calves were purchased from private producers at weaning, backgrounded, and grazed on ryegrass for 150 d. Following grazing, the steers were shipped to a commercial feedlot in south Texas for feeding. Steers were slaughtered in groups of about 45 head when they reached an approximate average endpoint weight of 530 kg and 1 cm backfat. All carcasses were subjected to high voltage electrical stimulation during slaughter. After a 24 hr chill, carcasses were removed from the large end of the strip loin and randomly selected for calpastatin assay (CALP). Traits available for study included slaughter weight (SWT), hot carcass weight (HCW), ribeye area (REA), backfat (BF), marbling (MB), and four MM procedures that were equally spaced throughout the lactation. Both techniques were used to generate 24 h milk production estimates. Least squares means were generated for the four Breed x Level interactions and the two Levels for each of seven WSW and four MM procedures that were equally spaced throughout the lactation. Least squares means, in kg, from MM for HA, LA, HH, and LH with p values for high versus low were: period 1) 5.76, 4.36, 6.01, and 3.94 (p<.01); period 2) 3.72, 3.22, 3.91, and 3.01 (p>.05); period 3) 3.97, 3.35, 4.19, and 2.46 (p<.01); period 4) 1.27, 1.18, 1.69, and 0.63 (p<.05). Likewise, least squares means, in kg, from WSW for HA, LA, HH, and LH with p values for high versus low were: period 1) 3.70, 3.49, 3.66, and 3.09 (p=.13); period 2) 2.96, 1.97, 2.48, and 1.66 (p<.01); period 3) 3.16, 2.15, 2.55, and 2.66 (p=.08); period 4) 2.41, 1.71, 1.95, and 1.98 (p=.36); period 5) 2.24, 1.76, 1.78, and 1.29 (p=.09); period 6) 1.78, 1.41, 2.65, and 0.92 (p=.01); period 7) 1.89, 2.0, 0.74, and 1.21 (p=.44). In addition, WSW and MM totals were highly correlated (r=.82). These results demonstrate that high milk EPD bulls sired daughters that produced more milk. The high correlation between WSW and MM should increase the confidence of that conclusion. Milk EPDs can be used with confidence to influence milk production.

**Key Words:** Beef Cattle, Milk EPD, Milk Production

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**87 Genetic polymorphism of milk protein in Chinese black and white dairy cattle.** J. Luo*, H. Qiu, S. H. Wang, and J. W. Li, School of Animal Science and Veterinary Medicine, Northwestern Agricultural University, China.

This study was to investigate the characteristics of genetic markers of principal milk proteins of Chinese Black and White Dairy Cattle, a main milk-producing dairy breed in China. Morning milk samples of 747 cows (farm 1, n=328; farm 2, n=419) were collected from two farms in Shandong province, China. Three phenotypes of am-lactoglobulin (LG) loci were identified using isoelectric focusing electrophoresis. Three phenotypes of αs1-CN, κ-CN, and β-CN and six phenotypes of β-CN were detected. The gene frequency of two herds was similar (P > .05), therefore pooled data were used for calculation. The allelic frequency at each milk protein locus was as follows: αs1-CN B, 0.85; αs1-CN A, 0.15; β-CN A, 0.52; β-CN B, 0.08; κ-CN A, 0.61; κ-CN B, 0.39; β-LG A, 0.43; β-LG B, 0.57. The dominant allele of locus mentioned above was B, A2, and A and B respectively. Linkage relation of milk protein loci were analyzed using the Chi-square test and the sequential probability test with the data of dam-daughter pairs. There were significant linkages among three casein loci (P < .05). A genetic linkage existed between αs1-CN and β-CN, and αs1-CN and κ-CN (P < .01), but there was no linkage between β-LG and κ-CN and the casein complex (P > .05). The results of this study should be useful in marker assisted selection for any association with milk protein properties, however, the selection of specific milk protein genotype may be affected by linkage relationships among milk protein loci.

**Key Words:** Chinese Black and White dairy cattle, Milk Protein, Polymorphism

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**88 Development of a heterogeneous mixed linear model with maternal genetic effects for multiple traits case.** E.-C. Lin1, and P. J. Berger2. 1Pig Research Institute Taiwan, Chunan, Miaoli, Taiwan, R.O.C., 2Iowa State University, Ames, Iowa.

A heterogeneous mixed linear model for multiple traits was developed for a model with fixed effects, direct genetic random effects, uncorrelated random effects and residual. There are two assumptions about the genetic correlation in this model: one is perfect correlation (equal to 1) between heterogeneous groups within trait; the other is treating the correlation between heterogeneous groups across traits as a function of genetic variances and covariances in each heterogeneous group within and across traits. The heterogeneous mixed linear model is implemented by adjusting the direct genetic effects and corresponding incidence matrices with matrices of eigenvalues and eigenvectors of the genetic (co)variance matrix. Following the same assumptions and implementation, maternal genetic effects can be considered as another trait in the direct genetic (co)variance matrix. The same assumptions as described above for the genetic correlation are also satisfied in a model with both direct and maternal genetic effects. The genetic (co)variance matrices of direct (Ga) and maternal (Gm) genetic effects need to be combined as one (Gm) when the mixed linear model equations are implemented. Generating eigenvalues and eigenvectors of the Gm matrix is the same as a model without maternal genetic effect, but with twice the number of rows and columns. Traits affected by maternal genetic effects can be evaluated together by the model when heterogeneous (co)variances exist, such as in international genetic evaluation and genetic evaluation for progeny of AI sires raised across herds. The number of (co)variances that need to be known are reduced greatly due to these assumptions about the genetic correlation.

**Key Words:** Heterogeneous (co)variance, Mixed linear model, Maternal genetic effect

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**89 Comparison of the reliability of genetic evaluations from an organized progeny test and a field level performance recording program.** N. Caron* and R. A. Kemp, Lethbridge Research Centre.

Calf performance records collected by two different recording programs were used to compare the reliability of their genetic evaluations (EPD). Records on 3,393 crossbred calves sired by 74 sires were available from Canadian Genomics (CG), an organized progeny test program, while records on 154,411 calves sired by 6,872 sires were used from the Charolais Herd Analysis and Records Management (CHARM), a field
level recording program. All sires were purebred Charolais. Multiple-trait evaluations were run independently using a sire model for the CtoC records and an animal model with the CHARM data. Traits evaluated were birth weight (BW), weaning weight (WW) and postweaning gain (PG). Edits, adjustment factors and genetic parameters were similar to the ones used in the North American (NA) evaluation. From birth to yearling, there was a decline of 17.5% in the number of records on CtoC in comparison to 45.0% on CHARM. Only 71.5% of sires on CHARM had PG records submitted on their progeny in comparison to all sires on CtoC. Correlations between sire EPDs from CtoC or CHARM with NA were satisfactory ranging from .72 to .85. Lower correlations between sire EPDs from CtoC or CHARM with NA were from .47 to .63. Sire EPDs from CtoC and CHARM were obtained: .62 for BW, .49 for WW and .46 for PG. This situation was explained by the low number of progeny records for some sires on CHARM. An organized progeny test such as CtoC allows to obtain fairly accurate EPDs with a minimum of records while a field recording program like CHARM allows to test a large number of sires in an inexpensive way. An organized progeny test can be especially helpful for traits difficult to collect such as carcass and feed intake traits.

**Key Words:** Beef cattle, Genetic evaluation, Reliability


We previously reported a length polymorphism in a TG-repeat microsatellite 90 base pairs upstream from the start site in the bovine growth hormone receptor gene. An 11-TG-repeat allele is enriched in Bos indicus (Zebu) cattle, but rare in Bos taurus (Taurine) breeds in which 16 to 20-TG-repeat alleles predominate. Tightly linked to this polymorphism are other sequence differences such as a 1.2 kb retro-pozon 0.5 kb upstream from the start site in the Taurine haplotype which is absent in the Zebu haplotype, as well as single base substitutions in exons 5, 6, 7, and 10. The purpose of this study was to compare growth and carcass traits between Angus steers that were homozygous for the Zebu growth hormone receptor haplotype (n = 4) to their half-siblings that had one copy of the Zebu haplotype (n = 33). Animals were genotyped with respect to the TG-repeat using a microsatellite assay. A series of single trait analyses were then performed on 75 steer progeny of four purebred Angus sires that contained one growth hormone receptor haplotype commonly found in Taurine cattle and one haplotype commonly found in Zebu cattle. Contrasts between the Taurine and Zebu haplotypes were estimated using MTDFREML. The model included fixed effects of contemporary group, age of dam, haplotype within sire, and a random animal effect. No interaction was detected between sire and haplotype so this term was replaced with haplotype. Contrasts (Taurine - Zebu) were considered significant (P < .05) if the absolute value of the contrast was at least twice the standard error. Contrasts were significant for weaning weight (18 ± 6 kg), carcass weight (13 ± 2.6 kg), and marbling score (-.4 ± .2), while no significant differences were detected for birth weight (-.5 ± .8 kg), fat thickness (.01 ± .1 cm), or ribeye area (.3 ± 1.7 cm²). This polymorphism may have potential for use in a marker assisted selection program.

**Key Words:** Growth Hormone Receptor, Cattle, Microsatellite

91 Mixed model estimates of genetic effects for beef cattle birth and weaning traits. D. E. Franke*, Louisiana State University Agricultural Center.

Considerable variation exists among cattle breeds for traits of economic importance. Breed differences are important genetic resources that can be especially helpful for traits difficult to collect such as carcass and feed intake traits. For BWT, the direct additive effect of B was ± 1.2 kg less than A. Direct dominant effects of A-B, C-B and H-B combinations were larger than for non-B combinations. For ADG, the direct additive effect of C (.5 ± .9 kg/d) and the maternal additive effects of B (.5 ± .9 kg/d), C (.6 ± .1 kg/d) and H (.5 ± .1 kg/d) were different from A. Direct dominant effects for combinations including B for ADG were larger than for non-B combinations. Brahman and H direct additive effects for WWT (.5 ± .1 kg/d and .6 ± .1 kg/d, respectively) were larger than A whereas the maternal additive effect of H was less than A (-18.6 ± 3.8 kg). Direct dominant genetic effects for WWT were larger for breed combinations including B. Genetic effects for WWT were large and variable, and had large SE. For these breeds, results confirm the relative advantage of C for growth, the relative disadvantages of H for maternal ability and the larger dominant effects for breed combinations including B for growth traits.

**Key Words:** Beef Cattle, Preweaning Traits, Genetic Effects

92 Verification of a quantitative trait locus for dairy form in two families of Holsteins. T. S. Sonstegard*, C. P. Van Tassell1, M. S. Ashwell2, W. M. Garrett1, and S. M. Kappes2.

Preliminary analysis of variance for quantitative trait loci affecting conformation traits using the grandparent design and eight large US Holstein sire families showed strong associations between the predicted transmitting abilities for dairy form and marker genotypes for bovine chromosome 27 (BTA27). Results from Family 8 (79 sons) indicated an association (P = 0.000021) with a microsatellite marker located near the telomere of bovine chromosome 27 (BTA27). An association (P = 0.00001) was also detected in Family 2 (165 sons) with a microsatellite marker located approximately 20 cm from the cen-tromere of BTA27. Interval analysis performed with additional BTA27 marker genotypes generated from Family 8 yielded a genome wide significant test score for dairy form QTL near the telomere of BTA27. Interval analysis of Family 2 is in progress. Genes found in the genomic fragments of conserved synteny between human chromosomes 4 and 8 and BTA27 are being used to develop additional informative markers to retain information for dairy form. Even though the phenotypic scores for dairy form are based upon femininity, conditioning and dairyness; we hypothesize that this QTL is associated with fat metabolism. This hypothesis is supported by identi-fication of similarly located QTL found in other cattle populations for marbling, milk fat yield, and milk fat percentage.

**Key Words:** quantitative trait loci, mapping, cattle

93 Repeatability estimates of objective measurements on the rear legs of dairy cows. P. O. Boisot*, S. Rodriguez-Zas, and R. D. Shanks, University of Illinois, Urbana-Champaign, IL.

Feet and legs contribute to the longevity and profitability of dairy herds. Heritability of subjective measures of feet and legs are low, but selection should not ignore feet and legs because the low heritability estimates may be a function of inaccuracy of subjective linear scores. The objective of our research was to estimate the repeatability of different objective measurements on the rear legs of dairy cows in order to develop a method that could potentially replace subjective scores. Between September and November 1998, fourteen measurements, among dewclaw, hip, hock, pinbone, thurl and ground, were taken on 102 cows from the University of Illinois dairy farm. Measurements were combined to define triangles and therefore angles among points of interest. Three evaluators participated in the experiment and on a given day two sets of measurement were taken by two evaluators. Seventy-three of the 102 cows were measured twice at a 1 to 4 week interval. The data collection resulted in 352 observations. Cows were separated into two groups based on breed size: 74 big cows and 28 small cows. Size, evaluator, and time were fixed effects and cow, interactions of cow by evaluator and cow by time were random effects included in the model. Repeatabilities were computed from the ANOVA table obtained by the glm procedure in SAS using the formula: repeatability=variance between cows/variance between cows + mean square error. The linear model explained over 80% of the variation for each variable. Repeatability estimates of the measurements ranged from 0.64 to 0.90. The highest estimates were obtained for T-l, measured at the hip, pinbone, dewclaw, hip, pinbone, hock, and thurl with the ground and the lowest estimates involved either the hock or thurl. Repeatability estimates of angles were much lower ranging from 0.20 to

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0.50. The variation in natural standing position of the cow hampered the accuracy of the objective measurements. Low estimates of repeatability suggest that this method is not sufficiently reliable to replace subjective linear scores for feet and legs.

**Key Words:** Objective Measurement, Rear Leg, Repeatability

94 Multivariate Bayesian analysis of Gaussian, right censored Gaussian, ordered categorical, and binary traits using Gibb's sampling. I. R. Korsgaard, 1 M. S. Lund, 2 D. Sorensen, 1 D. Gianola, 3 P. Madsen, 1 and J. Jensen, 1 2 Danish Institute of Agricultural Sciences, 1 University of Wisconsin-Madison.

A fully Bayesian analysis using Gibbs sampling and data augmentation in a multivariate model of Gaussian, right censored and grouped Gaussian traits is outlined. The grouped Gaussian traits are either ordered categorical traits (with more than two categories) or binary traits, where the grouping is determined via thresholds on the underlying Gaussian scale, the liability scale. Allowances are made for unequal models, unknown covariance matrices and missing data. Having outlined the theory, strategies for implementation are reviewed. These include joint sampling of the location parameters; efficient sampling from the fully conditional posterior distribution of augmented data, a multivariate truncated normal distribution; and sampling from the conditional inverse-Wishart distribution, the fully conditional posterior distribution of the residual covariance matrix between traits.

**Key Words:** Multivariate analysis, Categorical traits, Right censored Gaussian traits

95 Maternal and direct genetic relationships between weaning weight and traits derived from the Brody growth curve in Angus cattle. M. Kaps, W. O. Herring, and W. R. Lamberson, University of Missouri-Columbia, Columbia, MO.

Direct and maternal genetic and environmental variances and covariances and associated genetic parameters were estimated for weaning weight, growth and maturing traits derived from the Brody growth curve data. Data consisted of field records of weight measurements of 3,044 Angus cows, and 29,943 weaning weight records of both sexes. Growth traits included weights, and growth rates at 365- and 550-d, respectively. Maturing traits included the age of animals when they reach 65% of mature weight, and relative growth rates, and degrees of maturity at 365- and 550-d, respectively. Variance and covariance components were estimated by REML from a set of two-trait animal models including weaning weight paired with a growth or maturing trait. Weaning and cow contemporary groups were defined as fixed effects. Random effects for weaning weight included direct genetic, maternal genetic, and permanent environmental effects. For growth and maturing traits only direct genetic effects were defined as random effects. Heritability estimates for growth traits ranged from .46 to .52, and for maturing traits they ranged from .31 to .34. Direct genetic and maternal genetic correlation estimates were -.05 and .55 between weaning weight and degrees of maturity at 365- and 550-d, respectively. Direct genetic correlation estimates ranged from .04 to .06, and maternal-direct genetic correlation estimates ranged from -.50 to -.56 for weaning weight with the age when animals reached 65% of mature weight and relative growth rates. Since maternal genetic weaning weight reflects an animal's milk producing ability, these estimates indicate that higher genetic capacity for milk production was related to higher body mass and degrees of maturity between 365- and 550-d of age, but was negatively related to absolute and relative growth rates in that life stage.

**Key Words:** Beef Cattle, Maternal Genetic Correlation, Growth Curve

96 Genetic parameter estimation of growth and lactation curve components in Polled Hereford cattle. J. B. Glaze, Jr.* and R. R. Schalles, 1 University of Vermont Extension, White River Junction, VT, 2 Kansas State University, Manhattan, KS.

Genetic parameters for growth and lactation curve components were estimated from weight and milk production records of Polled Hereford cows born from 1967 to 1979. These data were the result of a project at Kansas State University, in which selection was based on individual feed conversion. Cows that had complete monthly weight records from age five to ten, were used to estimate mature weight. Average weight over the five year period was considered to be mature weight. Monthly cow weights were also used to fit a growth curve. The three parameter function, \( W_t = A + B(1 - e^{-t})^k \), where \( W_t = \) weight at time \( t \), \( A = \) weight at time zero, \( B = \) gain from time zero to infinity, \( K = \) function of the rate of growth, and \( t = \) time, provided a means to describe the growth and development of the cattle in this study. During the final three years of the study, 205-d milk production was measured using the weigh-suckle-weigh technique. Milk production data were used to fit the lactation curve \( Y_n = n/(ae^{kn}) \), where \( n = \) week of lactation, \( Y = 24\)-hour milk yield, \( e = \) base of the natural logarithm, and \( a \) and \( k \) are parameters that define the shape of the curve. A multiple-trait, derivative-free, restricted maximum likelihood (MTDFREML) procedure was used to analyze the data generated in this study. A full animal model was used to calculate the genetic and phenotypic (co)variances. In the analyses of mature weight, age of cow was included as a fixed effect. Year of milking and age at milking were the fixed effects used during the analyses of milk production. The heritabilities of the lactation curve components \( K \) and \( A \) were found to be .15 and .40, respectively. The genetic correlation between these lactation curve components was -.78. Growth curve components \( A, B, \) and \( K \) had heritabilities of .35, .72, and .46, respectively, suggesting that selection for weight, gain, and rate of maturity can be effective. The genetic correlation between growth curve components \( A \) and \( B \) \((r_{AB} = .42)\) was positive, which is similar to reported genetic correlations between birth weight and mature weight. The genetic correlations between growth curve parameters \( A \) and \( K \) \((r_{AK} = -.34)\) and \( B \) and \( K \) \((r_{BK} = -.74)\) were negative. The negative association between \( B \) and \( K \) suggest that animals maturing fastest have less weight at maturity.

**Key Words:** Growth curve, Lactation curve, Genetic parameters

97 Estimation of genetic parameters for mature weight in Hereford cattle. J. M. Rump, 1 R. M. Koch, 2 K. E. Gregoire, 2 L. V. Cundiff, 2 and L. D. Van Vleck, 3 University of Nebraska, Lincoln, 2,3 USDA-ARS, USMARC, 2 Clay Center, 2 Lincoln, NE.

Genetic parameters for mature weight in Hereford cattle were calculated using 5285 records from 2517 cows in a control line and three lines selected for weaning weight, yearling weight, and an index of yearling weight and muscle score over 22 years. Data included cow age \((A_g)\), year \((Yr)\), line \((L)\), pregnancy status \((\text{bred vs. open, Pg})\), birth and method of rearing code of the parity \((\text{BMR})\), and calf disposal code \((\text{DSP})\). Weights were taken each year on three to nine year old cows at three times: brand clipping (generally prior to calving, BC), before breeding \((BB)\), and palpation for pregnancy checking \((PP)\). Heritabilities were estimated with REML using a univariate animal model with \(Ag\) and \(Yr\), \(Pg\), \(BMR\), and \(DSP\) as fixed effects and direct genetic, maternal genetic, permanent environmental, and residual as random effects. The analyses for BC and BB weights also included the interval between calving date and weigh date as a linear and quadratic covariate. Estimates of direct \(h^2\) and \(e^2\) were .48 \((.04)\), .46 \((.04)\), and .43 \((.05)\), of maternal \(h^2\) were .02 \((.02)\), .02 \((.02)\), and .00 \((.03)\), and of fraction of permanent environmental variance \(c^2\) were .24 \((.03)\), .29 \((.03)\), and .33 \((.04)\) for BC, BB, and PP weights respectively when covariable between direct and maternal effects was forced to be zero. When covariance between direct and maternal effects was in the model, direct \(h^2\) were .61 \((.08)\), .59 \((.07)\), and .54 \((.09)\), maternal \(h^2\) were .05 \((.03)\), .05 \((.03)\), and .04 \((.04)\), and \(c^2\) were .17 \((.05)\), .21 \((.05)\), and .27 \((.06)\) for the same weights. Correlations between direct and maternal genetic effects in the latter model were .46 \((.16)\), .47 \((.15)\), and .48 \((.21)\). Direct \(h^2\) is large enough to consider mature weight in breeding programs to optimize economic response to selection. Surprisingly, maternal genetic effects seem to be negatively correlated with direct genetic effects for mature weight although variance due to maternal effects is not large.

**Key Words:** Heritability, Growth, Beef Cattle

98 Estimates of genetic parameters and genetic trends for reproductive traits in Botucatu rabbits selected for litter and growth performance traits. A. S. A. M. T. Moura, 1, 2 A. R. C. Costa, and R. Polastre, Faculdade de Medicina Veterinária e Zootecnia, UNESP, Botucatu SP, Brazil.

Genetic parameters and genetic trends were estimated for number of services per parturition \((NS)\), and parturition interval \((PI)\) in rabbits of a local strain in Botucatu, Southeast Brazil. Individual selection according to a multiple-trait index was practiced over a 2.6-yr period.

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Two litter (number weaned, and litter weaning weight), and two individual performance traits (30-d weaning weight, and 70-d weight) were included in the index. Contemporary breeding stock were approximately 120 does and 15 bucks. Parturition-mating interval was 10 to 15 d. Mating pairs were randomly formed and mating between close relatives was allowed. Doe culling criteria included three consecutive conception failures. A square root transformation of NS was adopted. Data on 2,162 parturitions and 1,630 PI produced by 551 does were fitted to an animal model to estimate variance components and breeding values for NS and PI. The bivariate model included the random effects of animal and permanent environment, the fixed effects of parity and parturition date, and the covariance of doe inbreeding coefficient. Overall means of NS and PI were 1.123 ± .005 services and 49.5 ± 4 d, respectively. Doe inbreeding coefficient averaged .059 ± .001, ranging from zero to .33. Estimates of direct heritability and permanent environment effect for NS and PI were .03 and .02, respectively. The estimated genetic correlation between the two traits was .73. Estimates of direct genetic trends per year for NS and PI were -.0037 ± .0003 services (P < .001) and -.200 ± .030 d (P < .01), respectively. Both reproduction traits showed discrete but favorable genetic change with selection for litter and individual performance traits.

Key Words: Genetic trends, Rabbits, Reproduction

99 Genetic and environmental weaning weight parameter estimates across and within Hereford populations in three countries. J. K. Bertrand*, D. de Mattos, and I. Misztal, University of Georgia, Athens.

Original data consisting of 487,661, 102,986 and 2,322,722 weaning wt records from the Hereford Associations of Canada (CA), Uruguay (UY) and the US were available for analysis to obtain genetic and environmental parameters within and across the three populations. Ten samples containing between 12,000 and 57,000 records were obtained by randomly selecting herds with greater than 500 records. An animal model that contained maternal effects and an EM-REML algorithm was used to estimate (co)variances. Pooled estimated phenotypic variances were 617.0, 630.0 and 579.9 kg² for CA, UY and US, respectively. Pooled direct genetic variance, maternal genetic, permanent environment and error variances, expressed as a percentage of the phenotypic variance, were 20, 16, 21 and 49% for CA, 23, 18, 16 and 53% for UY and 24, 16, 16 and 52% for US. Pooled direct-maternal covariances were negative and were 8, 10 and 0% of the phenotypic variance for CA, UY and US, respectively. To investigate the possibility of genotype by environment interactions across countries, pair-wise data sets (CA-Uy, CA-US, US-Uy) were created by randomly sampling herds that had greater than 500 records and that also had progeny or grandprogeny from sires used across all three countries. For comparison purposes, regions within the US were defined, Upper Plains (UP), Cornbelt (CB), South (S) and Gulf Coast (GC) and pair-wise analyses were also conducted (UP-CB vs S-GC, UP vs CB, S vs GC). A multiple-trait animal model that considered weaning wt at a different trait in each environment was fit to the data in each pair-wise analysis, utilizing an EM-REML algorithm. Direct and maternal (in parentheses) estimated genetic correlations for CA-Uy, CA-US, US-Uy, UP-CB vs S-GC, UP vs CB, S vs GC were .88 (.84), .86 (.82), .90 (.85), .88 (.87), .88 (.84), .87 (.85), respectively. Results of these analyses strongly suggest that genetic and environmental (co)variances are such that these three populations could be considered as one single population for the purposes of genetic evaluation.

Key Words: Across Country Genetic Parameter Estimates, Beef Weaning Wt, Hereford

100 Heritabilities and genetic correlations for male scrotal circumference and female reproductive and growth traits, in Canchim cattle. M. M. Alencar1,2, A. M. Silva3, A. R. Freitas4,5, R. T. Barbosa1,6, I. A. Correa1,7, EMBRAPA-Centro de Pesquisa de Pecuária do Sudeste/Sao Carlos, SP/Brazil, 2Graduate student/UNESP, Jaboticabal, SP/Brazil (Bolsista da FAPESP).

The objective of this study was to estimate heritabilities of and genetic correlations among male scrotal circumference (SC12; 857 observations) at 12 months of age, and female body weights at first (BWFC; 927 observations) and second (BWSC; 769 observations) calvings, age at first (AFc; 1466 observations) and second (ASC; 1136 observations) calvings, adult weight (AW; 956 observations), and mature weight (A; 486 observations) and maturation rate (k; 486 observations) obtained using the Von Bertalanffy model, for Canchim (5/8 Charolais + 3/8 Zebu) cattle. The restricted maximum likelihood method with an animal model that included the fixed effects of contemporary groups (year-season of birth for SC12, AFC, ASC, A, and k, and year-season of calving for BWFC, BWSC and AW) and the random effects of animals, was used to estimate the variance and covariance components. The heritability estimates, obtained by univariate analyses, were equal to: 0.30 (SC12), 0.38 (parameter A), 0.35 (parameter k), 0.12 (AFC), 0.33 (BWFC), 0.04 (ASC), 0.39 (BWSC), and 0.38 (AW). The genetic and phenotypic correlations between the parameters A and k were equal to -.074 and -.075, respectively. The genetic correlations, obtained by bivariate analyses, among SC12 and the female traits were: -.024 (parameter A), 0.27 (parameter k), -.047 (AFC), 0.09 (BWFC), -.067 (ASC), 0.07 (BWSC), and -.17 (AW). These results indicate that male scrotal circumference, and female weights (BWFC, BWSC and AW) and growth curve parameters A and k have enough additive genetic variation to respond to mass selection. Selection to increase SC12 should result in desirable correlated responses in AFC, ASC and k, without any considerable change in female adult body weights. Thus, SC12 is a good selection criterion to increase reproductive efficiency of the herd studied.

Key Words: Beef cattle, Growth and reproductive traits, Genetic parameters

101 Interactions between genotype, environment and disease affect breeding against susceptibility for a production disease. K. H. de Greef* and L. L. G. Janss, ID-DLO Leystad NL.

There is concern that the increase in growth potential of broilers increases susceptibility and incidence of ascites (a metabolic disease related to a too high oxygen demand). Opportunities for breeding against ascites were studied in 2000 cold housed broilers by assessing genetic parameters of many ascites and production related traits. The most striking and relevant result in this was the sign of the observed genetic relation between body weight and ascites. It was contradictory (-.31) to the generally assumed positive relation. Below, this contradiction is unraveled and the importance of recognizing such underlying mechanisms for breeding against production diseases is stressed.

The observed negative r² is to be considered particular for the disease inducing (cold) environment. It can be explained through three interfering genetic, environmental and GxE effects: - ascites susceptibility is only expressed in a challenging environment (simple G*E) - faster growing animals have a higher ascites susceptibility (genetic effect) - when ascites actually occurs, body weight is depressed (environmental effect triggered by a genetic liability) So the animals that were expected to be the heaviest ones ended below average due to ascites, resulting in the reversed genetic correlation. This explanation was substantiated in two ways. First, regression of ascites on actual weights resulted in a negative regression, whereas regression of ascites on the breeding values (based on mid-parent values for growth in a ‘normal’ environment) showed a positive relation. Secondly, analysing the non-diseased part of the population resulted in the expected positive r² between ascites and body weight (.21).

For the specific case, it can be stated that for an effective breeding program aiming at reducing ascites, there is not a unique testing environment that produces all correct genetic parameters. An important generalised implication is that r²’s between interrelated traits may be very dependent on the environment. Unraveling the interfering (simple) operating mechanisms may prevent breeders from being unsuccessful caused by using irrelevant genetic parameters.

Key Words: Breeding, Disease, Genotype - environment interaction

102 Effect of sire by year interaction on estimates of genetic parameters from a selection experiment with Hereford cattle. L. D. Van Vleck1,2, I. Dodenhoff2, and R. M. Koch1, USDA-ARS, USMARC, Lincoln, NE, 2University of Nebraska, Lincoln, NE.

Estimates of genetic correlation between direct and maternal effects for early weights of beef cattle often are negative. Several reasons have been proposed. Studies of field records have shown that including sire by year interaction and grandmaternal effects improve the model and change the estimate of the direct-maternal genetic covariance. This
103 Effects of sporidesmin on mouse lines divergently selected for response to toxins in endophyte-infected fescue. W. D. Hohenboken*1, J. L. Robertson1, D. J. Blodgett2, C. A. Morris2, and N. R. Towers2. 1Virginia Polytechnic Institute and State University, 2AgResearch, Ruakura Animal Research Centre, Hamilton, New Zealand.

For eight generations, mouse lines were selected for smaller (Resistant = R) or larger (Susceptible = S) growth reduction from endophyte-infected fescue seed (EIFS) in the diet. After five generations of relaxed selection, this experiment was conducted to determine whether R and S lines differed in response to the mycotoxin, sporidesmin (Spd). At 8 wk of age, R and S mice were fed EIFS for 7 d and a second EIFS dose was assigned (six or seven per line x sex x dose subclass) to receive DMSO carrier or 10, 20, 30 or 40 mg/kg Spd by oral gavage. Livers and kidneys were collected for histological examination at death or euthanasia 13 d post-treatment. At all ages, S mice were significantly heavier than R mice. Mice that succumbed to 40 mg/kg Spd died sooner than mice dying from 30 mg/kg (62 vs. 124 h; P = .02), but there was no line or line x dose interaction effect. Within those mice, liver weight as a proportion of body weight was not influenced by line, dose or their interaction. The R mice were more resistant to Spd than S mice; LD50 values differed by a factor of 1.35 (23.6 versus 31.8 mg/kg for S and R mice, respectively; P < .05). Treatment with Spd caused dose related liver and kidney lesions in both lines. Infarcts of hepatic lobules and fibrosis cholangitis in livers of mice dosed at 30 and 40 mg/kg were less severe in R than in S mice. In both lines, foci of acute tubular necrosis and tubular basophilia (indicative of tubular regeneration) were seen in the kidneys of mice receiving 30 and 40 mg/kg Spd, with no clear-cut protection against these lesions in the R line. In mice, bi-directional selection for weight gain response to EIFS resulted in a favorable correlated change in resistance to a chemically unrelated toxin. It may be possible to select within livestock populations for broad-spectrum resistance to toxins.

Key Words: Beef, Cattle, Growth, Selection


Twenty-five breeding objectives corresponding to twenty-four niche markets and production efficiency were derived for both a large and medium frame beef population in integrated production systems. Objectives were compared to determine whether cattle within a population or herd should be bred to match a particular niche market or production efficiency. Niche markets were identified for two optimum carcass weights, two sets of weaning weight or pre-weaning gain. Correlations between two breedings objectives for medium frame niche markets and the large frame production efficiency objective were 0.99. Correlations between production efficiency in the medium frame herd and large frame niche markets ranged from 0.88 to 0.97. Correlated response of the objective traits in the medium frame herd included an increase in all carcass traits accompanied by an increase in herd feed costs, resulting in an average change in profit of $11.00 per head. Objective trait responses suggested that increasing production efficiency in a large frame herd may result in more rapid changes in profit than breeding for niche markets in a medium frame population. Therefore, to maximize change in profit in integrated production systems, large frame populations should be bred for production efficiency and medium frame herds for niche markets.

Key Words: Breeding objective, Selection, Beef

105 Selection of bulls for cryopreservation of semen for the conservation of Kerry Cattle. R. K. Splan*,1 and E. P. Cunningham2. 1University of Nebraska, Lincoln, 2Trinity College, Dublin 2, Ireland.

The objective of this study was to examine levels of inbreeding of the Irish Kerry Cattle population over time, and to devise a strategy to select bulls as semen storage candidates for future use in conservation of the breed. Kerry Cattle are an endangered, dual-purpose breed, and one of the last remaining indigenous breeds in Ireland. The Irish population now consists of less than 700 breeding females and 50 males currently available for either live cover or artificial insemination. Pedigree records on 17,141 individuals registered with the Irish Kerry Cattle Herd Book from 1890 to 1998 were used to estimate current and historical levels of inbreeding. The current level of inbreeding in the herd is about 14%.

After review of several methods of measuring genetic diversity among individuals, a strategy to select bulls for cryopreservation of semen was developed. Average genetic relationship between each bull and all other members of the breeding population will be calculated and bulls with minimal values proposed as semen storage candidates. To generate a list of proposed matings to produce potential bull calves with maximal genetic diversity, specific matings between all individual bulls and cows in the breeding population will be ranked on average genetic relationship between their resulting potential progeny and a random sample of contemporary breeding animals. Implementation of these methods will aid in maximizing genetic diversity of the threatened Irish Kerry Cattle population.

Key Words: Inbreeding, Genetic Diversity, Breed Conservation

106 Effects of including rear leg defects on finishing trait EBV’s of Yorkshire gilts. J. J. Chewning* and C. N. Fitzgerald, Pork Group, Tyson Foods Inc, Rogers AR.

The purpose of this study was to investigate the effects of accounting for rear leg defects (RLD) on genetic parameters and EBV’s in a closed population of Yorkshire gilts. All gilts born on three farms from 1992 to 1996 were individually fed a high protein and energy diet. Gilts were visually scored for being sickle-hocked, cow-hocked and post-legged using a scale of 0 to 3 (0=absent through 3=non-functional). Scores were summed and one was added to avoid zeros. Frequencies of RLD scores were 6069, 6359, 5858, 2515, 604, 129 and 14 for scores 1 to 7, respectively and none scored 8-10. Phenotypic weights at the end of the test were similar for all RLD scores, whereas P2’s were 16.4, 16.4 16.2 15.7 15.2, 13.6 and 14.9 mm for RLD scores 1 to 7, respectively. Genetic parameters were estimated using a multiple trait animal model (38161 animals in A−1)
using MTDFREML with and without inclusion of RLD score as a trait. Heritabilities were .37, .37, .53 and .21 for W100, GAIN, P2 and RLD score, respectively. Genetic correlations were moderate between W100, GAIN and P2 (.37 to .45), low between W100 and GAIN and RLD score (.07 and .04), and -.25 between P2 and RLD score. Spearman correlation coefficients between P2’s EBV’s calculated with and without RLD scores were .92, .86, .86, .84, .83, .82 and .84 for gilts with RLD scores of 1 to 7, respectively. These data suggest inclusion of RLD score into selection programs may allow better estimation of P2 EBV’s, particularly for gilts with higher RLD scores.

Key Words: Swine, Leg Defects, BLUP


The objectives of this research were to determine genetic parameter estimates for real-time ultrasound (RTU) measured composition traits on yearling Angus bulls and to compare sire expected progeny differences (EPD) based upon RTU measured traits to those based upon carcass measured traits of steer progeny. The RTU measures in this study were from 4,222 yearling bulls. The bulls came from 88 contemporary groups as defined by birth year and dam date. The bulls were 497 sires represented in the data. RTU images were collected by technicians participating in a two-year research project at Iowa State University (ISU) and funded by the American Angus Association (AAA). ISU image-interpretation technicians made all RTU measurements at the ISU centralized ultrasound processing laboratory from images received from field RTU technicians. The measures included rump fat thickness (RFAT), 12-13th rib fat thickness (FAT), ribeye area (REA), and percentage intramuscular fat (%IMF). Measures were adjusted to a 365-d age end point. Genetic parameter estimates were made using restricted maximum likelihood procedures. The genetic prediction model was a multiple-trait sire model with sire and maternal grandsire additive genetic relationships. Carcass EPD used for comparison came from the 1998 Fall AAA Sire Evaluation Report. The \( h^2 \) estimates for RFAT, FAT, REA and %IMF were .52, .44, .39 and .42, respectively. Genetic correlation estimates for RFAT-FAT, FAT-%IMF, REA-%IMF and REA-FAT were .82, .17, -.12, and .23, respectively. Of the 497 sires with RTU-based EPD, 193 also had carcass-based EPD. Comparisons were made between EPD from the two sources of data using sire rank correlations. In general, as RTU-based EPD accuracy levels increased, rank correlations increased between RTU-EPD and the carcass-EPD. For RTU-EPD accuracy levels of .8 and higher, the rank correlations were .83, .91 and .84 for Marbling Score-%IMF, REA, and 12-13th rib fat thickness. There was no minimum accuracy assigned to the carcass EPD used in these rank correlations. These results would indicate that breeders could use EPD based upon RTU measures from yearling bulls to predict the same genetic differences observed from steer progeny carcass measures.

Key Words: Beef cattle, Composition, Ultrasound

108 Evaluation of maternal performance for crossbred cows sired by Tuli, Senepol, Brahman, Angus or Hereford sires. J. F. Baker*, R. C. Vann, and L. Varnadoe, University of Georgia Coastal Plain Station, Tifton, GA, USA.

Birth (n=388) and weaning (n=358) records for calves from seven types of crossbred cows were used to evaluate maternal performance of the cows. The dams of calves were type: 1/2 Brahman (Bn) 1/2 British (Bt) (BnBt), 1/2 Senepol (Sn) 1/2 British (SnBt), 1/2 Tuli (Tu) 1/2 Brahman (TuBt), 3/4 British 1/4 Senepol (BnSn), 1/2 British 1/4 Senepol (BnBu), 1/2 Sn 1/4 Bn 1/4 British (SnBb), 1/2 Tu 1/4 Bn 1/4 British (TuBu), and Bt cross. British was either Polled Hereford or Angus. Heifers were mated to either Hereford, Angus or Limousin bulls to calve at 2 yr of age with calves born in January through early March. Weights of calves at birth, in late March, and at weaning, cannon bone length at birth, hip height at weaning and ADG from March to weaning were analyzed to evaluate maternal performance for the seven types of dam. Data were analyzed with a model that included fixed effects of cow breed type, cow age, sire breed of calf, year, and calf sex. Weaning weight and height models included age at weaning as a covariate, Marbling score was a significant source of variation for all six traits evaluated. Calves from BnBt cows were heavier (\( P < .01 \)) in March (83 ± 2 kg) and at weaning (240 ± 4 kg) than calves from SnBt (70 ± 4, 212 ± 8 kg) and TuBu (70 ± 3, 211 ± 5 kg) dams. In March the calves from BC and SBB dams were similar but heavier (\( P < .05 \)) than calves from TBB dams (78 ± 2, 79± 3, 70 ± 3 kg, respectively) but at weaning SBB calves were heavier (\( P < .05 \)) than calves from BC and TBB dams (235 ± 8, 214 ± 4, 215 ± 5 kg, respectively). In summary, important differences were measured for maternal performance for birth and weaning traits in cow types adapted to the hot, humid Southern U.S.

Key Words: Breeds, Weaning weight, Maternal performance

109 Responses in ovulation rate and litter size to two-stage selection in swine. A. Ruiz-Flores*, J. J. Urick, and R. K. Johnson, 1 University of Nebraska, Lincoln.

The objectives were to estimate genetic parameters for ovulation rate (OR) and fully formed pigs (FF), and to quantify responses to 2-stage selection. Three lines were used. Line IOL was derived from a line previously selected for an index to increase OR and embryonic survival. It had greater OR (4.22 ova) and FF (1.94 pigs) at generation 0 than line C, its control line. Line COL originated from line C. Lines IOL and COL underwent 8 generations of 2-stage selection. In stage 1 all gilts from the 50% of the litters with greatest FF were retained and OR was measured in them. Approximately 50% of these gilts were selected for OR (4.22 ova) and FF (1.94 pigs) at generation 2. The gilts selected for FF were mated to boars selected from the upper one third of the litters for FF and the two-stage selection was repeated in their progeny. Line C was maintained with random selection. Each line had 40-45 litters by 15 sires per generation. Ovulation rate was measured by laparotomy 11 days after second estrus. The hypothesis was that after selection for OR, FF was a measure of uterine capacity (UC) as selected gilts were expected to have OR that exceeded UC. Phenotypic data on first parity gilts for OR (n=1742) and FF (n=974) were analyzed. The MTDFREML program with an animal model including random effect of animal and fixed effect of generation was used. Differences between lines within generation were calculated using linear contrasts of EBV for OR and FF. Heritability estimates were .42 and .18 for OR and FF, respectively, and the genetic correlation was .51. At generation 5, differences in EBV for OR and FF between IOL and C were 6.10 ova and 4.10 pigs; differences between COL and C were 2.24 ova and 2.23 pigs; and differences between IOL and COL were 3.92 ova and 1.88 pigs. The 2-stage selection procedure was effective in improving OR and UC. All the increase in OR was realized as an increase in FF in line COL. Number of fully formed pigs increased more than in line IOL presumably because UC was limiting litter size in generation 0.

Key Words: Litter Size, Pigs, Two-stage Selection

110 Effects of selection for below average birth weight and high yearling weight for high yearling weight on characteristics of Line 1 Hereford females. M. D. MacNeil*, and J. J. Urick, USDA Agricultural Research Service, Miles City, MT.

Simultaneous selection for low birth weight and high yearling weight has been advocated to improve efficiency of beef production. Two sub-lines of Line 1 Hereford cattle were established by selection either for below average birth weight and high yearling weight (YY) or for high yearling weight alone (YW). Direct effects on birth weight and yearling weight diverged between sublines with approximately four generations of selection. The objective of this study was to estimate genetic trends for traits of the cows. A three parameter growth curve \( W = A(1 - e^{-kT^2}) \) was fitted to age(d)-weight (W) data from cows surviving past 4.5 years of age (n=738). The resulting parameter estimates were analyzed simultaneously with birth weight and yearling weight using multiple trait restricted maximum likelihood methods. To estimate maternal additive effects on gain from birth to weaning (MILK) the two-trait model previously used to analyze birth weight and yearling weight was transformed to the equivalent three-trait model with birth weight, gain from birth to weaning and ADG from birth to weaning as dependent variables. Heritability estimates were: .03, .02, .01, and .02 for A, B, K, and MILK, respectively. Genetic correlations with direct effects on birth weight were: .34, -.11, and .55, with direct effects on yearling weight were: .65, -.01, and .11 for A, B, and K, respectively. Genetic trends (per generation) for YY and YW were: A (kg) 8.0 ± 2 and 10.1 ± 2; B (x1000) -1.34 ± .07 and -1.16 ± .07; K (x1000) -14.3 ± .1 and 4.3 ± 1; and MILK (kg) 1.25 ± .05 and 1.89 ± .05, respectively. Beef cows resulting from simultaneous selection for below average birth
weight and increased yearling weight had different growth curves and reduced genetic trend in maternal gain from birth to weaning relative to cows resulting from selection for increased yearling weight.

Key Words: Selection, Growth curve, Beef cattle

111 Evaluation of Simmental sires for daughters’ length of productive life. B. E. Cunningham*1, R. L. Quaas2, and E. J. Pollak2. 1American Simmental Association, Bozeman, MT, 2Cornell University, Ithaca, NY.

An analysis of length of productive life (LPL) was conducted using 25,512 Simmental cows from 22 herds representing 1,647 Simmental sires. LPL was the number of days from first calving to the day the cow disappeared from the herd. Records were censored if the cow changed herds or produced a calf in 1998. The data were analyzed using the Survival Kit V3.0 (Ducrocq and Sölkner, 1994; Ducrocq and Sölkner, 1998) for proportional hazard models. The baseline hazard function was assumed to follow a Weibull distribution. Management groups (M) were formed using herd-season-year subclasses. Four models were evaluated to describe LPL. Model 1 had Y (Year), Percent Simmental (PS), M, and Sire (S). Model 2 used Y, PS, M, S, and calving ease score (CE) of the cow’s first calf. Model 3 had Y, PS, M, S, and the cow’s predicted producing ability (PPA) for calf weaning weight. Model 4 used all effects. The S and M effects were random with normal and log-gamma distributions, respectively. The estimated \( \sigma^2 \) were .035, .017, .036, and .016 for models 1, 2, 3, and 4, respectively. The \( \gamma_M \) estimates were 3.10, 3.01, 2.86, and 2.74 for models 1, 2, 3, and 4, respectively. Using the predicted S hazard values, simple correlations were .99 between models 1 and 2, .99 between models 1 and 3, and .89 between models 1 and 4. The use of CE scores reduced the variation among sires but had little effect upon sire rank. The use of PPA did not reduce variation among sires but caused some changes in sire rank.

Key Words: Beef Cattle, Genetic Evaluation, Survival Analysis

112 Comparison of threshold and linear models for calving difficulty in beef cattle. R. Ramirez-Valverde*, I. Misztal, and J. K. Bertrand, University of Georgia, Athens, Georgia.

The purpose of this study was to compare several sire-maternal grandsire (SM) and animal (AM) models for calving difficulty (CD). The models were: univariate threshold (T) and linear (L) models for CD, and bivariate threshold-linear (TL) and linear-linear (LL) models for CD and birth weight (BW). Data obtained from the American Gelbvieh Association included 84,420 first-parity records with both CD and BW available. Additionally 95,038 pedigree records were available. CD scores were distributed as 73.4% in the first category (no assistance), 18.7% in the second category, and 8.9% in the third category. Rules included in AM were fixed sex-age of dam, random herd-year-season, and random animal direct and maternal. Effects included in AM were fixed sex-age of dam, random herd-year-season, and random sire and maternal grandsire. Genetic parameters and thresholds were obtained from an earlier study. Data splitting techniques were used to compare the predictive ability of the models defined through correlation between estimated breeding values (BV) from two samples, with one half of CD records discarded randomly in the first sample and the remaining CD records discarded in the second sample. Reported correlations are average of two replicates for direct effects of 6,954 sires only. For SM, the correlations were .45, .46, .86, and .90 for L, T, LL and LT, respectively. For AM, the correlations were .50, .57, .86, and .91, respectively. In all cases, the correlations for T were better than for L and for LT were higher or equal than LL. Differences in correlations between the linear and threshold models were larger with AM than with SM. The correlations for the bivariate models were much higher than for the univariate models, and differences in correlations between SM and AM were larger for univariate than for multivariate models. Animal threshold-linear model is the model of choice for genetic evaluation of calving difficulty.

Key Words: Threshold model, calving difficulty, beef cattle

113 Analysis of herd life in a four-breed diallel in beef cattle. V. E. Vega-Murillo1*, S. D. Kachman1, L. V. Cundiff2, and L. D. Van Vleck1. 1University of Nebraska, Lincoln, 2ARS, USMARC, 3Clay Center, 4Lincoln, NE.

Survival analysis was used to investigate herd life of 537 females produced in 1973 and 1974 in a four breed diallel design including Red Poll (RP), Brown Swiss (BS), Hereford (H) and Angus (A) breeds. Data were collected at the U.S. Meat Animal Research Center, and included records of cows from 57 sires (15 H, 16 A, 15 RP, and 11 BS). A Weibull regression model was used to explain the effect of the breed combination on herd life measured by the number of days from the beginning of the first breeding season of the cow to her termination from the herd. Model included fixed effects of breed combination, and year of birth of the cow, with sire within breed of sire as a random effect. Significance of the explanatory variables was tested using a likelihood ratio test. The effect of breed combination was significant (P < .05). The change in log likelihood associated with the effect of breed was small compared with that of other effects. The estimate for the scale parameter was 0.81 ± 0.04, indicating a baseline hazard function which decreases over time. Solutions for fixed effects indicated a higher probability of being culled for purebred than for crossbred cows (P < .01). Heterosis was favorable for F1 Angus-Brown Swiss and F1 Hereford-Brown Swiss crosses (P < .01 and P < .05, respectively). The risk ratios for the breed combinations were 1.2, 1.5, 0.8, 0.9, 0.6, 1.6, 0.7, 0.5, 0.9, 0.5, 1.2, 0.9, 0.8, 0.9, 0.7, and 1.0 for RP, RPxBS, RPxH, RPxA, BSxB, BSxH, BSxA, HxB, HxH, AxRx, AxRx, AxxB, AxH, and A, respectively. Brown Swiss crosses were superior to A and H breeds. The significant breed group differences in herd life indicate that purebred cattle have a higher risk of leaving the herd than crossbred cows.

Key Words: Survival Analysis, Heterosis, Risk Ratios

114 Iterative bootstrap bias correction of (co)variance components from a bivariate linear-threshold sire model. P. J. Gates1*, K. Johansson1, C. Moreno2, and J. Jensen3. 1Swedish University of Agricultural Sciences, Uppsala, Sweden, 2University de Zaragoza, Zaragoza, Spain, 3Danish Institute of Animal Science, Foulum, Denmark.

The iterative bootstrap bias correction (Kuk, 1995) was applied to (co)variance component estimates from the mode of the joint posterior distribution of both location and dispersion parameters from a bivariate linear-threshold sire model. The data were generated as a Monte Carlo simulation with 30 replicates. Each replicate consisted of 6450 observations that were made in one of 60 contemporary groups. Each contemporary group contained offspring from 30 dams mated to 7 “sire sires” and 10 dams mated to 2 “reference sires.” Thus, every “herd sire” had 30 progeny in only one contemporary group, whereas the “reference sires” could have progeny in between 1 and 10 contemporary groups. Three traits were simulated: a continuous trait 1 (\( h^2 = .25 \)) and binomial traits 2 (\( h^2 = .10, 15\% \) incidence) and 3 (\( h^2 = .5\% \) incidence). The genetic and environmental correlations between all trait combinations were simulated to be .50 and .20, respectively. Combinations of trait 1 and trait 2, and trait 1 and trait 3 were analyzed with bivariate linear-threshold models that fitted effects of contemporary group and sire for both traits. All of the (co)variance component estimates from the joint mode were extremely biased. 150 rounds of iterative bootstrap bias correction were applied to the joint mode estimates of sire and residual (co)variances. Each bias correction round was based on only one bootstrap resample. Point estimates for each of the (co)variance components were taken to be their mean over the last 30 iterations and were used to calculate heritabilities, as well as genetic and environmental correlations for each replicate. Averaged over 30 replicates, the absolute bias for the heritabilities, as well as for the genetic and environmental correlations between trait 1 and 2 were small (.02). The average biases for the genetic and environmental correlations between trait 1 and trait 3 were large, .116 and .048, respectively. The results indicate that bias corrected (co)variance components from a linear-threshold model are essentially unbiased, as long as the incidence and heritability are not too low. This is unfortunate, since low incidences and heritabilities are a common source of bias when variance components are estimated with threshold models.

Key Words: Variance components, Threshold models, Bias
Sixty-three trailer loads of horses (1,008) arriving at slaughter plants in Texas were observed in July and August of 1998 for incidence of welfare problems. Forty-two percent of the horses were transported on double-deck, 9% on single-deck semi-trailers and 49% on goosenecks. The average number of horses on each load was: double-deck 28, single-deck straight trailers 22, and goosenecks 11. The maximum number transported on each type of trailer was: double-deck 45, single-deck straight trailers 25, and goosenecks 22. Ninety-two percent of the horses arrived in good condition while 1.5% were not fit for travel. Seventy-eight horses (7.7%) had severe welfare problems. Sixty horses (6%) out of the 78 horses had conditions caused by owner neglect or abuse and 1.8% (18 horses) had transport and marketing injuries severe enough to be rated a severe welfare problem. Origin problems were significantly greater than transport problems (p<.001). Examples of origin welfare problems were: loaded with a broken leg, emaciated, foundered, race horses with bowed tendons, and horses that were too weak to be transported. Fighting was a major cause of injuries during transport and marketing. Thirty percent of the carcasses had bruises caused by bits or kicks. Bites or kicks caused fifty-one percent of all carcass bruises. Loads from dealers who picked up horses from more than one auction had more external injuries and carcass bruises than direct loads (p<.001). The authors make the following recommendations: 1) Educate horse owners that they are responsible for horse welfare. 2) Regulate aggressive mares and geldings. 3) A lack of federally inspected slaughter facilities will increase the number of horses that will die from neglect, or are diverted to Mexico or to non-inspected facilities in the United States.

**Key Words:** Welfare, Slaughter, Transportation

**117 Simulated greenhouse gas emissions from beef and dairy systems.** H. W. Phetteplace*, D. E. Johnson, and A. F. Seidl, Colorado State University, Fort Collins, CO.

Inventory assessment and mitigation strategies for greenhouse gas (GHG) emissions from all sources including the livestock industry are expectations of the Kyoto protocol. Greenhouse gases of concern in animal agriculture are methane (CH$_4$), nitrous oxide (N$_2$O) and carbon dioxide (CO$_2$). A computer model was developed simulating beef (cow-calf, stocker, feeder) and dairy production systems at several US locations. Inputs include the animal’s production stage, body weight, age, amount of milk or meat it produced and the amount and type of feed it consumed (including how the feed is processed and fed). Simulated herds were structured on a 100-head basis, into 15 to 25 classes, based on physiological or production stage. On a per unit product basis, the cow-calf segment produced 520 g of Enteric CH$_4$/kg weaned weight, the stockers and feeders produced 270 and 80 g CH$_4$/kg body weight gain, respectively, and dairy cattle produced 20 g Enteric CH$_4$/kg milk. Manure CH$_4$ was estimated to be 11 g/kg weaned weight for the cow-calf system, 6 and 1 g/kg weight gain for the stockers and feeders, respectively and 2 g/kg milk for dairy cattle. Nitrous oxide production was 31 g/kg weaned weight for cow-calf, 15 and 7 g/kg weight gain for stockers and feeders, respectively, and 2 g/kg milk for dairy cattle. Nitrous oxide production was 31 g/kg weaned weight for cow-calf, 15 and 7 g/kg weight gain for stockers and feeders, respectively, and 2 g/kg milk for dairy cattle. The total global warming potential (GWP) was 21 kg/kg weaned weight for cow-calf herds in both Virginia and Wisconsin. Total GWP was 12 versus 8 kg/kg weight gain for stockers in Virginia and Wisconsin, respectively. The total GWP for feedlot cattle was 3 versus 4 kg/kg weight gain for Iowa and Texas, respectively. The simulated dairy system produced a total GWP of 1 and 2 kg/kg milk for California and Wisconsin, respectively. Current GHG inventories and imposed mitigation strategies can be evaluated with this model.

**Key Words:** Greenhouse gases, Computer model, Ruminants
to onion feed, resulting in increased garlic feed intake. Although these results are preliminary, they do suggest that piglets are capable of perceiving and remembering olfactory and gustatory cues presented in their prenatal environment, affecting postnatal behavior. By adding volatile compounds to diets during gestation, it may be possible to increase feed consumption and reduce stress at weaning.

Key Words: Cognition, Behavior, Pig

119 Restricting feed intake of feedlot steers during summer, S. M. Holt¹, T. L. Mader², J. B. Gaughan¹, R. T. Cowan³, and A. T. Lisle⁴. ¹School of Veterinary Science and Animal Production, University of Queensland, Australia, ²University of Nebraska, Concord, USA, ³Australian Tropical Dairy Institute, University of Queensland, Australia, ⁴School of Land and Food, University of Queensland, Australia.

Eighty-four Bos taurus steers, initial BW 386 ± 3.7 kg were used in a randomized complete block experiment (BW as block) to investigate the effects of level and duration of restricted feeding during summer on tympanic temperature and growth rate. Steers were randomly assigned to one of 12 pens (7 head/pen). Dietary treatments (Trt) consisted of 1) Corn Gluten Feed based (CGF) ration restricted to 75% of ad-libitum for 21d; 2) CGF ration restricted to 87.5% of ad-libitum for 21d; 3) CGF ration restricted to 75% of ad-libitum for 42d; 4) CGF ration restricted to 87.5% of ad-libitum for 42d; 5) Dry Rolled Corn (DRC) based ration ad-libitum (control). Daily DMI for Trt 3 and 6 was predicted from NRC (1996) recommendations. Trt 1, 2, 3, and 4 were adjusted every 7 days accordingly from the predicted intakes. BW was obtained at the start of the study and then every 21d. Tympanic temperatures (Tt) of 2 to 3 steers per treatment were recorded throughout the study. Climatic data (ambient temperature and relative humidity) were recorded hourly and days were partitioned into 3 categories: 1)Thermoneutral (TNL) mean THI=73; 2)Moderate (MOD) mean THI=78.5 and 3)Hot (HOT) mean THI=82. Tt was lowest (P<0.05) for Trt 2. Mean Tt for Trt 1 to 6 were 39.18 ± 0.23 °C, 39.15 ± 0.24 °C, 39.33 ± 0.25 °C, 39.26 ± 0.20 °C and 39.24 ± 0.21 °C, respectively. During TNL, Tt was lowest (P<0.05) for Trt 6, while for MOD Tt was lowest (P<0.05) and Trt 2 was lowest (P<0.05) for HOT. Although there was no difference (P>0.05) in ADG, steers fed Trt 5 obtained the highest ADG. There appears to be some benefits in restricted feeding of cattle during the summer as lower Tt. However, the amount and duration of the restriction, along with composition of rations needs further investigation.

Key Words: Environmental Stress, Tympanic Temperature, Restricted Feeding

120 Effects of diet quality and milk flavor on post-weaning behaviors of piglets, J. M. Gardner¹, T. M. Widowski, and C. F. M. de Lange, Department of Animal & Poultry Science, University of Guelph, Ontario, Canada.

Early weaning of pigs can lead to an increase in belly-nosing and other oral-nasal (o-n) behavior patterns. Since these behavior patterns resemble massaging the udder and sucking, they may be associated with hunger or feeding. The objectives of this study were to determine any effect of the establishment of feeding or the presence of milk in the diet on o-n behavior (nosing, chewing or sucking other pigs) of pigs weaned at 14-18 days. During the first 2 weeks post-weaning, pigs were fed diets differing in quality and flavor. Six replicates of 8 pigs per replicate (n=192) were fed 1 of 4 diets: 1) high quality, high in milk products; 2) high quality, no milk products; 3) poor quality, no milk products; 4) diet 2 sprayed with milk replacer 5 times daily. After 2 weeks the pigs were fed a standard nursery diet. Feed intake was measured daily for week 1 and weekly for week 2. Behavior was recorded every 5 min during two 4h periods on days 2-7, 10, 14, 17, and 21 post-weaning. Diet quality but not the presence of milk influenced ADFI and ADG during week 1. ADFI (P<0.05) and ADG (P<0.05) of pigs on diet 3 were less than those of pigs on the other diets. During week 2, ADFI was the same for all diets (P>0.05). Although diet did affect ADFI and ADG during week 1, there were no effects on any behavior pattern recorded, including time spent at the feeder (P>0.10). Belly-nosing was low (0.09±0.07%) and was rarely observed before week 2. Overall, the pigs spent 4.23±0.17% of their time in o-n behavior and 7.36±0.18% at the feeder. During week 1, o-n behavior appeared to be inversely related to the time spent at the feeder. On day 1, pigs spent 3.22±0.81% of time at the feeder and 5.15±0.81% engaged in o-n behavior. From days 2-4, time at the feeder increased to over 7% while o-n behavior decreased to 3%. During week 2 both time at the feeder and o-n behavior increased for pigs on all diets. The establishment of feeding and the presence of milk in the diet had no effect on piglet-directed behavior during the first 3 weeks post-weaning.

Key Words: Pigs, Diet, Post-weaning behavior

121 Preliminary study of dairy cow response to ergotized barley during heat stress, H. Al-Tamimi¹, D. Spiers², J. Spain³, G. Rottinghaus⁴, N. Hill⁵, D. Chatman⁶, J. Underwood⁷, and M. Ellerseick⁸. ¹University of Missouri-Columbia, ²University of Georgia.

Limited information is available about the effect of dietary ergot on dairy cow performance during summer months. A field experiment was carried out to determine the combined effects of summer heat and ergot on thermal status and performance of lactating Holstein cows (Average BW = 588 ± 28 kg). Animals in two treatment groups (n = 5 per group) ingested either a control diet (E-) or a diet containing barley seeds (E+) infected with the fungus Claviceps purpurea (10µg ergot/kg BW/day) for 10 d, preceded by a 5-d period of feeding on a control diet. Measurements included daily dry matter intake (DMI), milk production (morning and afternoon) and hourly air temperature (Ta). Thermal status was evaluated 4 times daily using measurements of respiration rate (RR), rumper temperature (Tr), skin temperature (Tt), and rectal temperature (Tre). Moreover, every other-day milk samples were analyzed for lysergic acid content using a developed ELISA procedure. None of the milk contained lysergic acid as a result of E+ treatment. Results of this study show that short-term heat stress of lactating dairy cows ingesting ergot at 10 µg/kg BW/day does not result in a significant shift in thermal status or productivity. Additional studies are needed to determine the ergot-induced thresholds for a shift in dairy cow performance.

Key Words: cattle, ergot, heat

122 Biological markers of cattle response to heat stress on endophyte-infected tall fescue, D. E. Spiers¹, J. Lakritz², P. A. Eichen¹, G. E. Rottinghaus¹, H. Al-Tamimi¹, J. R. Dodam¹, and J. Underwood⁷, ¹University of Missouri.

A summer field study was conducted to correlate changes in thermal status with biochemical indices of homeostasis for cattle grazing on endophyte-infected tall fescue (EIF), with the ultimate goal being the identification of markers for these stress conditions. Summer heifers (n=12; average initial weight = 431 kg) were placed on EIF pastures (germination level = ~200 ppb) and monitored from early June, when daily ambient temperature (Ta) fell below 35°C, through late July, when Ta rose above 35°C. All measurements were made 3 times per week, with daily determinations during morning (0800-0900h) and afternoon (1500-1600h) periods to cover the extremes in ambient conditions. Animals remained exposed to sun during sample periods to ensure collection of values representative of the field environment. Measurements of respiration rate (RR), rectal (Tre), and skin temperatures were made on resting animals under these conditions. In addition, there were determinations of standard ambient conditions, with blood and tissue samples collected to identify biochemical markers of animal strain. Average daily gain during this period was .48 kg. The best indicator of thermal strain was skin temperature, which was linearly related to Ta (r²≥0.70). A polynomial relationship existed between Ta and both RR and Tre, with r²≥0.59 and .48, respectively. A number of blood parameters exhibited significant (P≤0.01) morning versus afternoon differences, and changes over time with the increase in heat stress and continuous exposure to EIF. These included red blood cell count, hematocrit, and serum levels of glucose, chloride, potassium, and bilirubin. Whole blood and liver-reduced glutathione (GSH) was highest during the first week of exposure, and returned to baseline thereafter. Blood levels of GSH in morning and afternoon samples were not significantly different (P≥0.05). Further analyses are needed to determine which markers reliably identify animal sensitivity to heat stress and endophyte-infected tall fescue in the field environment.

Key Words: cattle, endophyte, heat stress

Fescue toxicosis is a serious problem in cattle grazing endophyte-infected tall fescue (EIF). In previous studies, acute injection of rats with ergovaline, one of the toxins in EIF, showed body temperature changes similar to those seen in cattle fed EIF. Feeding EIF to rats allows development of a more accurate chronic model. Twelve 50 day-old, male rats were implanted with transmitters (Mini-Mitter, Sunriver, OR) to continuously monitor core body temperature (Tc) and activity. Rats were housed at thermoneutrality (TN; 21°C) and fed a diet containing endophyte-free fescue seed (EFF). After two weeks equilibration, rats were randomly assigned to either EIF or EFF diets and maintained at TN for one week. They were then exposed to heat stress (HS; 31°C) for 23 days, followed by one week recovery at TN (RTN). Body weight and feed intake were measured daily. Rats receiving EIF showed decreased feed intake (P<0.0001) and weight gains (P≤0.001) immediately upon introduction of EIF diet. During HS, EIF- and EFF-fed rats showed parallel decreases in feed intake (P≤0.02). Average daily Tc was similar for both groups during initial TN (ITN) period, but was higher for EIF- compared to EFF-fed rats during HS (P≤0.001) and lower during RTN (P≤0.0001) periods. Maximum Tc was higher in EIF-fed rats during ITN and HS periods (P≤0.0007), but was not different from EFF-fed rats during RTN. Daily minimum Tc was lower in EIF- compared to EFF-fed rats during all three phases of treatment (P≤0.02). Average daily activity levels were not different during ITN and HS periods, but were lower for EIF- compared to EFF-fed rats during RTN (P≤0.02). The primary shifts in activity were a lower daily maximum level in EIF-fed rats during RTN and HS periods (P<0.0007), and a lower daily minimum level in EIF-fed rats during HS (P<0.02). The rat model of chronic response to EIF contains many of the same responses noted in cattle, and at the same time allows for detailed analyses of shifts in thermoregulatory ability and activity.

Key Words: rats, fescue toxicosis, heat stress


The relationship between hair whorl position and temperament was assessed for 1,636 beef type (Bos taurus, Bos indicus) and dairy breeds (Bos taurus) from three distinct genetic lines were used (high-lean-gain (HLG), n=14; moderate-lean gain. The objectives of this study were to determine if selected genotypes of pigs respond differently to transportation stress. Using a randomized complete block design, market-weight pigs from three heterogeneous variances were corrected using a log transformation. As physiological traits included the plasma concentrations of cortisol (C), pig major acute phase protein (pig-MAP), haptoglobin (HAP), creatinine kinase (CK) and the polymorphonuclearlymphocyte ratio (PM). Physiological traits included the plasma concentrations of cortisol, CK, and PM. The PM ratio for each group was 1.64 ± 0.14 (G1), 1.54 ± 1.32 (G2) and 1.18 ± 1.14 (G3). According to the results of C, CK and PM, the lowest welfare status was indoors but, following pig-MAP or HAP data, we find that welfare status was lower outdoors. On the other hand, according to the productive data, the three systems seem to provide good welfare situation. Correlation coefficients between productive and physiological welfare indicators were not significant.

Key Words: Pig, Welfare, Housing System

Behavioral and physiological responses to transportation stress in three genetic lines of pigs. C. S. Busse* and M. M. Shea-Moore, USDA-ARS Livestock Behavior Research Unit.

In pigs, there are genetic lines selected for rapid muscle growth (lean gain) that display elevated levels of fear and anxiety during handling. Producers are reporting handling problems with these pigs selected for lean gain. The objectives of this study were to determine if selected genetic lines of pigs respond differently to transportation stress. Using a randomized complete block design, market-weight pigs from three distinct genetic lines were used (high-lean-gain (HLG), n=14; moderate-lean gain (MLG), n=11; low-lean-gain (LLG), n=12). Baseline salivary samples were collected for cortisol analysis two weeks prior to transportation. Pigs were mixed within each genetic line and loaded into one of three pens in a livestock trailer, with a maximum of 5 pigs/treatment/pen. Pigs were then transported for 2 h over a variety of road and speed conditions and videotaped for behavioral analysis during transport. This was repeated 3 times until all pigs from each genotype were tested. The frequency of aggressive behavior in different genetic lines of pigs was significantly different (X²=6.063, X²<0.05(2)=5.991, P<0.05). HLG pigs were more aggressive (17 occurrences) than LLG pigs (6 occurrences) (P<0.05), although MLG pigs were no different from either LLG or HLG treatments. Salivary samples were collected post-transportation prior to unloading, and after unloading. The data were analyzed using a mixed model analysis and heterogeneous variances were corrected using a log transformation. As others have found, cortisol was significantly increased after transportation in all genotypes (P<0.05). However, there were no differences among treatments. Physically moving pigs from the trailer to the unloading pens was a stressor that significantly elevated (P<0.0001) cortisol levels within all treatment groups. In conclusion, these results indicate that an animal’s behavior, in addition to multiple physiological measurements is necessary to truly understand the whole animal response to transportation stress.

Key Words: Genotype, Aggression, Cortisol
127 The development of indices of welfare for beef cattle in feedlots. S. C. Wilson1, R. L. Ferl1, and D. P. Collins2.
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This study was instigated to develop a set of welfare indices for beef cattle in the feedlot environment. Firstly, ethical frameworks for the study were examined then a model for assessing welfare was determined. In this model cattle were considered to have reduced welfare if they were under a significant state of distress which includes entering a pre-pathological state. This is characterized by physiological processes such as elevated hypothalamic-adrenal-axis (HPA) activity in conjunction with depressed immune function. Matched groups of cattle were placed in three environments: (1) pasture, (2) a feedlot with a stocking density of 12.0 m²/head plus a firm dry feedlot pad and (3) a feedlot with a stocking density of 6.0 m²/head and a wet and muddy feedlot pad. Two trials were conducted (N=14/treatment, 42 d duration). Behavioral observations (scan samples, 10 min intervals) were conducted on all treatments. Results showed that with regard to the HPA axis there was a higher (P<.05) relative adrenal mass in both feedlot groups (4.78 ± 0.15 and 4.76 ± 0.14 g/kg bwt, mean ± SE for environments 2 and 3) compared to the pasture group (4.36 ± 0.11 g/kg bwt). But out of 20 immune variables tested, only two; serum IgA, and the gamma delta T-lymphocyte WC1, showed decreased activity in the feedlot groups in comparison to the pasture group. It was concluded that although there may have been a potential disruption of epithelial/mucosal immunity this was still insufficient evidence to state that the total immune system was depressed and thus that pre-pathological states existed in the feedlot treatments. Behavioral observations were conducted primarily to ascertain if there are behavioral correlates to pre-pathological states. Ultimately this was not possible. However, the data provides information on pasture and feedlot cattle with regard to the following: frequencies and circadian patterns of agonistic and affiliative behaviors, spatial relationships, and time budgets and circadian patterns of lying, standing and feeding behaviors.

Key Words: Cattle, Pre-pathological States, Behavior

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The objective of this study was to reduce the dust generation in a commercial feedlot by understanding and managing dust-generating behaviors of feeder cattle. It was hypothesized, that through changes in feeding management practices, cattle activity patterns that result in high quantities of dust may be redirected towards feeding and ruminating behavior which generate significantly less dust. Treatments were either the (1) conventional feeding at sunrise, 10 AM and noon (CON) or (2) feeding at sunrise, noon, and just before sunset (ALT). A mobile behavior lab was used to observe and quantify behaviors (feeding, ruminating, locomotion, agonistic and bulling) of 1,123 crossbred steers in four pens at a commercial Texas feedlot. Dust data loggers (DustTrak, TSI, MN) measured particulate matter counts (particle size <2.5 μm) each 15 min over the entire summer season (June–September, 1998). Simultaneously, the ambient temperature, humidity, wind speed and direction, precipitation, air pressure and solar radiation were measured with a weather station (Grompel, Austria). Multiple linear stepwise regression analysis determined that weather parameters explained only 18% of the variation in dust levels (R² = 0.18, P<.001). High dust levels were observed around sunrise. When cattle were ALT they were engaged in dust-generating behaviors 20.6% of the time compared to 69.0% in the control pens (P<.01). Unlike CON steers, steers fed at sunset ate, were waiting to eat or ruminated (8% vs. 32.6%, P<.01) during the sunset period. This change in behaviors had a positive effect on the dust levels. The EPA threshold for dust with a particle size <2.5 μm is 0.065 mg/m³. Over a period of 10 days, the 24-hr dust average in pens where cattle experienced ALT was 0.044 mg/m³ vs. 0.61 mg/m³ for CON. Changing the feeding regime of cattle to ALT redirected the cattle away from dust-generating behaviors thereby reducing aerial dust concentrations below EPA allowable limits.

Key Words: Cattle, Behavior, Dust

1Texas Tech University, Lubbock, 2USDA-ARS, Lubbock.

A total of 32 Charolais cross feeder cattle were used to assess the impact of heat stress on behavior, physiology, and production during late summer 1998. The objective was to determine the effects of the provision of shade and (or) water misting to minimize heat stress. For behavioral observations a split split plot treatments were: (1) shade and misting (SHMI), (2) only shade (SHAD), (3) only misting (MIST), and (4) no shading or misting (CONT). Two heifers were housed per pen. Maximum ambient temperature during late August was 32±4°C and humidity 62±8%. Behavior was continuously video recorded over 3d. Walking, standing, lying, feeding, drinking (main plot) and the location where these behaviors were performed (shaded or misted area) were measured and analyzed on a daily and hourly basis. Rectal temperatures, respiration rates as well as average daily gain were measured. Heifers in CONT spent more time lying down than the treated animals (SHMI=4.0±1.24, SHAD=3.5±1.24, MIST=3.68±1.24, CONT=4.9±0.29, P<.01). Cattle in CONT (1.37±0.37) spent less time (P<.01) standing than SHAD (3.15±0.31) and MIST (2.68±.31) cattle. Standing behavior in SHMI (2.27±.31) was not different from SHAD or MIST. Misting lowered (P<.001) rectal temperature and misting and shade combined showed an additive effect of lowering respiratory rates in heifers (SHMI=30±1.3, SHAD=33±2.8, MIST=37.3±3.2, CONT=46.7±3.3, P<.05). Average daily gains between the four treatments did not differ significantly. The guide for the care and use of agricultural animals in research and teaching identifies a requirement for cooling for beef cattle during heat. Our results indicate that cattle without shade or misting have a physiological stress response to heat (increased RR and rectal temperature) and alter their behavior as a result. MIST and SHAD appear to be equivalent solutions to reducing heat stress and their effects are largely additive.

Key Words: Cattle, Heat Stress, Shade

130 Shade-seeking behavior of cow-calf pairs in a moderate climate. T. M. Widowson1, 2Department of Animal & Poultry Science, University of Guelph, Ontario Canada.

In moderate climates, there is some concern that the benefits of providing beef cattle shade on pasture may not outweigh the associated costs. Congregating in shade can result in manure accumulation and reduced pasture fertility. There is also a perception among some producers that providing shade may reduce the time that cattle spend grazing. The objectives of this study were to compare the activities and locations of cattle provided Shade (S) and No Shade (NS) in the climatic conditions of southern Ontario. Three beef cow-calf pairs were held on each of 12 fields (N=72). Each field was divided into 8 rotationally grazed paddocks with a central lane-way leading to a water trough. On half of the fields, a structure providing 80% shade was located in the lane-way. Cattle were observed during 6-h periods (distributed between 0800 and 1700 H) on each of 24 days from May-July 1998. At 10-min intervals, the numbers of cows and calves in shade, near the structure but not in shade, near the water trough, out on pasture (but not grazing) and grazing were recorded. During observation periods, means and (ranges) were 26.5°C (16.8-40.7°C) for air temperature, 39.2% (25.6-91.4%) for relative humidity, and 35.3°C (24.1-49.9°C) for black globe temperature. Overall, S cows spent (mean±SEM) 18.0±1.4% of time in shade. Cows without shade spent more time at the water trough (NS 19.8±1.6% vs S 13.2±1.0%, P≤.05) and more time on pasture (NS 36.8±1.3% vs S 23.0±1.3%, P<.05). Time spent grazing was the same for both treatments (NS 43.2±1.0% vs S 42.6±1.0%, P>0.1). Calf behavior was similar to that of cows except that calves spent more time near the structure (10.1±1.0%) and less time grazing (16.8±0.9%). Black globe humidity index significantly affected time spent in shade (P≤.05) and time spent at the water trough (P≤.05). These data indicate that cattle without shade spend significantly more time congregating at the water trough on hot days. Although cattle with shade spend less time on pasture overall, this does not result in reduced grazing time.

Key Words: Shade, Cattle, Behavior
131 Reducing negative effects of weaning on behavior and growth in beef calves. J. E. Harris* and E. O. Price.

One-hundred Angus/Hereford-cross calves were randomly assigned to five treatments to determine the effect of different weaning techniques on the behavior and subsequent growth of beef calves. These treatments were: 1) fenceline separation from dams - on pasture; 2) total separation from dams - on pasture; 3) total separation from dams - feedlot for one week - preconditioned to hay; 4) total separation from dams - feedlot for one week - not preconditioned to hay; 5) non-weaned controls - on pasture. Calves totally separated from dams on pasture were more active (walking) than calves in the other four treatments (P<0.05) and spent less time grazing than the other calves on pasture (P<0.05) in the three days following weaning. Totally separated calves on pasture vocalized at much higher rates than the rate of fenceline calves on the day of weaning. Fenceline calves were more active than non-weaned control calves (P<0.05) but did not differ in time spent grazing. For the first two days after weaning, calves in the fenceline treatment spent the majority of their time within 3 meters of the fence separating them from their dams. Thereafter, they were found at greater distances (P<0.001). Cumulative post-weaning weight gains for calves in the fenceline contact treatment were similar to weight gains of the non-weaned control calves for the first three weeks after weaning. Calves in the fenceline treatment exhibited greater cumulative weight gains than totally separated calves for four weeks after weaning (P<0.05). At the conclusion of the study (10 wks) the cumulative weight gain of the fenceline calves continued to be greater than that of the non-preconditioned feedlot calves (P<0.05). Other weaned treatments did not differ. It was concluded that providing fenceline contact between beef calves and cows at weaning reduces the negative effects of weaning on calf behavior and growth rate.

Key Words: Beef Calves, Weaning, Cattle Behavior

132 Aversion learning techniques to evaluate cattle cow handling practices. E. A. Pajar*, J. Rushen2, and A. M. de Passille1.1 Department of Animal Sciences, Purdue University, West Lafayette, IN. 2Agriculture and Agri-Food Canada, Lennoxville, Canada.

Fear of humans is a major source of stress for cows and can have a negative effect on milk production. Much of the cows' fear is thought to result from certain forms of handling which are aversive. The objective of our research was to determine if an aversion corridor could be used to determine which handling practices dairy cattle find most aversive. In an aversion corridor experiment the animal must learn the relationship between walking down the corridor and the treatment received at the end of the corridor. If the treatment is aversive the animal is expected to take more time and require more force to reach the end of the corridor than if the treatment was neutral or positive. In the first experiment, 54 cows were randomly assigned to 4 different treatments (hit/shout, brushing, control, and food). Cows were walked down a corridor and treatments applied when they reached the end. Treatments (2 min in duration), were applied 12 times, 3 times a day over 4 d. The time and force required for cows to walk down the corridor were measured. Cows on the hit/shout treatment took more time and required more force to walk through the race than cows on the other treatments (all comparisons, P < 0.001). In addition, brushed cows took longer to move through the race than cows given food (P < 0.05). In a second corridor experiment, 60 cows were randomly assigned to 5 different treatments (electric prod, shouting, hitting, tail twist, and control). Treatments (1 min in duration), were applied 9 times, 3 times a day over 3 d. Cows on the shout and electric prod treatments took more time and required more force to walk down the corridor than cows on the control treatment (all comparisons, P < 0.05). Aversion learning techniques show promise as an effective method to determine what handling practices cows find most aversive.

Key Words: Cow, Handling, Learning


Casual observations indicated that some cattle are sensitive to sudden movement or intermittent sound. Six commercial livestock auctions in two states and 1,636 cattle were observed, to assess the relationship between breed, gender, and temperament score, on the response to sudden intermittent visual, touch, and sound stimuli. A four point ring score was used to score each animal while it was in the ring. The scores used were 1. Stands still or walks, no head, tail or ear movement, head in normal alert position. 2. Walks, some head, tail or ear movement, alert head position. 3. Runs, displays aggression, erratic head, tail and ear movement, alert head position. 4. Hits fence, people or partitions. Animals were observed for flinches, startle responses or orientation towards sudden intermittent sounds, motions, and tactile stimulation such as being touched with a cane or plastic paddle. The cattle observed were mostly Bos taurus beef breeds, and Holstein dairy cattle. Holsteins were more sound sensitive (p<0.02) and touch sensitive (p<0.01) than beef cattle. Sensitivity to sudden intermittent stimuli increased as ring score (excitability) increased. Cattle with a ring score of one were the least sensitive to sudden intermittent movement and sound, while those with a ring score of four were the most sensitive (p<0.01). This same relationship was observed for touch stimuli, but was not statistically significant. Motion sensitive cattle were more likely to score a temperament rating of three or four than non-sensitive cattle (p<0.01). Steers and heifers were more motion sensitive than the older bulls and cows (p=0.03). Beef cattle urinated (p<0.01) and defecated (p<0.01) more often in the ring than dairy cattle. Reactivity to sudden intermittent stimuli may be an indicator of an excitable temperament.

Key Words: Cattle, Temperament, Start response

134 Effect of animal density and trough placement on drinking behavior and dehydration in slaughter horses. A. E. Gibbs* and T. H. Friend. 1 Texas A & M University, College Station, TX/USA.

The effects of density of horses and trough placement on latency to drink and the amount of time spent drinking water on-board a semi-trailer were determined. Three experiments using 19, 20, and 24 slaughter-type horses, ranging in body condition scores from 2 to 6, were conducted in hot weather. The horses were deprived of access to feed and water for 4 h prior to and for 8 h during transportation. Transport in a commercial 16-m long, single-deck, open-topped semi-trailer commenced at 1200 h and lasted until 2000 h, followed by a 1 h watering period. In Exp. 1 and 2, the trailer was divided into four 2.4 x 3.6 m compartments into each of which two steel water troughs (25 x 90 cm) were hooked on the inside of the trailer during the watering period. Each compartment contained 4 to 6 horses. The troughs were placed along one side of the trailer in Exp. 1 and placed on opposite corners of each compartment in Exp. 2. In Exp. 3, the trailer was divided into two 2.4 x 7.2 m compartments each containing 12 horses. Two troughs were staggered on the opposite walls of each compartment (four troughs per compartment). Three of the 19 horses were blocked from drinking in Exp. 1, 5 of the 20 horses were blocked from drinking in Exp. 2, and all of the horses drank in Exp. 3. All horses that drank took their first drink within 15 min of water entering the troughs in Exp. 1 and 2 and within 25 min for Exp. 3. Total serum protein, Na, and Cl were not significantly different between Exp. 1 and 2 (P>0.52) or between densities (P>0.16). Total serum protein and electrolytes indicated that the horses that did drink were not dehydrated following the water period. The larger compartment (2.4 x 7.2 m) and group size (12 horses) used in Exp. 3 provided adequate maneuvering room so that all of the horses could get access to the water when the water troughs were placed on both sides of a compartment at the rate of 0.8 m of trough per 2.4 m of wall.

Key Words: Horse, Transportation, Dehydration

135 Effects of density on displacement, falls, injuries, and orientation during horse transportation. M. N. Collins*, F. D. Jousan, S. C. Chen, and T. H. Friend, Texas A & M University, College Station, Texas/USA.

Three groups of slaughter-type horses, totaling 30 mares and 29 geldings, were used to determine density effects on displacement (distance moved during a stop), falls, injuries, and orientation using a single-deck, open-topped commercial semi-trailer. Each horse was assigned to one of two treatments: high density (1.28 m² per horse with 14 horses) or low density (2.23 m² per horse with 8 horses). Both treatments occurred sequentially on the same day (treatment order was alternated each trial), using the middle 2.44 x 7.32 m compartment of a large semi-truck trailer. The horses were transported for two laps around a 7.28

Ninety-two ram lambs born either to sires selected for high or low sexual performance were evaluated for their sexual behaviors at 8 mo of age when individually exposed in 5 x 5 m pens to four estrous ewes for 30 minutes in four weekly tests. Different ewes were used each week. Number of mounts and successful matings were recorded. Fourteen of 17 high performing ram lambs were sired by high-performing sires whereas 22 of 37 low performing ram lambs were sired by low-performing sires. The sires of high performing lambs showed significantly more ejaculations than sons of low performing sires in 30-min test sessions (mean +/- SE = 2.37 +/- 0.17 and 2.82 +/- 0.13, respectively; P < 0.04). Likewise, sons of high performing sires exhibited more mounts without ejaculation than sons of low performing sires (15.44 +/- 1.7 and 10.42 +/- 0.95, respectively; P < 0.02). Groups did not differ in efficiency (mounts per ejaculation). It was concluded that a significant response to artificial selection for sexual performance in rams can be attained in a single generation.

Key Words: Rams, Sexual performance, Selection

137 Evaluation of aggression, antler growth and testis function in yearling Fallow bucks with zeranol implants or GnRH immunization. S. M. Webb1, D. A. Neuendorff1, A. W. Lewis2, T. E. Adams2, and R. D. Randel3, 1Texas Agricultural Experiment Station, Overton, 2University of California, Davis.

The objective was to examine alternative methods to alter the behavior of yearling market Fallow bucks. Harvest season for the Fallow deer producer coincides with the Fall breeding season. The Fallow bucks become very aggressive during rut, causing considerable bruising, death, and injuries to each other, as well as posing a threat to handlers. Seventeen yearling fallow bucks (BW=26.93±5.2 kg) were randomly assigned to three treatment groups: control (C; n=6), immunized (I; n=6), and zeranol (Z; n=5). The I bucks received 1 mg of GnRH-KLH (keyhole limpet hemocyanin) emulsified in equal volumes of saline and Freund’s complete adjuvant on d 1. A secondary (booster) immunization of 0.5 mg of emulsified GnRH-KLH was administered on d 175. The Z bucks were implanted with 12 mg zeranol on days 1, 112, and 224. Body weights were recorded and blood samples taken on d 1 and at 28 d intervals. Antler length and weight were recorded and hard antlers removed on Aug. 13 (d 204). Aggression was evaluated within treatment for head butts, head pushes, fights, and avoidance during 10-minute video observation sessions. As previously reported, body weights and ADG were not affected (P>0.10) by treatment and antler length and weight were reduced (P<0.01) in Z. Plasma testosterone was lower during the early rut (P<0.01) and mid rut (P<0.01) and highest at the end of the rut (P<0.04) for the I group compared with C and Z. Plasma testosterone was affected by treatment (P<0.05), day (P<0.01), and a treatment by day interaction (P<0.04). Aggression and plasma testosterone were correlated in the I group when looking at head butts (P<0.01; r2=0.99), head pushes (P<0.05; r2=0.88), and lights (P<0.04; r2=0.83), but were not correlated in C and Z. As previously reported, scrotal circumference (P<0.02), testicle length and width measurements (P<0.05) and paired testes volume (P<0.01) were reduced in I compared with C and Z. The use of zeranol suppressed antler development and early aggression, while GnRH immunization dramatically suppressed testicular development and aggression in 50% of the treated animals.

Key Words: GnRH Immunization, Zeranol, Fallow Deer


Segregated early weaning (SEW) system which consists of early maternal separation and transportation of the newly weaned piglets to a separate pigpen has been widely adopted in North America. Behavioral and adrenal responses were monitored in SEW and control pigs in two studies. Pigs were weaned between 9 and 13 d of age (SEW1, n=23), or kept with the sows (control, n=24). Behavior was observed on the weaning day (d 0), and on d 1, 2 and 3 post-weaning (PW). Urine samples were collected pre-weaning and on d 1, 3 and 5 PW. Pigs were weaned between 9 and 12 d of age (SEW2, n=24) or between 20 and 23 d of age (CW, n=23), and were videoed daily for a week PW, then weekly up to 8 weeks of age. Pigs were mixed and transported for 20 min at 10 weeks of age. Pre and post-transportation saliva samples were collected. The outcome and duration of fights were recorded for 3 d after mixing. Cortisol was measured using RIA. Data were analyzed using ANOVA and contingency table. Results are not presented as mean and standard deviation due to high variability of the data.

In the first study, pigs in SEW1 showed higher levels of vocalization (freq/min, P<0.01) than control pigs on d 0 (1.83±0.58 vs. 0.57±1) and 1 (7.44±0.58 vs. 0.67±0.57) PW. They spent less time lying on d 1 AM than control pigs (% of time, 20.46±5.50 vs. 53.96±5.38, P<0.01). Urinary cortisol/creatinine ratio (nmol/mmol) was higher (P<0.02) on d 1 (221.45±14.87 vs. 74.05±16.43) and 3 (102.43±14.87 vs. 71.62±12.73) PW in SEW1 pigs than control pigs. SEW pigs showed a higher frequency of belly-nosing (freq/hour, P<0.04) than CW pigs in both weeks 5 (2.37±0.23 vs.1.56±0.24) and 7 (1.91±0.23 vs. 1.23±0.24) of age. Transportation caused a 7-fold increase in salivary cortisol, but there were no differences between treatments. SEW2 pigs showed higher proportion of fights with no clear outcome (n=821, 44.57% vs. 32.18%, P<0.04) and tended to fight longer than CW pigs (sec, 34.17±4.98 vs. 22.98±6.44, P<0.08). Transportation caused a higher proportion of belly-nosing, and sustained high levels of urinary cortisol in SEW piglets that the procedure is stressful. Our data also indicated that SEW compromise the ability of piglets to establish a stable social hierarchy later in life.

Key Words: Segregated Early Weaning, Behavior, Cortisol


Our objective was to evaluate possible interactions between environmental temperature (ET) and the neonatal pig’s ability to cope with an endotoxin challenge. Twenty-eight male pigs (24 hr old) were placed in environmentally controlled chambers maintained at 18°C or 34°C (n=14/ET). Rectal temperatures (RT) were measured at 15 min intervals for a 3-hr period following an i.p. injection of saline (Cont; n=7/ET) or lipopolysacchride (LPS; 150 ug/kg; n=7/ET). All pigs were humanely sacrificed following the 3-hr challenge period for tissue and blood collection. There was a TIME X ET X TRT interaction (P<.0001) for RT such that LPS pigs exposed to 18°C experienced a period of hypothermia while RT for LPS pigs at 34°C did not differ from that of Cont pigs at 34°C. There was also an ET X TRT interaction (P<.004) for body weight (BWT) change such that LPS pigs maintained at 18°C lost the most BWT during the 3-hr period. At sacrifice, serum concentration of ACTH tended to be greater (P=.094) in pigs maintained at 18°C, but was not affected by LPS treatment (P>0.89). However, there was an ET X TRT interaction (P=.0013) for serum cortisol (CS) such that LPS pigs maintained at 18°C had a greater increase in serum CS at sacrifice as compared to LPS pigs at 34°C. Serum concentration of prolactin (PRL) was reduced (P<.017) in pigs maintained at 18°C as compared to pigs maintained at 34°C, however there was no effect (P>.14) of LPS on serum PRL. There tended (P<.098) to be an ET X TRT interaction such that LPS increased serum PRL at 18°C but had no effect on serum PRL at 34°C. There was not an ET X TRT interaction (P>.059) to serum tumor-necrosis factor alpha (TNF) such that LPS increased serum TNF at sacrifice in pigs maintained at 18°C, but had no effect on serum TNF

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in pigs maintained at 34°C. These results provide evidence that acute exposure to a cold ET can significantly compromise a neonatal pig's ability to cope with an endotoxin challenge, and suggest a possible role for PRL in the neonatal pig's immune response.

Key Words: Neonatal Pig, Tumor-Necrosis Factor Alpha, Environmental Temperature

140 Behavior and environmental impact of outdoor gestating sows: effect of cold weather and grass burning. H. A. Rachuonyo1, J. L. Morrow-Tesch2, J. G. Gentry1, D. L. Anderson1, S. C. Wilson1, J. W. Dailey1, H. T. Bird1, and J. J. McGlone1, 1Texas Tech University, 2USDA-ARS, Lubbock, TX.

The objectives of this study were to evaluate relationships among behavior of outdoor-kept PIC sows, changes in soil nutrients and percent ground cover and to determine if burning a pasture (Old World bluestem) prior to occupation has any effects on these relationships. Seven pregnant sows were assigned at random to one of four replicated paddocks (1 acre each) per treatment (control or burned). Behavior (rooting, wallowing, standing, lying down) of each sow was recorded at 10-minute intervals for a 24 h period (averaged for each hour) on a cold (mean of -5.3°C) and warmer (mean of 4.6°C) day. Soil samples were collected with a soil auger at a 0 to 15 cm depth on days 0 and 30 of the trial. Soil samples were extracted and assayed for nitrate by spectrophotometer. Ground cover was estimated visually on day 0, 30 and 60. Behavior measures were analyzed as a split-split plot over days and hours within days. Ground cover data and soil nitrate levels were analyzed as a split plot with two treatments, three areas (hub, middle and outside) within each paddock and two sample times (0 and 30 days). More sows (P<.05) spent time rooting on the cold than on the warmer day. On the warmer day, wallowing activity was greater (P<.05) than on cold. Other behaviors were not different between day nor between treatments. Ground cover decreased (P<.05) over time (0.1 - 0.27% per day) but was not different between burned and grass paddocks. Rooting hole numbers (0.18 per day) and sizes (55 cm² per day) increased (P<.05) with time but did not differ between treatments. Soil nitrate levels were lower (P<.05) for grass than burned paddocks but were not different over time. These results indicate that how long it might take a given number of sows to alter ground cover, how sow behavior changes with weather conditions and that burning increases soil nitrate levels.

Key Words: Pig, Behavior, Soil

141 Behavior and performance of lactating Newsham sows and piglets reared indoors or outdoors. A. K. Johnson1, J. L. Morrow-Tesch2, S. C. Wilson1, H. Rachuonyo1, J. G. Gentry1, and J. J. McGlone1, 1Pork Industry Institute, Texas Tech University, Lubbock, 2USDA-ARS, Lubbock, TX.

A total of 125 lactating sows and their litters were used to determine the effects of intensive indoor and intensive outdoor production systems on sow and litter productivity and behavior. All sows were Newsham genotypes of contemporary age and fed a completely balanced corn-soy diet. Outdoor sows were heavier at farrowing (212.9±7.5 kg) than indoor sows (209.7±7.5 kg). Outdoor sows also had greater (P<.01) acinar obesity (0.18 per day) and sizes (75.2±1.1% per day) increased (P<.05) with time but did not differ between treatments. Soil nitrate levels were lower (P<.05) for grass than burned paddocks but were not different over time. These results indicate that how long it might take a given number of sows to alter ground cover, how sow behavior changes with weather conditions and that burning increases soil nitrate levels.

Key Words: Pig, Behavior, Soil

142 Dust and microbe levels from indoor and outdoor pig units. J. L. Morrow-Tesch1, F. M. Mitloehner2, J. W. Dailey1, S. C. Wilson2, and J. J. McGlone3, 1USDA-ARS, Lubbock, TX, 2Texas Tech University, Lubbock, TX.

The EPA clean air acts set specific levels of acceptability for particulate matter (PM) in the air, at 2.5 μm that level is .005 mg/m³. Objectives of this study were to measure dust levels and microbiological contaminants on dust from pig units. A wheat field and a building at Texas Tech University were controls. Treatment sites were an indoor and outdoor gestation unit, and an indoor and outdoor farrowing unit. Dust was measured for 24 hr periods at each site using dust meters (Dust Trak, TSI, MN). Bacterial and fungal counts were determined by taking 5 min samples with a six-stage Anderson Sampler (Anderson, GA). Plates containing media favorable to either bacterial or fungal growth were incubated 48 hr and colonies were counted. The experiment was a repeated measure design. Dust levels were higher (P<.001) on d 2 except in the indoor farrowing unit. Dust levels at the gestation units also increased (P<.001) on d 2 but were similar (P>.05) between indoor and outdoor units (mean indoor .006 vs .049, and outdoor .004 vs .052, SE=.0007, mg/m³ for d 1 and 2). The outdoor farrowing pasture had a higher (P<.001) number of fungal colonies compared to all other environments (mean = 122.6, SE = 6.19 total counts). Most fungi were at stations 6 (through 6 corresponding to PM between 3.3 and 3.6 μm). Total bacterial counts did not differ (P>.05) among environments. During d 2 several sites (indoor farrowing, indoor and outdoor gestation) sampled approached the EPA limit (at PM 2.5 μm) for dust, including both the control sites. The outdoor farrowing pastures had the lowest dust levels for both days. Fungi are known allergens and have potential to be carried into the respiratory tract of both animals and humans on dust particles, especially at PM 4 μm or less. Our results indicate that methods of reducing particulate matter on certain days are needed in west Texas to enhance animal and worker health and well-being within indoor and outdoor pig production units.

Key Words: Swine, Well-being, Health

143 Pork quality of hogs finished on slats and deep-bedding. J. G. Gentry*, M. F. Miller, and J. J. McGlone, Texas Tech University, Lubbock, TX.

Current swine production practices often have a negative impact on consumer perception. Pork products from hogs raised under a sustainable environment may be more desirable to consumers than products from hogs raised in confinement. A group of hogs finished on deep-bedding (n=1765 pigs from 11 truckloads) were compared to a group of hogs finished on slatted flooring (n=1053 pigs from 8 truckloads) for carcass characteristics and meat quality. From these two groups, forty pork loins were purchased and evaluated on the following measures: Warner-Brazlitz shear force (WBS), sensory taste panel scores, percent fat and percent moisture. Taste panel scores ranged from 1-8 for all categories except off-flavor (1= least desirable and 8= most desirable). Off-flavor scores range from 1 to 5 (1= no off-flavor and 5= extreme off-flavor). Leanness scores means for percent of lean (percent of lean) for the pig was .87 for the slatted group and .802 for the deep-bedded group (P<.05). In addition, carcasses from the deep-bedded group had a trim loss (percentage trim events per truckload of pigs) of 5.8% compared to 14.9% for the group finished on slats. WBS values (kg) were 3.64 and 2.94 for the hogs finished on slats and deep-bedding, respectively (P<.001). Deep-bedded hogs had higher taste panel scores for tenderness, juiciness, flavor intensity and overall mouthfeel. No significant differences were found in percent fat, percent moisture, off-flavor and pork flavor. Pork from hogs finished on deep-bedding was more tender, more juicy and more flavorful. These preliminary results indicate that hogs finished on deep-bedding had an advantage in pork quality and had less trim loss. However, since these hogs were not slaughtered on the same day, a plant/day effect may exist. Further studies are needed to clarify and extend these findings.

Key Words: Pork Quality, Housing Systems, Animal Welfare
Equine infectious anemia (EIA) is a viral, contagious disease of horses, mules, and donkeys. Prevention or control of the disease is by testing, quarantine, and destruction of infected animals. Louisiana has historically reported a high incidence of infected animals. Data of infected animals was collected with cooperation from the Louisiana Department of Agriculture and Forestry from the Equine Infectious Anemia Test Program. Data collected included animals tested from January 1994 through June 1998. Location was verified for 673 of the 735 infected animals. In order to determine an estimated economic impact a detailed survey was sent out to a random sample of infected animals between January 19th and June 30, 1998. The survey requested information related to the use of the animal, method of disposal and an estimated dollar value of each animal pre and post infection. Results indicated that a majority of the infected animals were horses (93%) and that infections tended to be geographic in nature with the highest incidences being in mares and geldings and along the coastal regions of Louisiana. It was further discovered that the estimated impact of EIA to the Louisiana Agriculture Industry was approximately 5.7 million dollars between January 1995 and June 1998.

Key Words: Equine, Louisiana, Economics

145 Survey of consumption and attitude for goat products. A. C. Murry1, S. Turner1, M. Nelson2, and S. Gelaye4, 1The University of Georgia, 2Fort Valley State University.

The demand for goat products or goat services has increased over the last decade. The various products produced from goats, which include meat, milk and fiber are crucial to the growth of the goat industry. Investigation into the demand for these and other products is necessary in order to develop marketing strategies to expand demand. The purpose of this study was to investigate socioeconomic variables that can be used by marketers of various goat products to segment their markets. Demographic and socioeconomic variables were hypothesized to influence and explain goat product purchases and attitudes. The independent variables used in this study were age, gender, income, education, and race. The dependent variables used were consumption or use of any goat product, consumption or use of goat milk, and attitude toward goat products. A random telephone survey of Georgia residents was conducted in the fall of 1997 by the Survey Research Center at The University of Georgia. Of the 402 Georgia residents surveyed, 151 had consumed or used goat products, and of those 151, 63 had consumed or used goat milk. For goat product consumption, gender, education, and race were influential variables, however, only education was significant (P<0.10). Caucasian women with higher education levels were more likely to have consumed or used goat products. For goat milk consumption, the only identifying segment variable was education, with higher education levels being a negative influence. Also, attitude towards using goat products was influenced by age, gender, and education levels, with positive attitude more likely for older women with higher education levels being a negative influence. Also, attitude towards using goat products was more likely to increase with education. The only identifying segment variable was education, with higher education levels being a negative influence. Also, attitude towards using goat products was more likely to increase with education.

Key Words: Goat Products, Attitudes, Consumption

146 Exposing and evaluating pork producers' acceptance to distance education media. S DeCamp1, B Richert1, W Singleton2, N Vines1, and G Slipher2, 1Purdue University, West Lafayette, IN, 2Indiana Pork Producers Association, Indianapolis, IN.

A booth was developed by Purdue University and the Indiana Pork Producers Association for the 1999 Indiana Pork Conference to introduce pork producers to a variety of distance educational media. The booth provided producers a hands-on interaction with eight different media types: computer kiosk, CD-ROM (CD), self-study manuals (SSM), video (V), multi-media kits (MMK), video conferencing (VC), chat rooms (CHAT), e-mail (EM), and the World Wide Web (WWW). A survey was developed to help determine producer’s previous use of distance education and what they will try as a result of further exposure to different distance educational media. After producers explored the booth they had the opportunity to enter a drawing by completing the 11 question survey. 38 surveys were collected. Chi-square analysis and Cochran-Mantel-Haenszel statistics were used to determine associations and differences. The greatest amount of previous exposure was with video compared to the other media (p<0.05). After exposure, producers were willing to try a majority of the media except CHAT and MMK (p<0.001). Producers previously exposed to one type of media are more likely to try different media (eg. previously used EM will try WWW; p<0.01). Producers exposed to a media are more willing to continue to try that media in future situations (p<0.04). Producers feel that their questions will be answered adequately by distance education (p<0.001). However, live face-to-face with Purdue University Specialists was the preferred way to receive educational training over distance education (p<0.001). Producers also indicated that distance education will be the future mode for information access (p<0.001). These results display a justification for using distance education in extension programming and indicate that while distance education is not the preferred delivery method, it is an acceptable form of information transfer.

Key Words: Distance education, Pigs, Extension

147 Effective use of educational fair exhibits to increase the agricultural literacy of the general public. M. J. Wylie1, R. Schwinn2, and D. A. Cashman3, 1University of Wisconsin - Madison, 2Maryland Cooperative Extension, 3Maryland State Fair.

The general public is becoming less and less familiar with agriculture. Fairs attract a large percentage of the general population and are excellent sites for educational exhibits. An interactive exhibit can not only increase agricultural literacy, it can also serve to educate the people staffing the exhibit as to the perceptions of the general public regarding animals and agriculture in general. Today’s society is a sound byte world and traditional methods of catching people’s attention and educating them are often no longer effective. The fair-going public is a moving audience that is being bombarded with advertisements and information throughout their fair experience. An educational exhibit needs to be focused, easy to view, have a clear message, and offer more detailed resources if the public desires them. Teacher packets are an excellent supplement and prove to be extremely popular. They can also be followed up with an evaluation instrument to determine if and how educational material was utilized. Themes can create a fresh exhibit each year to attract previous fair-goers. Attention-getting and educational exhibit materials will be displayed in this poster presentation. Examples from the New York State Fair and the Maryland State Fair will be used. They are distributing information, it is important to provide educational material with proper credits. A balance between cute and straight information needs to exist. Hands-on experiences offer the most impact. Creating an effective educational exhibit takes some planning time, but the benefits are well worth the effort.

Key Words: Agricultural Literacy, Fair Education, Animal Exhibits

148 The Virginia cow-calf management course: teaching basic beef production to producers by a diverse combination of media. J. B. Hall*, B. R. McKinno, S. P. Greiner, and W. D. Whittier, Virginia Tech, Blacksburg, VA.

Producers often lack the basic knowledge or skills to adopt traditional as well as new technologies. We developed the Virginia Cow-Calf Management Course that combined at-home learning with hands-on workshops. The objective of this course was to improve production practices of beginning to mid-level producers. The course was offered from October to March including 5 all-day workshops. Workshops were held simultaneously in 4 locations. Participants received written materials about 2 wk before each workshop and had access to materials via the internet. Producers could interact with one another and instructors through an on-line discussion group. Producers were surveyed at the beginning and end of the class to characterize initial knowledge and assess changes as a result of the course. Producers (n=191) from 35 VA counties and 3 other states included. CD-Participants averaged 46.7 ± 1.2 yr of age with 11.8 ± 1.3 yr cattle experience. Most producers (61%) had off-farm jobs. Average farm size was 150-200 acres with 50-99 cows. Initially,
only 35% of producers body condition scored (BCS) cows, and few (27%) grouped cattle by nutritional needs. Average calving season was 90-120 d with only 14% of the calves from AI. Breeding soundness examinations were performed on 44% of operations. By the end of the course, some basic practices had improved. Most producers (85%) used BCS and improved herd nutrition (55.9%). Other improvements included use of EPD, renovated working facilities and enhanced reproductive management. Producer ratings (1=poor; 5=excellent) averaged 4.9, 4.8 and 4.7 for overall course, written materials and hands-on workshops, respectively. Questions and answers (n=71) were posted on-line with each read an average of 52 times. We conclude that this combination of at-home, hands-on and internet instruction is effective for improving production practices in cow-calf operations.

Key Words: Beef Cattle, Producer Education, Internet


Beef 509 was a three-day cooperative educational effort of Ohio State University Extension, The Ohio State University Department of Animal Sciences, and the Ohio Beef Council. This program was designed to provide participants with in-depth education on market cattle evaluation, grading, carcass fabrication, and industry issues. Classroom and hands-on training were provided by the Beef 509 program.

Key Words: Beef 509, Educational Program, Ohio State University

150 Centralized ultrasound processing to evaluate beef cattle for carcass merit. G. H. Rouse1, D. E. Wilson1, C. L. Hays1, V. R. Amin1, A. T. Hassen1, S. P. Greiner2, and J. Crouch3, 1Iowa State University, Ames, IA, 2Virginia Tech, Blacksburg, VA, 3American Angus Association, St. Joseph, MO.

Advances in real-time ultrasound technology and accuracy of compositional and quality evaluation using this technology will give beef cattle breeders a faster and less expensive means to improve carcass merit. In 1998, Iowa State University (ISU) and the American Angus Association (AAA) began a two year research project to utilize centralized processing technology to transfer this technology to seedstock producers. The objectives of this project were 1) provide the seedstock industry with timely, accurate and unbiased grading for fat thickness, ribeye area, and % IMF (marbling); 2) assist breed associations in the accurate assembly of data required to generate adjustment factors and EPD for carcass merit from ultrasound images; 3) provide education, training and operational assistance for ultrasound technicians working with breeders. During 1998, the Centralized Ultrasound Processing (CUP) laboratory processed images on 6,224 yearling bulls, 1,194 replacement heifers and 542 feedlot steers. Expertise gained in the 1998 project will be utilized in the 1999 project.

Key Words: Beef, Teaching, Carcass

151 Development of models for prediction of percent intramuscular fat in live cattle. A. Hassen*, D. E. Wilson, G. H. Rouse, C. L. Hays, and V. R. Amin, Iowa State University, Ames, IA, USA.

In the present study a total of 500 steers were used to develop models for prediction of percentage of intramuscular fat (%IMF) values in live beef cattle. Prior to slaughter, steers were scanned across the 12th and 13th ribs using an Aloka Ultrasound device. All images were collected per individual steer using each machine. After slaughter, a cross-sectional slice of the longissimus dorsi muscle from the 12th rib facing was used for chemical extraction to determine actual %IMF. Texture analysis software was used by two technicians to define image parameters which included Fourier, histogram, and texture parameters. These 42 parameters were used as independent variables in the development of %IMF prediction models. A total of four prediction models per machine were developed. These included, models developed without transformation of actual %IMF values (model-I), log transformation of actual %IMF (model-II), ridge regression (model-III) and principal components regression (model-IV). The results indicated that Fourier parameters played an important role in the prediction of %IMF (P < .05). Model R^2 and root mean square error (RMSE) of Aloka models I, II, III and IV were .72, .84%, .72, .86%, .69, .91% and .71, .86%; respectively. The corresponding R^2 and RMSE value of Classic models I, II, III, and IV were .68, .87%, .70, .85%, .64, .94%, and .65, .91%; respectively. All models were validated based on an independent data set from 71 feedlot steers. The overall mean bias, standard error of prediction, and rank correlation coefficient across the four Classic models were, 67%, .81%, and .91, respectively. For Aloka models the corresponding values were .42%, .84%, and .88, respectively. Both Aloka and Classic equipment can be used to accurately predict %IMF in live cattle. Further improvement in the accuracy of prediction could be achieved through increasing the development data set and the variation in %IMF of cattle used.

Key Words: Ultrasound, Beef Cattle, Carcass


The objective of this study was to determine the carcass and performance traits that affected feedlot net return. A total of 365 steers from the Arkansas Steer Feedout Program were used in this study. Stepwise regression analysis was conducted by year (1996 and 1997) with net return (NR) serving as a dependent variable. Average daily gain (ADG), dressing percent (DP) and quality grade (QG) were the top three indicators (R^2 = .84) of NR in the 1996 steers (n = 137), while feed cost of gain (FCG), (QG) and medicine cost (MC) were the top three indicators (R^2 = .69) of NR in the 1997 steers (n = 228). Least square means for ADG, DP, QG and NR from steers that ranked in the top 25% for NR in 1996 were 1.58 kg/day, 56.7%, 2.9 (2 = choice cut) and $194.88, respectively, while least square means for steers that ranked in the bottom 25% for NR in 1996 were 1.10 kg/day, 63.6%, 2.9 (2 = standard) and $10.91, respectively. Least squares means for FCG, QG, MC and NR from steers that ranked in the top 25% for NR in 1997 were 1.05/kg, 3.5 , $2.19 and $61.06 , respectively, while least square means for steers in the bottom 25% for NR in 1997 were $1.53/kg, 2.2, $18.92 and $183.41 respectively. Choice steers had higher (P < .05) average NR (1996 and 1997) than steers that graded select, standard or were
dark cutters. Least square means for NR were $76.82, $28.85, $44.15 and $162.64 among choice, select, standard and dark cutter steers, respectively. Regardless of year, DP, QG and MC were important indicators of NR. Steers that fit the following breed criteria (no more than 25% Brahman, 50% or less Exotic and 50% or more English breeding) had smaller (P < 0.05) ribeye areas and had higher (P < 0.05) percent choice, ADG, backfat and yield grades than steers that did not fit the breed criteria. Steers that fit the breed criteria had higher numerical net returns than steers that did not fit the breed criteria, but the differences were not significant. Although breed type affected NR, individual feedlot performance and carcase characteristics were more important indicators of NR.

Key Words: Beef Cattle, Net Return, Carcass Data

153 Effects of calving season and weaning age on bioeconomic efficiency in range beef cattle. M. H. Makarechan, Hang Pang, and J. A. Basarah, Department of AFNS, University of Alberta, 2Alberta Agriculture, Food and Rural Development.

A dynamic simulation model named "Alberta Beef Production Simulation System" which contains herd inventory, nutrient requirements, forage production and economic submodels was used to compare bioeconomic efficiency of spring and fall calvings and different weaning ages (220, 200, 180, 160 and 140d). Comparisons were made assuming a mature cow weight of 550 kg and a peak milk yield of 8.2 kg/d. The first day of calving season was assumed as March 28 and September 8 for spring and fall calving respectively. Bioeconomic efficiency was measured as the net return per cow (total return - total cost). The total copper concentrations for the three sampling periods were 90.9 ± 84.3, 4.9, 263.0, and 34.2 ± 31.7, 7.8, 112.0, and 31.0, and 31.47 ± 6.0, 236.0, 447.0, and 320.0, for initial, intermediate, and final samplings, respectively. The increase in liver copper concentration can be attributed to the daily consumption of Cu in the range cube. By removing the variability of free-choice mineral intake, adequate stores of tissue copper were achieved prior to the calving and breeding season, a time when quality trace mineral nutrition is most critical.

Key Words: Beef calf, Calving season, Weaning age

154 Trace mineral fortification of winter supplement is an effective means of addressing trace mineral deficiency in spring-calving beef cows. J. D. Arthington and L. R. Corah, 2University of Florida Range Cattle Research and Education Center, Ona, 2Certified Angus Beef, Manhattan, KS.

When balancing free-choice mineral, a uniform, daily consumption level is assumed. Due to many influencing factors, this desired intake level is rarely achieved on a continuous basis. The following evaluation was conducted with a Kansas commercial cattlemen experiencing difficulty with mineral consumption. An initial trace mineral evaluation was conducted via tissue mineral analyses of liver biopsy collections. The analysis revealed substantial copper deficiency (liver Cu < 50 ppm) in 7 of 12 animals tested. Action was taken to increase the amount of Cu sulfate included in the free-choice mineral to a final Cu concentration of 3.5%. Following 81 d of fortified-mineral supplementation, another trace mineral evaluation was conducted. Again, liver Cu concentrations were well below the adequate level in 9 of 11 animals tested (adequate defined as ≥ 75 ppm liver Cu). The reason for the continued deficiency was contributed to the failure of cows to consume adequate free-choice mineral. In attempt to better ensure mineral intake, Cu sulfate was added to the cow’s daily supplement of alfalfa range cubes. Cows were offered 1.82 kg of range cubes containing 10% Cu sulfate. A final trace mineral evaluation was conducted after cows were offered Cu sulfate-fortified range cubes for 90 days prior to spring calving. These results revealed adequate copper stores in all 10 cows tested. Mean liver copper concentration ± stdev. were: minimum, maximum, and median liver copper concentrations for the three sampling periods were 90.9 ± 84.3, 4.9, 263.0, and 34.2 ± 31.7, 7.8, 112.0, and 31.0, and 31.47 ± 6.0, 236.0, 447.0, and 320.0, for initial, intermediate, and final samplings, respectively. The increase in liver copper concentration can be attributed to the daily consumption of Cu in the range cube. By removing the variability of free-choice mineral intake, adequate stores of tissue copper were achieved prior to the calving and breeding season, a time when quality trace mineral nutrition is most critical.

Key Words: Copper, Mineral, Cow

155 Expression of peroxisome proliferator-activated receptor gamma (PPARγ) in porcine white blood cells (WBC). M. T. Leininger, C. P. Portocarrero, and K. L. Hauseknecht, Purdue University, West Lafayette, IN.

PPARγ is a key regulator of adipocyte differentiation and is previously studied in the transcriptional regulation of multiple adipocyte genes. Drugs which activate PPARγ may have potent anti-diabetic effects. We previously cloned the porcine PPARγ gene and reported high level expression in adipose tissue. Recently, in vitro evidence suggests that PPARγ may regulate macrophage function. The aim of this work was to determine if PPARγ is expressed in porcine WBC, which isoform(s) are expressed, and the effect of an acute endotoxin challenge on PPARγ expression in porcine WBC. Mononuclear cells were isolated from control pigs, total cell lysates were prepared and analyzed by Western blotting using antisera which measures total PPARγ, but does not distinguish between the γ1 and γ2 isoforms (PAN-PPARγ; Affinity Bioreagents, Inc., Golden CO). Additionally, samples were analyzed using antisera specific to the γ2 isoform (Affinity Bioreagents). Total PPARγ was detected in WBC but at lower abundance than in adipose tissue. In contrast, there was no detectable γ2 signal in white blood cells compared to a robust signal in adipose tissue, indicating that the γ1 isoform predominates. To determine the immune challenge, 36 growing pigs were divided into four groups. Each group was assigned to one of the following treatments: 0.06 ml of saline (Control) and lipopolysaccharide (LPS; 25 mg/kg BW). Following each injection, blood samples were collected hourly for 10 hr and were analyzed for no detectable γ1 expression, PPARγ expression increased 2-fold over basal, was maximal by 4 hr post-LPS (3.22 ± 8 fold) and was normalized to control by 8 hr post-challenge. These changes in PPARγ expression are consistent with reports that PPARγ expression is up-regulated during the conversion from monocyte to macrophage in response to immune challenge in vitro. This is the first evidence of dynamic changes in PPARγ expression in WBC in vivo in any species, and suggests that PPARγ may play an important role in the immune response in the pig.

Key Words: Adipose tissue, Inflammation, Immunity

156 Characterization of the porcine Lhx3 pituitary transcription factor. S. J. Rhodes, J. Blanton Jr., J. L. Bridwell, A. L. McCutchan, B. C. Meier, and G. E. Parker, Indiana University-Purdue University at Indianapolis, Indianapolis, IN.

The anterior pituitary gland contains five cell types that are characterized by the trophic hormones that they secrete. Recent studies have identified transcription factors that regulate development of the gland in mice and humans. Pit-1 is a POU homeodomain factor that is required for the function of the somatotrope, lactotrope and thyrotrope cell lineages. Other regulatory proteins appear to control early pituitary development. These include the LIM homeodomain transcription factor Lhx3/P-Lim. Mice lacking Lhx3 do not develop the anterior and intermediate lobes of the pituitary, indicating that Lhx3 is essential for pituitary organogenesis. To understand the events that regulate pituitary development in general, and in particular, how pituitary signaling pathways that regulate growth and reproductive fitness, we have cloned complementary DNA clones encoding porcine Lhx3 (pLhx3). The pLhx3 protein
sequence exhibits strong similarity to murine Lhx3 within the aminoterminal Lim domains and the DNA-binding homodomain, but is less conserved outside these motifs. Northern analysis demonstrated that the pLhx3 gene produces a rare 2.2 kb transcript in the adult swine pituitary. Assay of gene expression during porcine embryogenesis revealed that the pLhx3 expression is bivalent for each gene. Expression vectors for pLhx3 activated porcine alpha-glycoprotein promoter luciferase reporter genes in transfaction assays. Recombinant pLhx3 protein specifically bound to a target site within the porcine alpha-glycoprotein gene promoter in gelshift assays. Porcine Lhx3 expression vectors induced transcription from prolactin enhancer/promoter reporter genes in synergy with Pit-1. Lhx3 protein specifically interacted with Pit-1 and the Lim domain-binding protein NLI in solution binding assays. Green fluorescent protein/confocal microscopy studies demonstrated that Lhx3 is a nuclear protein. Our results suggest general conservation of Lhx3 function. Supported by a grant from the NRICGP/USDA to S.R.

Key Words: Transcription, Pituitary, Trophic hormone

157 Chronic in vitro porcine leptin treatment alters porcine adipocyte metabolism. T. G. Ramsay¹ and X. Yan². ¹USDA-ARS, Beltsville, MD, ²Pennington Biomedical Research Center, Baton Rouge, LA.

Leptin has numerous metabolic effects on peripheral tissues. However, it is unclear as to whether many of these effects are due to direct actions of leptin or perhaps due to indirect actions through intermediary molecules. This study was performed to determine whether leptin has acute (direct) or chronic (indirect) effects on adipocyte metabolism. Primary cultures derived from neonatal porcine adipocyte tissue were used to perform this experiment. The stromal vascular cell fraction of the adipose tissue was isolated by collagenase digestion, filtration and subsequent centrifugation. These SV cells were seeded on 25 cm² tissueculture flasks and permitted to proliferate to confluence in 10% FBS in DMEM/F12 (50:50). Cultures were then induced to differentiate using 2% FBS + 10 mM IBMX + 1 uM Dexamethasone for 48 hours. This medium was then replaced with 5% pig serum + 1 uM insulin to permit the adipocytes to fill with lipid. After 7 days of lipid filling, adipocytes were washed free of this medium, incubated overnight in serum free medium and then replaced with test medium. Test medium contained 0-1000 ng/ml recombinant porcine leptin and 2% pig serum. Cultures were incubated with these leptin containing media for either 4 hours (acute) or 120 hours (chronic) exposure. At the end of incubation, cultures were harvested for analysis of glucose metabolism ± insulin (10 nm). LPL activity and lipolytic response to isoproteronol (1 μM) were determined at 48 hours in 10% FBS. Acute leptin treatment had no effect on the evaluated metabolic parameters. Chronic leptin treatment reduced lipogenesis by 35% in the presence of insulin (n = 5; p<0.1). Heparin releasable LPL activity was unaffected by leptin treatment in the absence or presence of insulin. Lipolysis was elevated by 23% when insulin was also included in the lipolytic medium (n = 5; P<0.05). These data suggest that porcine leptin functions through indirect mechanisms to alter porcine adipocyte metabolism as chronic stimulation was necessary to identify an effect of porcine leptin. (This research was funded by a grant from USDA-NRI)

Key Words: Leptin, Adipocyte, Metabolism

158 Quantification of satellite cell populations using fluorescent immunocytochemistry. N. T. Mesires* and M. E. Doumit, Michigan State University, East Lansing.

Postnatal muscle hypertrophy is associated with increased muscle DNA content. To understand the mechanisms of muscle growth it is crucial to quantify populations of proliferating and differentiating satellite cells. Our objective was to develop an in vitro immunocytochemical staining method to quantify populations of proliferating and differentiating satellite cells in growing pigs. Satellite cells were isolated from a 46kg barrow. Cultures were incubated with 46kg barrow and an 80kg barrow. Cells were seeded and allowed to attach to fibronectin coated coverslips for 48 hours. Cultures were washed of cellular debris with phosphate buffered saline (PBS) and stained with 5.1H11, an antibody against a cell surface protein expressed in myogenic cells. Following 5.1H11 staining, cultures were fixed in 1% formalin and absolute methanol (−20°C), blocked with 2% goat serum in PBS, and stained for myogenin, a marker of differentiation, using an anti-myogenin antibody (F5D). Parallel cultures were also fixed and stained for proliferating cell nuclear antigen (PCNA) using an anti-PCNA (PC10) antibody. Detection of bound antibodies was accomplished using an anti-mouse IgG with fluorescein isothiocyanate conjugate. All cultures were counterstained with Hoechst 33258 for detection of total nuclei. Staining treatments for each barrow were done in triplicate and analyzed via fluorescent microscopy. Total nuclei, as well as 5.1H11, PCNA, and myogenin positive cells were counted from 25 random fields. Eighty five percent of cells isolated from the 46kg barrow were satellite cells (5.1H11 positive) while 81% of cells isolated from the 80kg barrow were satellite cells. Ninety one percent of the cells from the 46kg barrow were proliferating (PCNA positive) while 79% of cells from the 80kg barrow were PCNA positive. No myogenin positive cells were detected in either culture. These data indicate that a high percentage of cells in initial isolates are satellite cells, most of which are in a proliferative state. This method will be useful for determining the changes in satellite cell proliferative activity associated with different muscle growth rates.

Key Words: Satellite cell, Differentiation, Proliferation

159 Prolactin inhibition by bromocriptine decreases mammary gland development in pregnant gilts. C. Farmer*, D. Petitetier, and M. Sorensen. ¹Agriculture and Agri-Food Canada, Lennoxville Research Centre, Canada, ²Danish Institute of Agricultural Sciences, Foulum Research Centre, Denmark.

This project was undertaken to determine the extent of prolactin involvement in mammosogenesis in gilts. Twenty-eight pregnant gilts were assigned as controls (CTL; n=15) or received 10 mg of bromocriptine orally thrice daily (bromo; n=13) from d 70 to 110 of gestation. Jugular blood samples were collected on d 70 of gestation before the onset of bromocriptine administration and every 8 days thereafter, and were assayed for prolactin, IGF-I and progesterone. Gilts were slaughtered on d 110 of gestation and fetuses were counted and weighed. One row of mammary glands was used for dissection of parenchymal and extra-parenchymal tissues, and for determination of DNA, RNA, dry matter, protein and fat contents. Tissue from the other row was used for measurements of prolactin receptor and affinity. Prolactin receptor affinity in gilts receiving bromocriptine were drastically reduced throughout the bromocriptine treatment period (P<0.001) whereas there was no overall treatment effect on progesterone and IGF-I levels (P>1). Total weight and extraparenchymal tissue weight of the mammary glands were unaffected by treatment (P>2) but weight of parenchymal tissue (1011 vs 881 g, SEM=110), total DNA (3.2 vs 1.7 g, SEM=0.7) and total RNA (3.1 vs 1.5 g, SEM=0.4) decreased (P<0.01) with bromocriptine treatment. Percentages of fat (67.3 vs 77.2, SEM=2.5) and dry matter (39.9 vs 45.6, SEM=1.3) in parenchymal tissue increased with bromocriptine treatment (P<0.01) while that of protein (33.5 vs 25.4, SEM=2.1) decreased (P<0.01). Both number of prolactin receptors (204.5 vs 125.3 fmol/mg protein, SEM=14.1) and receptor affinity (67 vs 39 mg/mL, SEM=0.4) in parenchymal tissue decreased with bromocriptine treatment (P<0.001). Average fetal weight was lower in gilts receiving bromocriptine when compared to control gilts (1.25 vs 1.13 g, SEM=0.04, P=0.05) while fetal number did not differ (P>1). These results clearly demonstrate that prolactin is essential for normal mammary gland development and can affect fetal growth during the last third of gestation in gilts.

Key Words: Sows, Prolactin, Mammary Gland Development


Efficient development of gilts such that they conceive early and continue to produce offspring is a primary objective of swine production. Herein, we investigated different prepubertal feeding regimens on reproductive performance of gilts. At 13 wk of age white crossbred gilts were penned individually and assigned to treatments: AL, ad libitum access to feed starting on d 70 of gestation (204.5 vs 125.3 g/fem/mg protein, SEM=14.1) and receptor affinity (67 vs 39 mg/mL, SEM=0.4) in parenchymal tissue decreased with bromocriptine treatment (P<0.001). Average fetal weight was lower in gilts receiving bromocriptine when compared to control gilts (1.25 vs 1.13 g, SEM=0.04, P=0.05) while fetal number did not differ (P>1). These results clearly demonstrate that prolactin is essential for normal mammary gland development and can affect fetal growth during the last third of gestation in gilts.

Key Words: Sows, Prolactin, Mammary Gland Development
35 to 45 d of gestation. At that time piglets were moved to pens (5/pen) where they were fed at approximately 1.5 x maintenance until 105 to 110 d of gestation when they were slaughtered or moved to farrowing crates (term). Average feed consumed (kg) from 13 wk of age to removal or term by all pigs assigned was 445 ± 11 by AL, 477 ± 11 by C, and 404 ± 11 by R (P < .01). Each piglet was assigned a growth index (GI) which was the GI was 6.8 ± .7 in AL, 8.1 ± 7 in C, and 6.9 ± .7 in R (P < .24) and efficiency (pigs/kg feed) was .0139 ± .0014 in AL, .0163 ± .0014 in C, and .0157 ± .0014 in R (P < .45). No. of pigs produced and efficiency in pigs reaching term were 10.5 ± .5 and .0214 ± .0011 in AL, 9.7 ± .4 and .0192 ± .0009 in C, and 9.7 ± .5 and .0223 ± .0011 in R (P < .36 and P < .08, respectively). This result indicated restricted feeding of piglets during prepubertal development may increase the efficiency of swine production without negative impact on reproduction from mating to term.

Key Words: Gilts, Puberty, Growth


This experiment was undertaken to determine the influence of somatotropin (pST)-treatment of pregnant sows on the development of offspring during postnatal growth. Seven gilts received daily i.m. injections of 6 mg pST from day 10 to 27 followed by decreasing doses down to 0 mg pST from day 28 to 37 after artificial insemination (pST-group). Seven sows received a placebo (control). Three neonates of the highest (HW), of the middle (MW), and of the lowest (LW) birth weight from each litter were dissected into meat, fat cover, bones, skin, and internal organs. Subsequently, several tissues were analyzed to determine the composition of water, protein, lipid, and ash. The remaining piglets of the litters were allocated to three birth weight classes by the help of frequency distribution (low, middle, high) and reared up to 182 days of age on average. After slaughter, carcass composition and meat quality of the pigs were examined. All data were statistically analyzed using proc GLM. At birth the LW- and MW-piglets from treated sows were somewhat heavier in comparison to the corresponding piglets from untreated sows (by 11 and 6%, respectively; NS). The body composition of the piglets was slightly influenced by pST-treatment. The percentages of meat and internal organs were increased whereas the percentages of fat cover and bones were decreased. Water percentage in meat and in adipose tissue were reduced whereas protein percentage was elevated. The total protein percentage in LW-piglets from treated sows was 1.56 % (P<0.05) compared to corresponding controls. Live weight development up to slaughter was not clearly affected by pST. However, we found indications of slower growth up to 14 days of age compared by growth compensation up to 28 days of age. Thereafter, the influence of pST on live weight development differed slightly between pigs from different birth weight classes. Total daily gain was the same for pST- and control pigs on average. Carcass quality of slaughtered pigs was not clearly affected by pST-treatment of their mothers. PST-pigs of lower birth weight tended to exhibit higher carcass meat percentage in comparison to corresponding controls.

Key Words: Somatotropin, Growth, Pig

162 Effects of weaning on somatotrophic gene expression and circulating levels of growth hormone (GH), insulin-like growth factor-1 (IGF-1), and IGF-2. R. L. Matteri*1, K. J. Toucheü2, J. A. Carroll1, and G. L. Alle2, 1Animal Physiology Research Unit, Agricultural Research Service, USDA, Columbia, MO, 2University of Missouri, Columbia, MO.

Weaning the piglet results in a well-characterized reduction in growth, increase in GH secretion, and a reduction in circulating levels of IGF-1 and IGF-2. The objective of this study was to evaluate postweaning changes in the secretion of these hormones and the expression of genes involved with their production. At 14 d of age, piglets were either cross-fostered to a sow (S, n = 8) or weaned onto phase 1 diets containing 0 (NP, n = 8) or 7% (SDP, n = 8) spray-dried plasma. Animals were slaughtered after 4 d for blood and tissue collection. Weight gain over this 4-d period was significantly greater in S, compared to NP and SDP groups (1.3 +/- .09, 1.1 +/- .06, and .97 +/- .04 kg, respectively; P < .001). Respective gains over the last day of the study were .33 +/- .05, .05 +/- .03, and .29 +/- .04 kg (P < .001). Serum GH concentrations at sacrifice were higher in NP and SDP, compared to S piglets (P < .001). Conversely, IGF-1 and IGF-2 concentrations were equivalently lower in NP and SDP, compared to S piglets (P < .001). The level of pituitary GH mRNA did not differ among groups (P = .3). Levels of IGF-1 and IGF-2 mRNA were equivalent among groups in liver, muscle (l. dorsi), and fat tissue; however, a tendency was noted for lower liver IGF-1 mRNA in S piglets (P = .09). Liver IGFBP-3 mRNA also was unaffected by treatments (P = .4). A strong tendency for lower liver GH receptor mRNA was noted in S piglets (P = .06); however, muscle GH receptor mRNA in S was equivalent among groups (P = .7). The results indicate that the abundances of specific mRNAs in the present tissues are not the immediate determining factors of circulating GH and IGF levels. The high rate of gain between d 3 and 4 in the SDP piglets is not accompanied by a normalization of GH or IGF secretion, suggesting a significant lag time between recoveries of postweaning gain and somatotropic axis function.

Key Words: Piglet, Insulin-like Growth Factors, Growth

163 Effects of weaning on gene expression of neuroendocrine regulators of feed intake. C. J. Dyerm1, K. J. Toucheü2, J. A. Carroll1, G. L. Allem2, and R. L. Matteri1, 1Animal Physiology Unit, Agricultural Research Service, USDA, Columbia, MO, 2University of Missouri, Columbia, MO.

One of the greatest challenges in swine nutrition is to decrease the postweaning lag by stimulating feed intake and growth. Spray-dried plasma (SDP) is often added to phase 1 diets to attempt to stimulate appetite during this lag. The current study was designed to investigate changes in gene expression (messenger ribonucleic acid, mRNA) of neuroendocrine appetite regulators during weaning. Young pigs (14 d, 4.69±0.13kg) were either crossfostered to a sow (SOW, n=8), weaned and fed a phase 1 diet containing no SDP (NP, n=8), or weaned and fed a diet containing 7% SDP (SDP, n=8). Animals were sacrificed 4 d after weaning (or crossfostering) for tissue collection. Gene expression was compared between treatments using initial (pre-weaning) body weight as a covariate. Expression of neuropeptide Y (NPY), a potent stimulator of feed intake, was equivalently decreased (P<0.011) in SDP and NP pigs compared to SOW pigs. There were no treatment effects seen on adipose leptin, or hypothalamic leptin receptor, orexin (ORX), or orexin receptor type 2 (Orec2), or insulin-like growth factor 1 (IGF-1) gene expression. Correlation analysis revealed significant (P<0.001) correlations between initial body weight and hypothalamic ORX, Orec2, NPY, and IGF-1 expression (R=0.664, 0.759, 0.791, and 0.697, respectively) across treatments. Interestingly, no such pattern was observed for adipose leptin or hypothalamic leptin receptor expression. Expression of Orec2 mRNA was strongly correlated to ORX expression across treatments (R=0.690, P=0.0002). This study provides not only the first report of endogenous orexin mRNA expression in a livestock species, but gives new insight into the neurochemical impact of weaning.

Key Words: Piglet, Appetite, Weaning

164 Biological effects of dietary porcine plasma protein on growth performance, small intestinal mass and morphology, and plasma urea levels in early-weaned pigs. R. Jiang, X. Chang, B. Stoll, M. Fan, and D. G. Burri*n, USDA/ARS Children’s Nutrition Research Center, Baylor College of Medicine.

We quantified the effects of diets containing porcine plasma protein on growth, small intestinal mass, mucosal morphology and plasma urea of early-weaned pigs. Ninety-six pigs (14 d old; 4 kg body weight (BW)) were assigned in groups of 32 to three dietary treatments: (control diet- ad libitum (C), plasma protein diet-ad libitum (P), and plasma protein, pair-fed to C (PFP)). Pigs (N=8 per treatment) were killed after 2, 4, 8 or 16 d of feeding. On day 16, daily food intake and weight gain in the P group were 30% and 43%, respectively, greater (P < 0.05) than C pigs; weight gain was similar in C and PFP groups. Intestinal masses in all three groups were similar at 2, 4, and 8 d. By 16 d the jejunal (JEJ) and ileal (ILE) protein and DNA masses (mg/kg BW) in both the P and PFP groups were lower than in C (P<0.05). Dietary plasma protein did not affect either crypt depth or villus height in the JEJ. Among dietary groups, ratios of 4 h in vivo crypt labeling (%total cells) with BrdU into the jejunal (JEJ) were 23%, 39%, 35%, and 36% at 2, 4, 8, and 16 d, but were not
affected by dietary plasma protein. Plasma urea concentrations were decreased by 40% and 42% in P and in PFP group (P < 0.05) during the 16 d of dietary plasma protein treatment, respectively. Regardless of food intake, pigs receiving plasma protein had lower relative small intestinal protein and DNA masses. Decreased plasma urea concentrations suggest that dietary plasma may reduce amino acid catabolism.

Key Words: Protein, Urea, Porcine

165 Enhanced carcass composition in IGF-I transgenic barrows and gilts. V. G. Purse1, A. D. Mitchell2, K. D. Wells1, R. J. Wall3, M. E. Coleman2, and R. J. Schwartz3, 1 USDA, ARS, Beltsville, MD, 2 GeneMedicine, Inc., The Woodlands, TX, 3 Baylor College of Medicine, Houston, TX.

The objective of this research was to determine whether directing expression of IGF-I specifically to striated muscle would enhance lean muscle growth in barrows and gilts. Although growth hormone is considered the primary growth-promoting hormone in mammals, many of its effects are thought to be mediated by insulin-like growth factor-1 (IGF-I). Transgenic pigs were produced with a fusion gene composed of avian skeletal α-actin regulatory sequences and the cDNA encoding IGF-I. A founder transgenic line (1) was mated to seven non-transgenic gilts from two hybrid sire lines to produce G1 transgenic and sibling control progeny. After weaning, pigs were provided feed ad libitum until they reached 120 kg body weight. At 90 and 120 kg body weight 13 transgenic and 24 sibling control pigs were anesthetized and sampled by dual-energy x-ray absorptiometry (DXA) to estimate body composition. At 90 and 120 kg the transgenic pigs had more lean and less fat than sibling control pigs (P < 0.05 at each weight). The day after the last DXA scan all pigs were killed, the right half of each carcass was scanned by DXA after one day of chilling, and the loin eye area and back fat measurements taken. In comparison to sibling controls, transgenic gilts and barrows, respectively, had a larger LEA (29.4 and 31.4%, P < 0.01), more carcass lean (10.1 and 11.4%, P < 0.01), less carcass fat (20.1 and 22.0%, P < 0.01), and less average backfat (15.1 and 30.0%, P < 0.01). Average daily gain was similar for transgenic and control pigs. Based on these results we conclude that enhancing IGF-I specifically in skeletal muscle had a positive effect on carcass composition of terminal cross market swine.

Key Words: Swine, Transgenic, IGF-I

166 Porcine (pST) somatotropin administration increases protein balance by promoting protein conservation in fasted swine. R. C. Vann1, H. V. Nguyen2, J. M. Vargason3, P. J. Reeds1, N. C. Steele4, and T. A. Davis2, 1 USDA/ARS Children’s Nutrition Center, Houston, TX, 2 USDA/ARS Growth Biology Laboratory, Beltsville, MD.

Fasting lowers protein synthesis and increases degradation, thus it is important to conserve protein when feed is not available. The objective of this study was to determine the effect of pST on whole body protein turnover in fasted, young swine. Previously, Vann et al. (1998) reported pST promotes growth by lowering both protein degradation and amino acid oxidation in young, fed swine. Groups of six pair-fed, weight matched (15 kg), growing barrows were treated with pST (150 µg/kg/d) or diluent for 7 d and fasted overnight. The animals were then maintained with a 4 h somatotropin and replacement insulin (20 ng/kg/66/min) infusion. Insulin concentrations were 5 µU/ml and fasting glucose and amino acid levels were maintained by infusion. Whole-body protein turnover and leucine (Leu) oxidation were determined with primed, continuous infusion of [1-13C]Leu and [14C]-bicarbonate. pST-treated pigs had increased protein synthesis (+17%; P < .05) and lower Leu oxidation (-47%; P < .001) resulting in an increased protein balance (47%; P < .01) compared to the control pigs. The results indicate that the effect of pST on fed state Leu oxidation survives fasting and that pST blocks the reduction in protein synthesis that occurs with fasting. We conclude that pST promotes maximum efficiency via minimizing protein loss in fasting, and maximizing protein gain in the fed state. Supported by USDA NRI 96-35206-3657

Key Words: Swine, pST, Insulin

167 Metabolic responses to short-term bST administration in milk-fed bull calves between birth and 100 days of age. J. M. Smith1, M. C. Diaz1, M. E. Van Amburgh2, M. C. Lucy2, and D. E. Bauman2, 1 Cornell University, 2 University of Missouri-Columbia.

Fifty-four Holstein bull calves underwent a single short-term bovine somatotropin (bST) challenge to evaluate the functional coordination of the somatotropic axis. Calves were injected with a reconstituted daily injectable bST formulation (Monsanto) simultaneously for three consecutive days and were slaughtered the day after the third injection. Calves were fed a 30% crude protein: 20% fat replacer (Milk Specialties) from birth to slaughter at either 65 kg, 85 kg, or 105 kg BW (18 calves at each weight). Calves were fed to achieve one of three target rates of gain, 500 g/d (TRT 1), 950 g/d (TRT 2), or 1450 g/d (TRT 3), to their respective slaughter points (6 calves per TRT to each slaughter weight). Calves reached 65 kg BW at an average of 42.5, 25.7, or 26.8 days of age after growing 610, 1060, or 1050 g/d, respectively. Calves weighing 85 kg at slaughter were 69.5, 40.0, or 35.3 days old, on average, having gained 625, 1100, or 1300 g/d, respectively. Calves slaughtered at 105 kg BW were 98.2, 65.3 or 51.7 days of age with ADG of 620, 960, or 1250 g/d, respectively. Least square means of plasma IGF-1 concentrations measured by RIA after glyceryl-glycine extraction of samples collected immediately prior to challenge and 14 h after the third bST injection (post-challenge) are presented in the following table. Post-challenge IGF-1 concentrations were higher (P < 0.009) than pre-challenge levels in all calves.

Liver tissue from each of these calves and from six calves slaughtered at one day of age was analyzed by ribonuclease protection assay (RPA) for mRNA specific for IGF-1 and the liver-specific growth hormone receptor, GHR1A. Low levels of IGF-1 mRNA were present in day-old calves and remained low in calves grown at the lowest rate of gain. IGF-1 and GHR1A mRNA increased in calves grown at the highest two rates of gain. GHR1A mRNA was present in day-old calves.

Key Words: Somatotropic axis, Insulin-like growth factor-1, Calves

168 Responsiveness to growth hormone-releasing hormone (GHRH) challenge: A physiological predictor of average daily gain in beef bulls. E. E. Connor1, S. M. Barao, and C. E. Dahl, University of Maryland, College Park.

The relationship between serum growth hormone (GH) concentration, after GHRH-stimulated release, and subsequent weight gain in weaning black Angus bulls (n = 38) was evaluated. Bulls averaged 272 ± 29 (SD = 29) of age when challenged with 1.5 and 4.5 µg/kg100 kg BW bovine GHRH (1 - 30) analog (i.v.) following a 19-h fasting period. All bulls were challenged with one of 2 doses of GHRH on consecutive days and dose was randomized by day. Two h prior to each GHRH challenge, all bulls received a "clearance" dose of 4.5 µg/kg/100 kg BW bovine GHRH (1 - 30) analog to reduce variation in subsequent response to GHRH challenge. Blood was collected via jugular venipuncture at 0 and 10 min relative to each injection of GHRH for serum GH determination by RIA. Pearson's ranked correlation revealed responses from the two 4.5 µg GHRH/100 kg BW clearance doses were consistent within animal over time (r = .38; P = .03). The relationships between GH response to each challenge dose of GHRH versus ADG during a 112-d growth performance test were evaluated using simple linear regression. A positive relationship (r2 = .18; P = .007) was demonstrated between GH response to the 1.5 µg GHRH/100 kg BW challenge versus ADG. Response to the 4.5 µg GHRH/100 kg BW challenge tended to be positively related to subsequent weight gain (r2 = .08; P = .09). The relationship between response to GHRH challenge and carcass composition at d 112 of the growth performance test will be evaluated. Results of this study suggest that GH response to GHRH challenge is a useful tool for identifying beef bulls superior for growth.

Key Words: Beef cattle, Growth, GHRH

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169 Effects of varying degrees of muscularity and muscular hypertrophy in Hereford, Limousin, and Piedmontese F2 crossbred calves on traits measured through weaning. R. E. Short*, M. D. Groz, M. D. MacNeil, E. E. Grings, and R. A. Bellows, USDA-ARS, Ft. Keogh LARRL, Miles City, MT.

Breeds that are similar in mature weight but differ in muscularity, especially with breeds that express muscular hypertrophy (double muscling), may affect production traits. Hereford (normal muscling, H), Limousin (moderate muscularity, L), and Piedmontese (muscular hypertrophy, P) sires (20 to 25 per breed) were bred to crossbred cows at random to produce F1 calves. F1 progeny were inter se mated within sire breed to produce F2 calves. P-cross F2 calves were genotyped for the G-A transition mutation at the myostatin locus characteristic of P, and their genotypes were classified on the basis of having 0 (P0), 1 (P1), or 2 (P2) copies of the mutant allele (mhP). Sires and dams of P-cross F2 calves were assumed to be P1, and H- and L-cross calves were assumed to have P0 genotypes. Included in the ANOV model were breed, sex, year, age of dam (first calve heifers, F or cows, C), and selected 2-way interactions for birth wt, kg (BWT, SD=5.0), calving difficulty score (CD, SD=1.2), and weaning wt, kg (WWT, SD=24). We conclude that differences in muscularity affected BWT with both the L and P2 genotypes increasing BWT. WWT was lowest in P but was not affected by the mhP allele. CD and %CD in F were decreased in P0 but were dramatically increased by the addition of the mhP allele. In C there were no effects of genotype on CD or %CD. Breeding schemes for optimal use of the mhP allele could use P1 dams mated to P0 as F and to P2 as C.


Angus steers of known parentage were used in a two year study (n=40, first year 1, n=45 year 2) to evaluate the relationship between intramusculat fat content and carcass characteristics of non-implanted steers with varying EPD for marbling. Steers were sorted by paternal grand-sire and breed and assigned to harvest groups. Data were analyzed as a completely random design with a factorial arrangement of treatments (Year, EPMD and Harvest group). Harvest group hot carcass weights (HCW) were 208 ± 15, 246 ± 23, 296 ± 19, 353 ± 25, and 381 ± 28 kg. EPMD did not affect (P>0.10) backfat, longissimus muscle area, yield grade, or marbling score. HCW and LM treatments had similar (P>0.10) HWC and on intellectuals rib lip content for harvest groups 1.23 and 4 and steers in harvest group 5 had heavier HCW (393 vs. 368 kg; P<0.05) and a greater amount of 12th rib lip content (9.0 vs 7.7%; P<0.10). Harvest group affected the level and extent of marbling (P<0.01). There was not a Harvest group x EPMD group interaction indicating no differences occurred in the pattern of marbling development due to marbling EPD. Carcasses expressed Small degrees of marbling between the HCW of 246 and 296 kg (harvest group 2 and 3). These data indicate that EPD for marbling of parental grand-sires was not indicative of differences in the onset or the rate of development of marbling. Greater differences in EPMD may be needed to recognize these differences.

Key Words: Marbling, Serial slaughter, Body composition

171 DNA binding site requirements for Lhx3-mediated gene activation. J. L. Bridwell*, A. L. McCutchan, J. R. Price, K. W. Sloop, and S. J. Rhodes, Indiana University-Purdue University at Indianapolis, Indianapolis, IN.

Cell-specific gene expression is temporally and spatially regulated by the coordinated actions of transcription factors that activate or repress the transcriptional activity of target genes. Lhx3 is a LIM-Homeodomain transcription factor expressed early in development, in Rathke’s pouch, the structure that forms the anterior and intermediate lobes of the adult pituitary. This protein plays a role in the development of certain subpopulations of motorneurons and is critical in the establishment and differentiation of four of the five hormone-secreting cell types of the anterior pituitary including, the growth hormone, prolactin, thyroid stimulating hormone and luteinizing/hollicle stimulating hormone cells. Knockout mice lacking a functional Lhx3 protein die at birth with no anterior/intermediate pituitary development. Since little is known about the transcriptional mechanism of this developmentally important protein, site-selection methods employing gelshift analysis and polymerase chain reaction (PCR) using degenerate oligonucleotides were used to identify the preferred target sequence for porcine and murine Lhx3. Results of this study show that Lhx3 binds to an A/T-rich DNA sequence and that the LIM domains of the protein regulate binding affinity to the DNA, but not specificity. This binding site is capable of conferring Lhx3-dependent transcription to heterologous promoters in transfection assays. Both full-length Lhx3 and LIM-deleted Lhx3 are capable of binding target DNA. We are currently using these results to investigate potential Lhx3 target genes in the pituitary and brain. Supported by the NRICGP/USDA and the NSF.

Key Words: Transcription, Pituitary, Trophic hormones

172 Cross-species conservation of protein structure and function of the LIM homeodomain transcription factor Lhx3. K. W. Sloop*, J. L. Bridwell, B. C. Meier, G. E. Parker, and S. J. Rhodes, Indiana University-Purdue University at Indianapolis, Indianapolis, IN.

Lhx3/P-Lim is a LIM homeodomain transcription factor critical to anterior pituitary organogenesis and motor neuron pathfinding in vertebrate development. This factor contains two cysteine-rich zinc finger-like LIM motifs in the amino-terminus that mediate protein-protein interactions and a DNA-binding homeodomain in the carboxyl-terminal. The objective of this study was to compare conservation of protein structure and function between the human, porcine, and murine Lhx3/P-Lim. Pituitary complementary DNA (cDNA) bacteriophage libraries screened with radiolabelled probes and RACE (Rapid Amplification of cDNA Ends) were used to identify Lhx3/P-Lim cDNAs. Electrophoretic mobility shift assays (EMSA) and in vitro luciferase reporter assays were used to assess DNA binding and promoter activation specificity. DNA sequence analysis of the human, porcine, and murine Lhx3/P-Lim revealed high conservation in the LIM and homeodomains, but low similarity outside of these regions. In addition, DNA binding and activation of pituitary hormone reporter genes was similar among the three factors. We conclude that the functional domains of the Lhx3/P-Lim transcription factor are structurally and functionally conserved throughout evolution. Supported by a grant from the NRICGP/USDA to S.R.

Key Words: Transcription, Pituitary, Trophic hormones


Mono-ADP-ribosylation is a core protein modification of proteins involving transfer of ADP-ribose from NAD to a protein by an ADP-ribosyl transferase (ADPRT). Arginine-specific ADPRTs have been identified in many tissues including skeletal muscle. We showed previously that inhibitors of the arginine-specific ADPRT inhibited differentiation of chick muscle cells in culture and that the muscle intermediate filament (IF) protein desmin is a substrate for the purified enzyme, suggesting that this modification has important functions in skeletal muscle. To further examine the role of ADPRT in muscle differentiation, cultures of the mouse skeletal muscle cell line C2C12 were treated with an antisense oligonucleotide to inhibit expression of the enzyme. A 22 base-pair phosphothioate-modified oligo complementary to the region of the mouse arginine-specific ADPRT mRNA that included the start codon was synthesized. Oligo was added to C2C12 cultures at a concentration of 1.5 μM either 1 d prior to or at the time medium
was changed from proliferation medium (20% fetal calf serum) to differentiation medium (4% horse serum). Antisense treatment reduced ADP-RT expression more than 50% in comparison to controls treated with random oligo and concomitantly inhibited differentiation to the same extent, as measured by creatine kinase activity. These results suggest that ADP-RT has a role in muscle differentiation. In addition, the effect of ADP-ribosylation on the properties of purified desmin was further characterized. We established previously that ADP-ribosylated desmin is incapable of assembling into IFs in vitro. In this study, we demonstrated that treatment of assembled desmin IFs with ADPRT resulted in disassembly, and that modified desmin does not coassemble with unmodified desmin. Further, stepwise enzyme cleavage of the ADP-ribose moiety attached to desmin was used to characterize chemical features of the ADP-ribose moiety necessary to inhibit assembly. These results provide additional information to suggest that ADP-ribosylation could regulate desmin assembly in muscle cells, and thus, ADPRT may be involved in regulation of both differentiation and IF assembly/disassembly in muscle. (Supported by USDA NRICGP Grant 96-35206-3857).

Key Words: skeletal muscle, ADP-ribosylation, myogenesis


The objective of this study was to determine if there are changes in myostatin expression and tissue protein in conjunction with compensatory growth in pigs. Forty eight pigs were assigned to 4 dietary treatments at approximately 14.5 kg BW. For the duration of the study (31 d), one group was allowed ad libitum (AL) intake and an alternative group allowed only that level of intake estimated for maintenance of BW (MNT). The third group was allowed maintenance intake for 21 d and ad libitum intake for the remaining 10 d (MNT-AL) whereas the fourth group was allowed ad libitum intake and switched to maintenance intake (AL-MNT). At the conclusion of the study, blood samples were obtained and all pigs were killed for collection of longissimus and semitendinosus muscle. The data also indicate that greater concentrations of the long isoform is the most competent in leptin signaling, these results perhaps absent from mid to late pregnancy based on our inability to detect the long isoform in the sheep placenta was evident at d 85, 110 and 140 for the intracellular domain of the sheep leptin receptor. Expression of GR in these placental samples using this high specific activity probe and prolonged autoradiographic exposure (14 d). A sheep leptin receptor cDNA was generated by reverse transcriptase-polymerase chain reaction (RT-PCR), based on clones. No detectable signal for sheep leptin was found in any of these placental samples using this high specific activity probe and prolonged autoradiographic exposure (14 d). A sheep leptin receptor cDNA was used to design a ribonuclease protection assay (RPA) capable of detecting simultaneously the long isoform and short isoforms of the leptin receptor. The glucocorticoid receptor (GR) mRNA expression in the sheep placenta. H. G. Klemcke*, J. L. Valet, and R. K. Christenson, USDA, ARS, U.S. Meat Animal Research Center, Clay Center, Nebraska.

Leptin and its receptor have been shown to be expressed in the placenta of humans and murines. Historically, the sheep has been an important model for investigations during pregnancy. The objective of the present work was to determine whether the sheep might serve as a good model for investigations of leptin biology during pregnancy. Placentomes were obtained from multiparous Finn x Dorset ewes at d 85, 110 and 140 post coitus (PC). Poly A RNA (5 µg) obtained from these placentae was subjected to Northern analysis and probed with a partial cDNA corresponding to exon 2 of the sheep leptin gene. This probe was labeled to high specific activity using a polymerase chain reaction (PCR) based method. No detectable signal for sheep leptin was found in any of these placental samples using this high specific activity probe and prolonged autoradiographic exposure (14 d). A sheep leptin receptor cDNA was used to design a ribonuclease protection assay (RPA) capable of detecting simultaneously the long isoform and short isoforms of the leptin receptor. The glucocorticoid receptor (GR) mRNA expression in the sheep placenta. H. G. Klemcke*, J. L. Valet, and R. K. Christenson, USDA, ARS, U.S. Meat Animal Research Center, Clay Center, Nebraska.

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Key Words: Pig, leptin, fatty acids

176 Analysis of leptin and leptin receptor mRNA expression in the sheep placenta. R. A. Ehhardt*, A. W. Bell, and Y. R. Boisclair, Cornell University, Ithaca, NY.

Leptin and its receptor have been shown to be expressed in the placenta of humans and murines. Historically, the sheep has been an important model for investigations during pregnancy. The objective of the present work was to determine whether the sheep might serve as a good model for investigations of leptin biology during pregnancy. Placentomes were obtained from multiparous Finn x Dorset ewes at d 85, 110 and 140 post coitus (PC). Poly A RNA (5 µg) obtained from these placentae was subjected to Northern analysis and probed with a partial cDNA corresponding to exon 2 of the sheep leptin gene. This probe was labeled to high specific activity using a polymerase chain reaction (PCR) based method. No detectable signal for sheep leptin was found in any of these placental samples using this high specific activity probe and prolonged autoradiographic exposure (14 d). A sheep leptin receptor cDNA was used to design a ribonuclease protection assay (RPA) capable of detecting simultaneously the long isoform and short isoforms of the leptin receptor. The glucocorticoid receptor (GR) mRNA expression in the sheep placenta. H. G. Klemcke*, J. L. Valet, and R. K. Christenson, USDA, ARS, U.S. Meat Animal Research Center, Clay Center, Nebraska.

Key Words: Pig, leptin, Blood

175 Regulation of PPAR but not leptin gene expression by dietary fatty acid supplementation. M. E. Spurlock1, K. L. Houseknecht2, C. P. Portocarrero2, S. G. Cornelius1, and G. M. Willis1, 1Purina Mills, Inc., 2Purdue University.

Leptin and PPARs are adipocyte genes which are important in the regulation of appetite (leptin) adipogenesis (PPARγ). To determine the effect(s) of dietary fatty acid supplementation. (Supported by USDA NRICGP Grant 96-35206-3857).

Key Words: Pig, Myostatin, Blood


The glucocorticoid cortisol is present within porcine fetuses or their uterine environment throughout gestation. If glucocorticoid exposure during fetal development, then GR must be present. The current study was conducted to determine the presence of fetal GR mRNA in fetal liver and placenta and to examine effects of breed and uterine environment. Porcine fetuses were obtained on days (d) 24, 30, and 40 of gestation from each of 3 treatments: intact (INT), unilaterally hysterectomized-ovariectomized white crossbred (UHO), and intact Meishan (ME) gilts (n = 5-6/treatment/day). A 436-bp cDNA was produced using reverse transcription and polymerase chain reaction procedures with pig liver
total RNA and primers complementary to porcine GR. The cDNA was cloned into a PCR II vector and sequenced. Northern hybridization analyses were conducted using 30 μg of total RNA. Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) mRNA expression was measured to adjust for lane loading differences. Relative concentrations of GR mRNA were reported as arbitrary units after analysis of covariance using GAPDH as a covariate. Embryonic liver steady state GR mRNA expression did not vary among treatments but was highest (P < 0.01) on d 24 (15402 ± 849 vs 12150 ± 737 vs 12246 ± 777; d 24, d 30, and d 40, respectively). Placental GR mRNA was lower (P = 0.03) in UHO fetuses on d 24 (14150 ± 1027) compared with INT fetuses (17646 ± 1149). ME placental GR mRNA increased (P < 0.01) between d 30 (13981 ± 1158) and d 40 (18703 ± 1411) and on d 40 was greater (P = 0.02) in ME than in white crossbred fetuses (14843 ± 1477). These data indicate the presence of GR mRNA in porcine fetal tissues during early gestation and provide strong evidence for an involvement of cortisol in porcine fetal development.

Key Words: Pig, Fetus, Glucocorticoid Receptor

178 Pharmacokinetics of pig beta-adrenergic receptors. T. Naile*, H. Cao, W. Liang, and S. E. Mills, Purdue University, West Lafayette, IN.

Beta-Adrenergic receptors (1AR) from pig adipose and muscle tissue are activated fully by only a few 1AR ligands and exhibit only partial activation to the common drugs used in animal growth trials. Partial agonist-responses are not related to ligand binding, but rather to incomplete 1AR activation. To determine if the high degree of selection is inherent in the 1AR protein, cloned pig 1AR and 2AR expressed in CHO cells were activated in adenylyl cyclase (AC) induction studies. CHO cells were grown to confluence, ruptured in hypotonic saline, and total cell membranes isolated by centrifugation. Membranes were incubated for 10 min at 37° in the presence of various ligands and cAMP determined by RIA. For the 2AR, results were consistent with data from pig tissue. Maximum rates of AC activation were compared with 10-8 M ligand. Isoproterenol (ISO), epinephrine, and norepinephrine exhibited similar efficacies (P > 0.05). Data support our hypothesis that pig 1AR are highly selective to the ligands which activate AC and that selection is inherent to the 1AR protein. The 1AR exhibited greater selectivity than the 2AR, however, the 2AR clone had nearly a 4-fold greater receptor density than the 1AR, which may have contributed to the greater responses. The 1AR is the predominant 1AR in pig adipose and muscle tissue and an attenuated response at this receptor may account for the apparent resistance of pig adipose tissue to growth modification by most tested ligands in vitro and in vivo.

Key Words: pig, beta-adrenergic receptor, adenylyl cyclase


The objective of this study was to evaluate IGF-I expression among muscles from 9 lines of transgenic (TG) pigs. Founder TG pigs carrying a fusion gene composed of avian skeletal β-actin regulatory elements and a cDNA encoding hIGF-I were mated to non-TG pigs to produce G1 TG and non-TG progeny. At 120 kg, TG pigs and control pigs were killed to collect cardiac (H) and skeletal muscles (SM): Gastrocnemius (GC), Longissimus (LD), Semitendinosus (ST), and Serratus ventralis (SV) for total RNA. IGF-I mRNA was only found in 6 of 9 TG lines, and one line had several indistinct bands instead of a single band. Further evaluations were confined to 17 progeny from five TG lines. In Northern Blot, IGF-I mRNA was probed with hIGF-I cDNA and quantitated by fluorimunofluorescence intensity. IGF-I mRNA abundance was then normalized for β-subunit mRNA for comparison. The mean and S.E. of IGF-I mRNA in H, GC, GM, LD, ST and SV were 3.7±2.7, 3.2±2.9, 5.1±1.3, 1.4±2.7, and 1.8±2.3, respectively.

Interaction of line X muscle was significant (P<0.05). In Line 1, IGF-I mRNA was more abundant in H than in SM (P<0.05) and IGF-I mRNA in LD was more abundant than in GC, ST, and SV (P<0.05). In Line 9, IGF-I mRNA was more abundant in LD than other muscles (P<0.05). IGF-I expression in H and SM muscle was similar for TG males and females. Lein eye area (LEA) was 4.6 cm² higher for TG pigs than for non-TG siblings (P<0.05), but the increased LEA among TG pigs was not correlated with the abundance of IGF-I mRNA of the LD (r=0.46). The findings suggest the level of IGF-I expression was adequate in all five lines for maximum muscle stimulation by this growth factor.

Key Words: Swine, Transgenic, IGF-I

180 Intramuscular injection of DNA encoding IGF-I increases IGF binding protein-2 expression in pigs. R. S. Everett, D. E. Gerrard, and A. L. Grant*, Purdue University, West Lafayette, IN.

To characterize the role of IGF-I and its interaction with IGF-binding proteins in vivo, we have been investigating a direct DNA injection approach for obtaining production of IGF-I in porcine skeletal muscle. Objectives of the present study were to determine if intramuscular injection of DNA encoding IGF-I results in recombinant IGF-I production, and to determine effects of local IGF-I production on IGF binding protein-2 expression in porcine skeletal muscle. To distinguish exogenous IGF-I from endogenous CMV-I, a plasmid DNA vector was designed to express recombinant IGF-I with an 11-amino acid epitope tag (TT tag) driven by a constitutive CMV promoter (TIGF-I). This construct results in production of biologically-active recombinant IGF-I in muscle cells. Each longissimus muscle of six 7-d-old suckling pigs was injected with TIGF-I DNA at two sites (100 μg/site). A third site was injected with vehicle only (negative control). At d10 of age, two of the injected pigs were euthanized for muscle collection, two pigs were weaned, and two pigs remained with the sow. At d11 of age, the remaining four pigs were euthanized. Muscle samples from injection sites were sectioned and immunoreactive TIGF-I was localized to myofibers of DNA-injected muscle. Amounts of TIGF-I in muscle homogenates were quantified by western blotting and ELISA. TIGF-I, expressed per 10 g muscle protein, was .39, .35, and .2 ng, in d10 suckling, d11 suckling, and d11 weaned pigs, respectively (P<0.01). Relative amounts of IGF-I binding protein-2 and binding protein-2 mRNA were determined by ligand and northern blotting. At d10, IGF binding protein-2 and mRNA were at least 6.7-fold and 1.6-fold greater, respectively, in muscle expressing TIGF-I than in negative controls. Weaning blunted (P<0.01) the TIGF-I induction of IGF binding protein-2. We conclude that direct DNA injections can be used for production of a biologically-active recombinant IGF-I, and that increased production of IGF-I results in increased production of IGF binding protein-2.

Key Words: IGF-I, IGF binding protein, Muscle

181 Nutritional regulation of the genes encoding the sheep acid labile subunit and other components of the circulating IGF system in sheep. R. P. Rhoads*, A. W. Bell, P. L. Greenwood, and Y. R. Boisclair, Cornell University, Ithaca, NY.

In sheep, the perinatal period is associated with maturation of the endocrine arm of the insulin-like growth factor (IGF) system, which is characterized by two developmental events. First, concentrations of circulating IGF-I increase rapidly after birth and become responsive to changes in nutrition and growth hormone (GH) status. Second, the liver initiates synthesis of a serum protein called the acid labile subunit (ALS) that promotes the endocrine actions of IGF-I and -II by extending their half-lives in circulation. This action of ALS is a consequence of its ability to recruit IGF-I or -II and IGF-binding protein-3 (IGFBP-3) to a complex of 150 kDa. In this study, we examined the effect of nutrition on the hepatic expression of the ALS gene and other genes encoding important components of the circulating IGF system during late fetal and neonatal life. To study the effect of nutrition during fetal life, livers were obtained from normal or growth retarded lambs (50% of normal size, P<0.05) at 130 d of gestation (n=8) and at birth (n=7). Growth retardation is the result of placental insufficiency and represents chronic fetal undernutrition. At 130 d of fetal life and at birth, chronic undernutrition caused lower expression of the ALS and IGF-I genes (P<0.05). Fetal undernutrition also decreased the levels of IGFBP-3 mRNA at birth (P<0.05), but did not affect expression of the IGFBP-2 gene at either times. To study the effect of nutrition in early
postnatal life, lambs (n=18) were fed a milk replacer to sustain gains of 150 or 337 g/d. Hepatic gene expression was analyzed between day 12 and 38 after birth. The high plane of nutrition increased the expression of the ALS and IGF-I genes and decreased the expression of the IGFBP-2 gene (P<0.05). Expression of the IGFBP-3 gene was identical across treatments. In summary, expression of the sheep ALS gene is modulated by nutrition in late fetal and in early postnatal life. These results are consistent with the hypothesis that changes in circulating ALS may be partly responsible for the effects of nutrition on circulating IGF-I.

182 Somatotropin inhibits sensitivity and responsiveness to the antilipolytic effect of insulin in adipose tissue from growing, but not neonatal pigs. Y. X. Wang*, S. K. Fried, and P. A. Schoknecht, Rutgers University, New Brunswick, N.J. We previously demonstrated that somatotropin (ST) antagonizes the stimulatory effect of insulin on lipogenesis in adipose tissue of both neonatal and growing pigs. The purpose of this study was to determine if ST also influences the antilipolytic effect of insulin. Subcapsular adipose tissue fragments from five neonatal (3.2 ± 0.2 kg, 7-d of age) and five growing (15.4 ± 0.7 kg, 26.4 ± 0.5-d of age) crossbred pigs were cultured with or without ST (4.5 mg/L) for 24h. Isolated adipocytes were then prepared from cultured adipose tissue and acutely incubated for 2h with varying concentrations of insulin (0, 10, 25, 40, 400 pM) and 8-Br-cAMP (1 mM) to stimulate lipolysis. To minimize variability, all incubations contained the adenosine analog (PIA, 20 nM) and adenosine deaminase to remove endogenous adenosine. Glycerol accumulation in the medium was used as an index of lipolysis. In both age groups, culture with ST significantly increased 8-Br-cAMP-stimulated lipolysis. In growing pigs, insulin significantly inhibited lipolysis, but the maximal effect was greater in controls (decreased by 79 ± 5% (C) vs 58 ± 1% (ST); p < 0.01). Culture with ST also decreased sensitivity to insulin (rightward shift in dose-response curve). ED50 was significantly increased from 12 ± 3 to 40 ± 3 pM (p < 0.01) by culture with ST. In contrast, in neonatal pigs, culture of adipose tissue with ST did not affect responsiveness or sensitivity to the antilipolytic effect of insulin (maximal decreased by 66 ± 2% (C) vs 68 ± 3% (ST); ED50: 9 ± 1 pM (C) vs 12 ± 2 pM (ST)). Taken together with our previous results, ST increases basal and cAMP-stimulated lipolysis in adipose tissue of both neonatal and growing pigs. However, in contrast to growing pigs, ST does not affect sensitivity and responsiveness to insulin’s antilipolytic effect in neonatal pigs. Thus, the mechanism by which ST leads to lower lipid deposition differs in neonatal and growing pigs.

Key Words: Somatotropin, Insulin, Lipolysis

183 Increased insulin-like growth factor-1 concentrations following injection or implantation of a human growth hormone-releasing factor (hGRF) analog in growing pigs. P. Dubreuil1,2 and P. Brazeau1,1 Faculty of Veterinary Medicine, 1Notre-Dame Hospital, Univ. of Montreal, Montreal, Quebec, Canada. Previously, hexenoyl trans 3 human (h) GRF(1-44)NH2 (TH9507) has been shown to be 80 times more potent than the hGRF(1-44)NH2 (hGRF) on ST release. To evaluate TH9507 on IGF-1 increment, 16 barrows (43.9 ± 4.9 kg) were injected s.c. twice daily for 6 consecutive days with either 3.0 or 30.0 µg/kg injection. IGF-1 concentrations on days 0,2,4,6,7, and P. Dubreuil and P. Brazeau. 1Faculty of Veterinary Medicine, 1Notre-Dame Hospital, Univ. of Montreal, Montreal, Quebec, Canada. Previously, hexenoyl trans 3 human (h) GRF(1-44)NH2 (TH9507) has been shown to be 80 times more potent than the hGRF(1-44)NH2 (hGRF) on ST release. To evaluate TH9507 on IGF-1 increment, 16 barrows (43.9 ± 4.9 kg) were injected sc BID for 6 consecutive days with either 3.0 or 30.0 µg/kg s.c. injection. IGF-1 concentrations on days 0,2,4,6,7, and 8 reached 178, 244, 281, 307, 249, 218 ng/mL; SEM = 18 and 166, 254, 318, 342, 293, 229 ng/mL; SEM = 17 for 3 and 30 µg/kg doses, respectively. All values were significantly different than day 0 at the exception of day 8 at the 3.0 µg/kg dose. Secondly, 64 barrows (40.6 ± 2.6 kg) were allotted in 8 treatment groups: 1) control; 2) hGRF (30 µg/kg sc SID) injected for 6 consecutive days; groups 3-8 were implanted sc (3 mm) with hGRF; 3) 1x7.5 mg; 4) 2x7.5 mg; 5) 4x7.5 mg; 6) 2x15 mg; and TH9507: 7) 1x7.5 mg; 8) 2x7.5 mg. Sera were obtained on days 0,1,2,3,4,5,6,7,10,12,14,16 for IGF-1 determination and hGRF treatment. The injection of either 3.0 or 30.0 µg/kg of TH9507 over 6 consecutive days produced increases of 72% and 106% of IGF-1 during 8 and 16 days, respectively and hGRF did not produce any significant increase . These data indicate that this analog is more potent than hGRF in increasing IGF-1. Sponsored by Theratechnologies Inc. Montreal, QC, Canada.

Key Words: GRF, IGF-1, Pig

184 The interaction of recombinant bovine somatotropin (rbST) and cottonseeds in the diet on performance, plasma hormone concentration and muscle fatty acids composition in Holstein-Friesian male calves. Z. Holzer1, Y. Aharoni1, A. Brosh1, A. Orlov1, and D. Sklan2, 1ARO, Institute of Animal Science, Newe Yaar Research Center, Israel, 2Faculty of Agriculture, The Hebrew University, Rehovot, Israel. In a former study (Holzer et al., 1999, JAS, in press) we have found a trend toward an increase in polyunsaturated fatty acids (PUFA) in rbST treated animals. The objective of the present study was to assess the interaction between rbST treatment and a diet containing delinted whole cottonseeds (CS), rich in PUFA, on performance, plasma hormone concentration and muscle fatty acids composition in Holstein-Friesian male calves. Fifty-six male calves, about 223 d old with an average weight of 276 kg at the start of the experiment, were assigned at random, in an a 2x2 factorial design (n=14), with two levels of rbST (0; rbST) and two diets (with and without 9.5% (CS). The diets contained about 2.7 Mcal/kg DM, metabolizable energy, and 13.4% crude protein. The rbST treated and the control animals received injections of 500 mg Posilac®, and placebo every 14 d. The experiment lasted 170 d and the animals were slaughtered at an average weight of 486 kg. There were no significant interactions between rbST and CS treatments, as for performance. The plasma concentrations of GH and IGF-1 was higher (P<0.001) in the rbST treated animals. There was a highly significant (P<0.001) interaction between rbST and CS as for urea-N concentration in blood ( rbST, CS animals had 23% less urea in blood than the CS fed and rbST untreated animals). Concentration of C16:0 was decreased and of C16:1 was increased by rbST in the muscle of the CS fed calves. These interactions were highly significant (P<0.001). rbST decreased the C18:1 (P<0.05), and increased the C18:2 (P<0.05). C18:3 (by 87% but NS), and C20:4 by 18% (NS). The results of the present study indicated the possibility of manipulating the muscle fatty acid composition by combining rbST treatment with a diet containing PUFA.

Key Words: Male Calves, Bovine Somatotropin, Cottonseeds

185 Effect of Posilac® and Revalor®-S alone and in combination on soft tissue composition and rate of soft tissue gain in feedlot steers. T. C. Bramble1,2, R. A. Roeder2, B. C. Peterson2, M. J. Roeder2, and G. T. Schelling1, 1Texas Tech University, 2University of Idaho. This study evaluated soft tissue carcass composition and rate of soft tissue gain in 18 Angus crossbred steers averaging 345 kg treated with Posilac® and Revalor®-S, alone and in combination, in a 120-d feedlot trial. In a completely randomized design treatments were: 1) CON (Control); 2) POS (Posilac®-S 320-mg recombinant bovine somatotropin s.c. injection/14 d); 3) REV (Revalor®-S, 120-mg trenbolone acetate and 24-mg estradiol 17β implant); and 4) POS+REV. The left side of the carcass was separated into the chuck, rib, round, loin, brisket,foreshank, flank, plate, and KPH fat. Individual cuts were weighed and separated into lean tissue, fat, and bone. All soft tissue was ground through a 64-cm plate followed by a .32-cm plate and analyzed for protein, ether-extractable fat, and moisture. Selected treatment effects are summarized below.
Liver biopsy samples were collected at 6, 12, and 24 h relative to injection. All LPS doses decreased (P < 0.05) plasma T4 and T3 at 6, 12, and 24 h: negative response, measured as area under the time × concentration curve (AUC), increased with LPS dose fitting a linear relationship with the LPS dose for T4 (r² = 0.996, P < 0.05) and with the log of LPS dose for T3 (r² = 0.999, P < 0.05). At all LPS doses, plasma T2 response (negative AUC) was less in C-fed than in F-fed animals (-155 vs -343 ng/mL × h, SEM = 40, P < 0.01). The bST treatment did not affect plasma T2 and T3 concentrations and response to LPS. Hepatic 5’D activity (mmol 1⁻ × h⁻¹ × mg protein⁻¹) was increased by bST treatment (2.02 vs 1.36, SEM = .12, P < 0.05), was greater in F-fed than in C-fed animals (1.90 vs 1.49, P < 0.05) but was not affected by LPS challenge. Results suggest that the reduction in plasma T2 and T3 in the early phase of acute response to LPS is related to reduced thyroid secretion which could be modified by diet but not by bST treatment.

Key Words: Thyroid hormone, Endotoxin, Somatotropin

188 Effect of selection for weight on body composition and carcass characteristics of Bos indicus and Bos taurus. R. F. Nardon¹, A. A. M. Sampaio², A. G. Razoook¹, L. O. Teodeschi³, L. A. Figueiredo¹, C. Boín³, and M. L. P. Lima³.

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This work evaluated the growth performance, and body and carcass composition of 144 animals of three Bos indicus breeds (selected Nelore - NeS, Guzerá - GuS, and control Nelore - NeC) and one Bos taurus (Caracu - CaS) in order to verify the effect of genetic selection on weight at 378 days of age (P≤378). These animals were born at Estação Experimental de Zootecnia do Sampaiozinho, SP, Brazil. The study was based on the average of P≤378 for each herd. The diet was composed of corn silage (45%, DM) and concentrate (55%, DM). The slaughter periods were performed at 88, 173, and 266 days of feedlot. At that time, animals had 16.1 ± 0.8, 19 ± 0.9, and 22 ± 1.1 months of age, weighing 383 ± 33, 464 ± 33, and 547 ± 53 kg respectively. NeS animals had higher (P<0.05) carcass weight (289.3 vs 259.3 kg) and half carcass edible meat (88.4 vs 88.7 kg) than NeC, respectively. NeS and NeC had similar (P>0.05) half carcass trimmed tissues (19.8 vs 18.1 kg). Also, NeS had higher (P<0.05) carcass weight and half carcass edible meat than GuS (268.4 kg and 90.8 kg), but identical (P>0.05) half carcass trimmed tissues than GuS (18.0 kg). In contrast to NeC and GuS, CaS had similar (P>0.05) carcass weight (280.8 kg) and half carcass edible meat than GuS (264.8 kg and 90.8 kg), but identical (P>0.05) half carcass trimmed tissues than GuS (18.0 kg). Regarding the empty body weight comparisons, NeS had higher (P<0.05) carcass edible meat percentage and hindquarter edible meat percentage than GuS and CaS (46.0, 44.1, and 44.6%; 20.7, 19.6, and 19.7%) respectively, but was similar (P>0.05) to NeC (46.0 and 20.8%). CaS showed lower (P<0.05) shear force (3.53 kg) than NeS and GuS, whereas had similar (P>0.05) shear force (4.58, 4.65, and 4.73 kg), respectively.

Key Words: Body composition, Carcass characteristics, Bos indicus

189 Adipocyte cellularity in Korean Native Cattle. C. B. Choi¹, S. K. Hong¹, H. C. Kim², K. J. Na³, and S. H. Lee³.

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One hundred and twenty (120) Korean Native Cattle (steers) were used to investigate changes in adipocyte cellularity during various physiological stages. Experimental animals were castrated at five months of age and assigned to the experiment at six months of age after a month acclimation period. Contents of crude protein and total digestible nutrients in concentrate were 15% and 70%, 12% and 71%, and 11% and 72% during the growing period, fattening period, and finishing period, respectively. Concentrates and rice straw, as a sole roughage source, were fed ad libitum during the entire experimental period. Starting from six months of age, eight to ten animals were sacrificed at two month intervals until termination of the experiment at 30 months of age. Adipose tissue from perirenal, mesenteric, subcutaneous, and intramuscular fat depots was fixed in osmium-collidine buffer and measured for adipocyte diameter, area, and volume using a Coulter Counter. Perirenal fat showed the fastest adipocyte growth and reached maximum diameter (210μm) at about 24 months of age. Adipocyte cellularity determined by Saïtou’s formula was 346.3 cells/mm². The subcutaneous adipocyte cellularity was lower than mesenteric and intramuscular fat depot at the same physiological stage. Extension of the feeding period beyond 24 months did not result in a greater increase in cellularity.
not affect adipocyte cellularity in any fat depot except intramuscular fat in which adipocytes kept growing until 30 months of age. Visually, intramuscular fat started to accumulate at about 10 months of age. However, dissection of fatty mass for cellularity determination was impossible until the animals reached 14 months of age. The results indicate that there might be at least three: 12-18 and 24 months of age - important threshold-like physiological stages in Korean Native Cattle for accumulation of triglycerides in adipocytes. In conclusion, the current study provides basic information about adipocyte growth in Korean Native Cattle. The data could be used to manipulate nutrient content in the diet of beef cattle, in relation to fat accumulation in various fat depots and body growth, at different physiological stages.

**Key Words:** Adipocyte, Cellularity, Beef cattle

### Effect of a nutritionally-directed compensatory growth regimen on growth potential and lactational performance of beef heifers. W. W. Poland¹, R. C. Runnells², D. R. Danielson³, J. W. Schoo4er², and C. S. Park². ¹North Dakota State University, Dickinson, ²Fargo, ND.

A nutritionally-regulated and time-dependent compensatory growth regimen during the hormone-sensitive growth phase prior to first parturition can effect mammary development and subsequent lactational performance. The objective of this study was to determine the effect of a stair-step nutrition program imposed during the pubertal phase on growth performance and lactation potential of beef heifers. Ninety-six beef heifers (25 ± 17.8 kg; 6.2 ± .38 body condition score [BCS]; approximately 305 d3 of age) were blocked by weight and assigned to either a control (CON) or stair-step compensatory nutrition (SSCN) regimen. Heifers assigned to CON were fed a diet balanced to meet the nutrient requirements of growing heifers (6.8 kg of timothy hay/t) and gain at 15.8 kg; 6.2 BCS (6.2 vs 6.7; 8.4 vs 1.7%); 17.8 kg; 6.2 body condition score [BCS]; approximately 305 d3 of age). The SSCN regimen provided an energy restricted diet for 10 wk. ME of the energy restricted diet was similar to CON, however, DMI was restricted to 60% of that of the CON. CP was increased in the restricted diet to allow similar daily intakes between dietary treatments. Following the restricted phase, SSCN heifers were given ad libitum access to a high energy diet (130% ME and 100% CP of CON) for 10 wk. Subsequently, all heifers were managed as CON through breeding. ADG (.56 vs .07 kg/d; P = .04), BCS (6.0 vs 5.2; P = .01) and growth efficiency (gain x 100/DMI; 8.4 vs 1.7%); P = .08) were reduced in the SSCN group during the energy restricted phase. Conversely, ADG (.84 vs 1.57 kg/d; P = .01), BCS (6.2 vs 6.7; P = .03) and growth efficiency (11.4 vs 17.4%; P = .01) were improved by SSCN during the high energy phase. DMI (7.4 vs .91 kg/d) was increased by SSCN during the later phase. Over the entire feeding period, ADG (.70 vs .82 kg/d; P = .16) and DMI (7.1 vs 6.7 kg/d; P = .14) were not affected by dietary regimen. However, growth efficiency (10.0 vs 12.0%; P = .07) and heifer conception rate during the breeding season (75.0 vs 89.6%; P = .06) were improved by the SSCN regimen. These results indicate that beef heifers raised on a stair-step nutrition and feeding regimen during puberty had improved growth performance.

**Key Words:** Beef Heifers, Compensatory Growth, Growth Performance

### Effects of increased feed intake in early gestation on sow farrowing performance and offspring carcass characteristics. R. E. Musser¹, S. S. Dr1z², M. T. Tokach¹, D. L. Davis¹, R. D. Gooband1, J. L. Nelson1, M. Heintz2, and J. Bauman3. ¹Kansas State University, Manhattan, 2Global Ventures, Pipestone, MN.

Three hundred and ninety-four sows (PIC 115) were used to determine the effects of increased feed intake during two stages of fetal development on farrowing performance and offspring carcass characteristics. Sows were fed either 3.62 kg/d of a gestation diet (.65% lysine, .9% Ca, .38 body condition score [BCS]; approximately 305 d3 of age) and gain at 15.8 kg; 6.2 BCS (6.2 vs 6.7; 8.4 vs 1.7%); 17.8 kg; 6.2 body condition score [BCS]; approximately 305 d3 of age). The SSCN regimen provided an energy restricted diet for 10 wk. ME of the energy restricted diet was similar to CON, however, DMI was restricted to 60% of that of the CON. CP was increased in the restricted diet to allow similar daily intakes between dietary treatments. Following the restricted phase, SSCN heifers were given ad libitum access to a high energy diet (130% ME and 100% CP of CON) for 10 wk. Subsequently, all heifers were managed as CON through breeding. ADG (.56 vs .07 kg/d; P = .04), BCS (6.0 vs 5.2; P = .01) and growth efficiency (gain x 100/DMI; 8.4 vs 1.7%); P = .08) were reduced in the SSCN group during the energy restricted phase. Conversely, ADG (.84 vs 1.57 kg/d; P = .01), BCS (6.2 vs 6.7; P = .03) and growth efficiency (11.4 vs 17.4%; P = .01) were improved by SSCN during the high energy phase. DMI (7.4 vs .91 kg/d) was increased by SSCN during the later phase. Over the entire feeding period, ADG (.70 vs .82 kg/d; P = .16) and DMI (7.1 vs 6.7 kg/d; P = .14) were not affected by dietary regimen. However, growth efficiency (10.0 vs 12.0%; P = .07) and heifer conception rate during the breeding season (75.0 vs 89.6%; P = .06) were improved by the SSCN regimen. These results indicate that beef heifers raised on a stair-step nutrition and feeding regimen during puberty had improved growth performance.

### Key Words:** Beef Heifers, Compensatory Growth, Growth Performance


Pregnancy and lactation have been shown to increase insulin resistance on a whole-body basis and in major insulin responsive tissues in many animal models. The time course of this phenomenon has not been studied in vivo in domestic ruminants throughout the reproduction-lactation cycle. The objective of the present study was to examine alterations in whole-body insulin resistance in vivo in the fat tailed sheep (Karakul breed) before mating (non pregnant, non lactating), and during mid pregnancy (d 50 with coitus [PC]), late pregnancy (d 125-135 PC) and early lactation (d 15-22 post parturition). The same multiparous ewes (n=8) were studied at each period. Blood samples were obtained periodically for approx. 2 h pre-injection, then a single injection of insulin was given (300 IU/kg body weight) and serial blood samples were taken via a jugular catheter for 3 h post-injection (time 0). The different plasma concentrations of insulin at time l in plasma insulin post injection (Δ glucose) was used as an index of whole-body insulin resistance. Δ glucose decreased between pre-mating (44.1 mg/dL) and mid pregnancy (38.6 mg/dL) and was further decreased (32.4 mg/dL) in late pregnancy (P<0.05). Δ glucose did not change between late pregnancy and early lactation. These data indicate that pregnancy associated insulin resistance increases progressively during lactation from mid to late pregnancy and early lactation in the fat tailed ewe. These data lay the groundwork for future studies aimed at understanding the regulation of insulin resistance and energy balance during these physiological states. The fat tailed sheep, in particular, provides a good model to study sequential physiological changes in adipose tissue metabolism and gene expression.

### Key Words:** Karakul Sheep, Insulin, Glucose

### Effect of zinc deficiency on thyroid hormone action in the rat. K. K. Guda*, H. C. Freake, and S. A. Zinn, University of Connecticut, Storrs.

Both zinc and thyroid hormone influence growth and development by poorly understood mechanisms. Since the thyroid hormone receptor is thought to be a zinc protein, we sought to determine whether effects of zinc deficiency were mediated in part by impaired thyroid hormone function. Four week old male Sprague-Dawley rats (n=45) were randomly assigned to treatment in a 3x3 factorial design with main effects of Zn status (Zn-deficient (Zn-D), pair-fed (PF) and control (CON) Zn-sufficient feed) and thyroid status (Hypo-, Eu- and Hyper-thyroid). Rats were made Zn-deficient by feeding a Zn-deficient diet (Dyets Inc. Bethle- hem, PA). Food intake of Zn-D rats was recorded daily and PF animals were given this amount of food the next day, corrected for metabolic body weight. Hypothyroidism was induced by inclusion of .025% methimazole in the drinking water and hyperthyroidism by daily injection with T3 (15 μg/100g BW 1.p). Rats averaged 107+3g BW at the start of the experiment and gained 43, 81 and 166g over the 25 days of the experiment in Zn-D, PF and CON groups respectively. Within a feed group, the hypo rats gained less weight (p<.05) than the eu and hyper-thyroid rats. Daily feed intake by the Zn-D group was 61% of the feed consumed by the CON group and within each feed group hypo rats had reduced feed intake (p<.05)feed intake and remained euthyroid-hyperthyroid rats. White adipose tissue weight was reduced (p<.05) as a percent of BW in hypo and Zn-D rats. Heart weight was increased (p<.05) in hyperthyroid rats, in all dietary groups. Serum Zn concentrations were 10.7, 32.8 and 30.9 μM in the Zn-D, PF and CON groups, respectively. S14 mRNA, a well-described sequence known to be responsive to thyroid hormone in liver, was measured in parallel tissue homogenates at time 0 and at the end of each treatment period. S14 expression was responsive to thyroid hormone status, this response did not differ between the three dietary groups. Thus, Zn deficiency and

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The influence of ageing and type of muscle on lysosomal proteinases degradation. F. Nicastro*, Università di Bari, Dipartimento di Produzione Animale, Bari, Italy.

Post-mortem storage or ageing of meat has long been regarded as essential to the production of tender meat. With the increasing consumer emphasis on quality rather than quantity, the importance of this process in meat production is greater than ever before. Activity of lysosomal proteases is an important factor contributing to post-mortem changes in muscle, including increased tenderness. The purpose of our contribution is to evaluate the role of one catheptic enzyme, cathepsin D, in post-mortem proteolysis in the longissimus thoracis (LT) and in the semimembranosus (SM) muscles from 24 lambs at 24h and 7 days ageing after the slaughter. A part from each muscle (20g) was minced and homogenized in 3 vol of the lysing buffer (50 mM sodium citrate buffer, 1mM EDTA and 0.2% Triton X-100 (vol/vol), pH adjusted to 5.0 with acetic acid). Haemoglobin was used as substrate at the 0.6 final concentration (m v/v). All samples and blank assayed in quadruplicate, were incubated at 45°C for 1h and the enzyme activity was defined as the increase in absorbance at 280 nm and 700 nm for hour at 45°C and R. Bickerstaffe, M. Ilian*, M. Ivan* and R. Bickerstaffe, Lincoln University, Canterbury, New Zealand.

The role of the muscle specific calpain p94 in intermuscular variation in tenderness in the sheep. M. Ivan* and P. J. Buttery, University of Nottingham, Nottingham, U.K.

Tenderisation of different muscles during postmortem storage at 4°C in an individual animal is variable. The biochemical basis underlying intermuscular variations in tenderness is not fully understood. The mechanism of meat tenderisation is under investigation by many labs worldwide. Proteolysis of key cytoskeletal proteins is responsible for improvement in meat tenderness during ageing. There has been considerable debate about the specific proteases responsible for meat tenderisation. Available evidence indicates that the majority of postmortem tenderisation is mediated by the calpains. However, calpains in skeletal muscle comprise the ubiquitous calpain I and calpain II active at μM and mM Ca2+ concentrations respectively and the muscle specific calpain p94. Current literature on the role of calpains in meat tenderisation applies to the ubiquitous calpains as it is these that are accessible for assaying enzyme activity. No research has been published on the role of p94 in meat tenderisation. The objective of our study was to further investigate the biochemical basis for intermuscular variation in tenderness by studying the role of p94 in this process using a molecular approach. An S1 nuclease protection assay was developed and validated to determine p94 mRNA levels in sheep skeletal muscle. Six lambs were used. Muscles studied were; Longissimus dorsi and Sememembranosus as type IIA and Psoas major and Semitendinosus as type IIB fibre type. Our results show that the relative rate of tenderisation is fibre type dependent. A possible determinant of meat tenderness is the muscle specific calpain p94 as shown by a strong correlation (r= 0.71, P≤0.05) between the relative rate of tenderisation and the p94 mRNA level across all muscles studied.

Key Words: Tenderness, Calpain p94, Fiber type

Immunochemical methods have been developed to test whether differences in calpains and calpastatin could underlie the variable shear force values (SF) encountered in commercially-produced pig carcases. Molecular recombinant technology was used to generate fusion proteins and specific antisera to porcine μ- and m-calpain large subunit and calpastatin for quantitative immunoblotting. Samples (5 g) were taken 2 h postmortem from the last rib region of 112 animals at a commercial abattoir and snap-frozen in liquid nitrogen. Chops from the same muscle were conditioned for 8 d at 2°C, at which point SF measurements were used to identify 12 tough (SF = 6.71 ± 28 kg, mean ± SEM) and 12 tender (SF = 3.87 ± 11 kg) carcases for analysis. Whole muscle homogenates or cytosolic extracts prepared from 2 h samples were subjected to 8% SDS-PAGE and immunoblotting. Extracts were screened using μ- and m-calpain and calpastatin antisera and homologues probed for calpastatin. Immunoactivity was visualized by enhanced chemiluminescence and quantified by densitometry. Characteristic 80 kDa μ- and m-calpain bands but no autolysed forms were detected, and their electrophotoreactive mobilities and intensities were the same in high and low SF groups. Both extracts and homogenates showed a dominant 135 kDa calpastatin band which had the same mobility in both groups, but whose intensity correlated positively with SF. The electrophotoreactive mobility data suggest that variable SF in porcine longissimus cannot be attributed to expression of different isoforms, autolysis, or splice variants of μ- and m-calpain and calpastatin. However, the intensity of the 135 kDa calpastatin band in 2 h samples correlates positively with SF, suggesting that the natural abundance of this factor could influence pork quality.

Key Words: Calpain, Calpastatin, Meat Quality

Changes in porcine skeletal muscle calpastatin expression induced by a single dose of a β2-agonist. T. Parr1, P. L. Sensky*,2, C. Warkup2, R. G. Bardsley1, and P. J. Buttery1, 1University of Nottingham, Nottingham, U.K., 2Meat and Livestock Commission, Milton Keynes, U.K.

The effects of short-term dietary administration of the β2-adrenergic agonist clenbuterol on the calpain proteinase inhibitor calpastatin in skeletal muscle was investigated in Large White-type pigs. Animals
were trained to eat their daily diet within a 1 h feeding period. Sixteen he before slaughter 6 control (C) pigs were given the standard diet whilst 5 received the same diet supplemented with .4 mg kg⁻¹ body weight clenbuterol (B). Samples of longissimus were taken within 10 min of slaughter and 10 minutes after vascular flush in liquid nitrogen. pH₄5 did not differ significantly between groups although all clenbuterol-treated animals exhibited signs of DFD on the basis of pH₄5 > 5.9. Calpastatin activity in extracts was significantly higher (P < .05) in the treated animals (C, 23.2 ± 1.3 (mean ± SEM); B, 29.0 ± 1.5 x 10² fluorescence units kg⁻¹). Extractable and whole muscle calpastatin protein levels were determined on western blots, using an anti-calpastatin antibody raised against a recombinant protein containing inhibitory domains 3 and 4. The extractable (C, .59 ± .91; B, 1.04 ± .12 Abs units μg⁻¹ protein) and whole muscle (C, 52.5 ± 8.75; B, 87.5 ± 20.8 Abs units mg⁻¹ tissue) calpastatin was higher in treated animals but this was only significant for the extractable calpastatin (P < .01). A cDNA probe complementary to a region encoding domains 3 and 4 was used to probe N-blots of 20 μg total RNA from the two groups. Multiple transcripts were detected but bands at 5.4 and 2.8 kb predominated. After reprobing the blots with an actin cDNA, the ratios of the 5.4 kb/actin (C, 2.27 ± 28; B, 4.09 ± .72) and the 2.8 kb/actin intensities (C, 1.24 ± .12; B, 2.15 ± .32) increased significantly in treated pigs (P < .05 for both bands). These results suggest a single dose of β₂-agonist is sufficient to induce calpastatin expression detectable at transcriptional level 16 h later.

Key Words: Calpastatin, Skeletal Muscle, beta-Agonist


Steers (n=355) of known genetic backgrounds from four fundamentally different genetic types were subjected to two production systems to study differences in carcass traits. Genetic types were large frame-mature, intermediate frame-intermediate maturing, intermediate frame-early maturing, and small frame-early maturing. Five calves from each genetic type were assigned to one of two production systems in each year of a 9-year study. Twenty-five steers were removed from the study because of accident or illness. System I included management on forage from weaning to slaughter at approximately 20 mo of age, while system II included management in the feedlot from weaning to slaughter at approximately 20 mo of age, because of accident or illness. System was a significant source of variation for SBW, HCW, CCW, MARB (P < .01), FAT, and YG. Data were pooled across years and analyzed by least-squares ANOVA with unequal subclass numbers. Included in the model were the dependent variables of carcass traits and the independent variables of year, genetic type, production system, 2- and 3-way interactions, and residual error. Within each production system steer age was included as a covariate. Year and genetic type were significant for all carcass traits. System was a significant source of variation for SBW (P<.10), but not for carcass traits. The genetic type x system interaction was significant for SBW, HCW, CCW, MARB (P<.05), FAT, and YG (P<.01), but was nonsignificant for DRESS, KPH, LMA, and YG. Carcass differences in measures of fatness were greater and more attainable in the feedlot based system which are important using current methods of evaluation. These data could aid producers in the match of beef genetic type to the production system most suitable for the efficient use of resources.

Key Words: Genetic Types, Production Systems, Carcass Traits

200 Effect of supplemental vitamin E in the diet of finishing steers on meat color stability after 1, 3, and 7 days postmortem. J. F. Calderon-Cortes*, F. Figueroa S. *, A. Plascencia J. *, N. F. Gonzalez M. *, H. Gonzalez R. *, and R. A. Zimm *, University of Baja California, Mexicali, B.C., Mexico, 1Centro de Investigacion en Alimentacion y Desarrollo, A.C., Hermosillo, Son., Mexico, 2University of California, El Centro, CA, USA.

Chilled *Longissimus dorsi* muscle samples (500 g) were taken 12 h after slaughter, polyurethane and plastic wrapped, maintained in marked-like refrigerated conditions (±4°C), and meat visual characteristics evaluated for 7 days. Muscle brightness (L*) and color indexes a* and b* were carried out in a Hunterlab D25M optical sensor, Restrom, Virginia, USA. There were no significant differences (P<.10) between the levels of vitamin E supplementation on meat brightness (L*) or on color indexes a* and b*. However there was a tendency, not due to vitamin E, on all treatments to show more brightness of the meat from three days postmortem than at one day after, which was probably due to postmortem muscle water liberation. There was a slight but significant increase in meat color index b* with 1.200 IU/d from day three postmortem. It is concluded that vitamin E at the levels studied here did not show any benefit on meat color stability postmortem.

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<th>Vitamin E supplementation on diet, IU/d.</th>
<th>Time postmortem, d</th>
<th>0</th>
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akMeans within columns with different letter are significantly different (P<.05).

Key Words: Finishing steers, Meat color stability, Vitamin E


To measure effects of diet on feedlot performance, carcass characteristics and beef appearance, one hundred forty-four crossbred beef steers (333 kg) were allotted within weight block (3) to a randomized complete block design with a 2 x 3 factorial arrangement of dietary treatments. Main effects were grain (barley or corn) and level of potato by-product (PB) (0, 10 or 20% of diet PM). Steers were fed diets containing 83% concentrate (grain plus PB), 10% supplement and 7% alfalfa on a DM basis for an average of 130d. Level of PB quadratically affected (P≤.10) DM intake and gain such that steers fed 10% PB ate more and gained faster. Corn-fed steers were more (P≤.05) efficient (5.8 vs. 6.3 kg DM/kg gain) and had more (P≤.05) kidney, pelvic and heart fat (2.2 vs. 2.0%) than barley-fed steers. A grain by PB interaction was detected (P≤.10) for marbling score where it was minimized in barley-fed steers (small 0) but maximized in corn diet (small 30) at 10% PB. Diet did not affect beef firmness or beef color score. Barley-fed beef had whiter fat (P≤.05) than corn-fed beef (2.6 vs. 2.9 on an F scale), however, fat luster score was not affected by diet. Overall, differences were small and probably not biologically important. These results indicate minimal effects of diet on beef appearance and carcass characteristics, meat composition and appearance.

Key Words: Growth performance, Carcass characteristics, Beef appearance
204 Effects of graded levels of potato by-product in barley and corn based feedlot diets. II. Palatability. J. R. Busboom1, M. L. Nelson1, L. E. Jeremiah3, S. K. Duckett1, J. D. Cronrath3, and L. Fahey1. 1Washington State University, Pullman, 2Agriculture and AgriFood Canada, Lacombe, AB, 3University of Idaho, Moscow.

Meat from cattle breeds that differ in muscularity and(or)express muscular hypertrophy (double muscling) may differ in muscle lipid composition. Hereford (normal muscling, H), Limousin (moderate muscling, L), and Blue Belgians (DB, double muscling) were crossed with the Hereford (H) to produce F1 calves. F1 calves were crossbred to crosses with different breeds to produce F2 progeny. F2 progeny were inter mated within sire breed to produce F2 calves that were weaned at 6 mo of age and placed on a growing diet until 341 kg for females and 386 kg for males. Calves were then fed a finishing diet for either 90 or 132 d and slaughtered. P cross sections were genotyped for the G-A transition mutation at the myostatin locus characteristic of P, and their genotypes were classified on the basis of having 0 (P0), 1 (P1), or 2 (P2) copies of the mutant allele (mH). One 2.5-cm cross section of longissimus (LD) from the 12-13 rib was sampled from H (n=12), L (n=12), P0 (n=19), P1 (n=13), and P2 (n=12). Visible intramuscular fat was separated from lean tissue. Fat was analyzed fresh, and lean was freeze-dried, finely ground, and homogenized. Both tissues were analyzed for cholesterol content and fatty acid composition by capillary column GLC. LD cholesterol (mg/100 g) was greater (P < .01) for P2 (67.1) than for P0, L, and H (58.5, 60.6, and 59.2, respectively) and intermediate for P1 (62.4). Fat tissue cholesterol was numerically highest for P2 (137.1 mg/100 g), but not different (P = .23) than the others (range 105.6-125.8). For LD fatty acids P2 had the lowest (P < .01) 16:0 (21.2%) and 18:1 (27.2%), whereas P2 had higher (P < .01) 18:0 (13.3%) than P0 or P1, but not H or L. P2 had the highest (P < .01) 18:2 (11.7%), 18:3 (7%), and 20:4 (5.6%). In fat, P2 had higher (P < .01) 18:0 (17.2%) and 18:2 (2.3%). P0–P2 had greater (P = .02) 18:3 than H or L. We conclude P2 contain greater LD cholesterol, and associated fatty acids reflect this change by containing greater proportions of unsaturated fatty acids.

Key Words: Cattle, Muscularity, Muscle Lipids

205 Deposition of energy and nutrients in the carcass during growth and meat quality of different cattle breeds. B. Enders*, H. J. Papstein*, G. Nuernberg1, M. Gabel2, and K. Enders*. 1University of Rostock, Agricultural Faculty, D-18051 Rostock, Germany, 2Research Institute for the Biology of Farm Animals, D-18196 Dummerstorf, Germany.

It was the objective of this study to determine the effects of selection on dynamic development of tissue and nutrients during the course of growth and on meat quality. For this purpose bulls from the following breeds were selected: German Angus (GA), Galloway (Ga), German Holstein (GH), and White–blue Belguim (WBB) with muscular hypertrophy. The recording of the substantial components of the value of the carcass was carried out during the growth period from birth to the age of 24 months, using the method of serial slaughters of different age groups which was then followed by an analysis of the carcass. In order to indicate the dynamic development of tissue and nutrients during the course of growth, a time—dependent growth function was applied. White–blue Belgians show very high protein contents and very low fat contents. The content of protein is not high enough to attain an energy content in total that is comparable to the other breeds. The edible part of the carcass of these bulls contains almost 50% less energy. The ratio of protein to water in the edible parts of the carcass (weight of meat and fat), calculated at a standard live weight of 600 kg, is 1:0.2 with WBB and 1:1.2 with Ga and therefore shows a wider range than with GA (1:1.2) and GH (1:1.1). Selection did not have an impact on the ratio of protein to water which is 1:3.4–3.7. This ratio remained constant during growth. However, the ratio of fat to water varies strongly, depending on the direction of selection and the animals’ weight. Selection did have an impact on the size of the rib-eye area and the intramuscular content of fat. WBB showed the palest meat. The intramuscular content of fat increased with age, the M. longissimus being the muscle with the highest fat content. The meat quality is causally related to the different chemical components of the carcass due to selection; it also depends on a multitude of other features, however.

Key Words: Growth, Meat Quality, Cattle
206 Effects of antioxidant and antimicrobial addition to ground beef and lamb on microbial growth, lipid oxidation and color. S. L. Cuvala, S. K. Duckett, G. T. Pritchard, and J. G. Andrae, University of Idaho, Moscow.

The objective of this study was to determine the effect of adding an antioxidant and/or antimicrobial to ground beef (GB) and ground lamb (GL) on microbial growth, lipid oxidation, and color over four d of storage at 4°C. Replicate samples of freshly ground lamb and beef were divided into four, 400 g batches. The four batches were treated with nothing (CON), ascorbic acid (AA; 0.05% v/w), chlorotetracycline (CTC; 0.001% v/w), or a combination of AA and CTC (COMB). Ground samples were placed on styrofoam trays, over-wrapped with oxygen permeable film, and stored under fluorescent lights at 4°C for 4 d. Total aerobic plate counts (APC), lipid oxidation (TBARS), pH, and discoloration were determined on all samples at 0, 1, 2, and 4 d. Data were analyzed by the repeated measure analysis of the General Linear Model of SAS with ground meat type, antimicrobial, antioxidant, and time as main effects with all interactions tested. Ground meat type and AA did not alter (P > .05) APC. Aerobic plate counts were lower (P < .05) at d 4 for CTC treated ground meat. In GL, AA treatment did not influence (P > .05) TBARS. In GB, however, AA treatment reduced (P < .05) TBARS at 0, 1, 2, and 4 d. Meat pH values were higher (P < .05) in GL than GB. Antioxidant or CTC treatment did not alter (P > .05) pH values over time. Discoloration scores were higher (P < .05) for CON and CTC than AA and COMB at 1, 2, and 4 d; however, GB values were higher (P < .05) than GL for CON and CTC. At d 0, 1, and 2, discoloration scores were similar (P > .05) for AA and COMB in both GB and GL. At d 4, GB had higher (P < .05) discoloration scores than GL for AA treatment but were similar (P > .05) for the COMB treatment. Scores for AA in both GB and GL were higher (P < .05) than COMB. As expected, CTC addition to ground meat reduced APC and AA addition reduced discoloration scores and lipid oxidation. However, the effect of AA treatment on lipid oxidation was only observed in ground beef. The combination of CTC and AA resulted in lower discoloration scores than AA at d 4 or CTC at d 1, 2, and 4. Overall, AA treatment alone maintained color in the ground meat samples for 4 d of refrigerated storage but APC exceeded spoilage levels (> 107) unless CTC was also included.

Key Words: Beef, Lamb, Bacteria

207 Effect of chilling on fresh pork quality. S. Ohene-Adeji1, M. Ellis, F. K. McKeith, and J. E. Cannon, 1University of Illinois at Urbana-Champaign, 2Dekalb Swine Breeders Inc.

A study was conducted to characterize the effect of chilling rate on fresh pork quality. A 2x3x3 factorial design (two chilling conditions, three genotypes and three sites within the muscle) was utilized. Pigs (Durocs, n=24), between 90-120kg, were genotyped for the halothane gene and allocated to three classifications: normal (n=7), carriers (n=10) and reactors (n=7). The pigs were slaughtered on four separate days after resting overnight. Intact sides were randomly allocated to accelerated (AC: -30°C for 150 min then 4°C for 22-23hr) or conventional (CC: 4°C for 24 hr) chill conditions. Muscle samples were obtained from inner (I), mid (M) and outer (O) sites of the Semimembranosus (SM) and the Biceps femoris (BF). The Longissimus (LD) and the Glatues medius (GM) were also evaluated. Color (L* a* and b*) was evaluated using a Hunter colorimeter at 24hrs postmortem. Drip loss and ultimate pH were evaluated 48hr postmortem. AC resulted in a reduced L* for the LD muscle and the SM. In addition, the a* was increased in the LD and GM and AC reduced drip loss in the GM. Genotype had no consistent effect on fresh pork quality attributes. Site within muscles had variable effects on quality. The inner portion of the SM had the highest L*, however, in the BF the outer section had the highest L* and the mid portion had the lowest L* and the highest drip loss. Results from this study suggest that AC can have some positive effects on the quality attributes of the loin but its effects were limited in the hams. Halothane status had no consistent effect on quality, however, site within the muscle had variable on quality attributes.

Key Words: Chilling, Pork, Quality

208 Influence of two dietary fat sources and energy levels on lipogenic activity in tissues of pigs. G. Bee1 and C. Wenk2, 1Swiss Federal Research Station for Animal Production, Postfach, Switzerland, 2Institute of Animal Science ETH-Zurich, Switzerland.

Fat deposition rate and fatty acid profiles are affected by factors such as dietary energy levels and fat sources. The aim of the study was to determine the relationship between high and low digestible energy levels (9.4 vs. 7.1 M DEl/kg) and soybean oil vs. M palm oil on (5%) on lipogenic activities and fatty acid profile of the subcutaneous adipose tissue and liver in finishing pigs. 20 Large White pigs were allocated into four dietary groups and fed the diets ad libitum from 30 kg up to slaughter at 106 kg live weight. The lipid content and fatty acid composition of the tissues were determined and glucose-6-phosphate dehydrogenase (G6PDH), the muscle enzyme (ME) and fatty acid synthase (FAS) activity were measured. Lipid deposition rate of animals fed the low energy diets was lowered regardless of fat supplementation. Unlike lipid deposition, fatty acid profile was influenced by both dietary factors. Pigs fed the low energy diet supplemented with soybean oil exhibited the lowest level of saturated (P<.001), monounsaturated (P<.001) and the highest level of polyenic fatty acids in the adipose tissue. The opposite occurred for the pigs fed the high energy diet supplemented with beef tallow. The fatty acid profile of the adipose tissue of animals fed the other two diets were intermediate. Independent of treatments, lipogenic activities were up to 10 times higher in the adipose tissue than in the liver. In the latter, G6PDH activity was higher (P<.05) due to high energy diet, whereas the activity of ME and FAS were not affected. Animals fed the high energy diet either supplemented with tallow or soybean oil exhibited higher ME activity (P<.04) in the backfat, without any effect on G6PDH activity. In contrast, dietary fat sources affected the FAS activity, with lower activity (P<.04) exhibited in the backfat of animals fed the soybean oil diets. The results suggest that FAS activity is downregulated by the high level of dietary polyenic acids from soybean oil, whereas ME activity by the low energy supply.

Key Words: pig, adipose tissue, lipogenesis

209 Interaction of halothane and Rendement Napole genotypes on carcass and meat quality characteristics of pigs. D. N. Hamilton*, K. D. Miller, D. F. Parrett, F. K. McKeith, and M. Ellis, University of Illinois, Urbana, IL/USA.

The objective of this study was to determine the effects of halothane and Rendement Napole (RN) genotypes on carcass and meat quality characteristics in pigs. Halothane and RN carrier (Nn/Rn−) Hampshire boars were mated to dams that were homozygous for the normal allele of both genes (NN/rn+n+). Progeny were classified into four genotypes 1. (NN/rn+n+) (n=31), 2. (Nn/rn+n+) (n=27), 3. (NN/rn+n−) (n=80), and 4. (Nn/rn−n−) (n=24). A DNA test was used to determine halothane genotype and longissimus glycolytic potential was used to predict the RN genotype. Halothane carriers (Nn−/n−) in comparison to halothane normal (NN−/n−) animals tended to have shorter carcasses (81.8 vs 82.7, SE=.61 mm, P=.06) greater loin eye area (44.6 vs 42.6; SE=1.21 cm2, P=.07), and showed a reduced ultimate pH (5.32 vs 5.45, SE=.076, P<.05) and lower subjective longissimus firmness scores (1.97 vs 2.32, SE=1.39, P<.05). Carriers of the detrimental RN allele (n+/rn+n−) in comparison to homozygous normal animals (n+/rn+n+) had lower longissimus ultimate pH (5.26 vs 5.51, SE=.042, P<.05) and higher cooking loss (26.26 vs 23.99, SE=.767, P<.05). The interaction between halothane and RN genotype was significant for a number of meat quality traits. Animals that were carriers for both genes (genotype 4) had the poorer values for subjective color score (2.60 vs.1.88 vs 1.85 vs 1.95, SE=1.80, P<.05, for genotypes 1, 2, 3, and 4, resp.), Minolta L* (47.76 vs 52.76 vs 53.6 vs 55.2, resp., SE=1.47, P<.05), and drip loss (3.44 vs 5.84 vs 6.77 vs 7.28, resp., SE=0.96, P<.05) suggesting paler meat with a lower water holding capacity for this genotype compared to the other 3. Marbling scores were higher for genotype 1 (2.11 vs 1.44 vs 1.53 vs 1.55, SE=1.52, P<.05) and shear force was highest for genotype 2 (3.83 vs 4.41 vs 3.79 vs 3.70, resp., SE=1.72, P<.05). This study shows that the detrimental alleles of both genes result in a reduction in fresh-meat quality, particularly in terms of color and water-holding capacity and that in combination the two detrimental alleles produced the palest meat with the highest drip loss of any of the genotypes evaluated.

Key Words: Rendement Napole, Halothane, Meat quality
210 Effect of genotype on carcass composition and meat quality characteristics. B. F. Wolter1, M. Ellis1, F. K. McKeith1, and M. Culbertson2, 1University of Illinois, 2Cotswold USA.

Thirty pigs from each of five great grandparent lines of pigs (N=150) were evaluated for carcass composition and meat quality characteristics. Lines evaluated included: Landrace (L), Maternal Large White (MLW), Terminal Large White (TLW), Duroc (D), and Pietrain (P). Slaughter took place on 5 occasions with six animals from each line, selected on the basis of mean BW and mean slaughter weights for them. Assays of carcass composition were performed in the model. Warner-Bratzler shear force values for rib chops aged 10 days, X and H; in contrast, CR group for all measurements. In TB muscle, it didn't founded differences between groups for WBSF, C and H; in contrast, CR group had a higher value of L (56.28 ± 7.55, P < 0.05) and a higher pH final (5.79 ± 0.14). Differences between muscles could be raised on different metabolic activities.

Palatability of loin chops from lambs fed concentrate or grazed on ryegrass to traditional or heavy weights. R. J. Barton*, K. E. McClure, and D. M. Wulf, The Ohio State University / OARDC.

Key Words: Meat Quality, Carcass Traits, Pigs

211 Sensory evaluation of loin chops from lambs fed concentrate or grazed on ryegrass to traditional or heavy weights. R. J. Barton*, K. E. McClure, and D. M. Wulf, The Ohio State University / OARDC.

Lambs (n = 30) were sired by either Suffolk Dorper or Suffolk rams and gestated by Columbia mature ewes. Fatty acid and cholesterol content of subcutaneous (SQ) and intramuscular (IM) lipid were determined by GLC. Fatty acid and cholesterol data were analyzed using the GLM procedure of SAS with breed and tissue as main effects with the two-way interaction tested. Warner-Bratzler shear force data was analyzed as above with only breed in the model. Warner-Bratzler shear force values for rib chops aged 10 days, X and H; in contrast, CR group for all measurements. In TB muscle, it didn't founded differences between groups for WBSF, C and H; in contrast, CR group had a higher value of L (56.28 ± 7.55, P < 0.05) and a higher pH final (5.79 ± 0.14). Differences between muscles could be raised on different metabolic activities.

212 Effects of Dorper genetics on tenderness, fatty acid and cholesterol content of lamb. S. K. Duckett*, S. L. Cuvila1, and G. D. Snowden1, 1University of Idaho, Moscow, 2U.S. Sheep Experiment Station, Dubois.

The objective of this study was to assess the effects of Dorper (D) genetics in comparison to Suffolk (S) on the longissimus muscle tenderness, fatty acid and cholesterol content. Lambs (n = 30) were sired by either Suffolk Dorper or Suffolk rams and gestated by Columbia mature ewes. Fatty acid and cholesterol content of subcutaneous (SQ) and intramuscular (IM) lipid were determined by GLC. Fatty acid and cholesterol data were analyzed using the GLM procedure of SAS with breed and tissue as main effects with the two-way interaction tested. Warner-Bratzler shear force data was analyzed as above with only breed in the model. Warner-Bratzler shear force values for rib chops aged 10 days, X and H; in contrast, CR group for all measurements. In TB muscle, it didn't founded differences between groups for WBSF, C and H; in contrast, CR group had a higher value of L (56.28 ± 7.55, P < 0.05) and a higher pH final (5.79 ± 0.14). Differences between muscles could be raised on different metabolic activities.

Key Words: Lamb, Tenderness, Fatty acids

213 Effects of rearing system on meat quality in young kids. A. Argüello*, A. Marichal1, R. Ginás1, J. Capote2, J. M. Afonso1, and J. L. Lópezm, 1Animal Production Unit, Las Palmas de Gran Canaria University, Arucas, Las Palmas, Spain, 2Animal Production Unit, Pastures and Forage, ICIA, Tenerife, Spain.

The objective of our study was to examine the effects of rearing system, nursed from their dams (ND) and fed a commercial milk replacer (CR), on meat quality in young kids. Thirty male and twin kids were allotted in two rearing systems (R1 and R2) and a commercial milk replacer (CR). All the kids were slaughtered at a live weight of ten kg. After slaughter, pH was measured on Longissimus dorsi (LD), Semimembranosus (SM) and Triceps brachii (TB). Twenty-four hours later (the carcasses were chilled at 4C), pH, Warner-Bratzler shear force (WBSF), Color (Lightness, L, Croma, C, Hue, H), Water holding capacity (WHC) of LD, SM and TB muscles were measured. In LD muscle it didn’t founded differences between ND and CR group for all measurements. In TB muscle, it didn’t founded differences between CR and R1 group for all measurements. In TB muscle, it didn’t founded differences between groups for WBSF, C and H; in contrast, CR group had a higher value of L (56.28±2.65 vs 50.77±5.13, P<0.05), smaller WHC (6.5±1.04 vs 4.97±3.12, %, P<0.05) and pH 24 hours postmortem (5.73±0.07 vs 5.84±1.10, %, P<0.05). In LD muscle only, it didn’t founded differences for C value (16.84±4.78 vs 17.95±7.55, P<0.05, in CR and ND respectively). Feeding a commercial milk replacer has small effects in kids’ meat quality, almost exclusively in TB muscle. Standard ANOVA procedures were used to analyze the differences between muscles; TB muscle was more firm (8.59±1.53 kg, P<0.05), had less WHC (7.96±2.72 %, P<0.05) and a higher pH final (5.79±1.11, P<0.05). Differences between muscles could be raised on different metabolic activities.

Key Words: Kid, Rearing System, Meat Quality


Enterohemorrhagic E. coli O157:H7 is a major concern of the food industry and the general public. Cattle have been implicated as the primary reservoir for this pathogen. It is of interest to study the characteristics of this microorganism's survival in the environment. Our
goal was to establish the survival of *E. coli* O157:H7 in soil. A soil sample was divided into groups to test survival at 4°C, 25°C, and 37°C. A nalidixic acid resistant strain of *E. coli* O157:H7 932 was inoculated to each sample. Samples of soil were taken over time, serially diluted, and plated to sorbitol MacConkey (SMAC) plates with nalidixic acid (50 µg/mL). Plate counts were made and the population of *E. coli* O157:H7 was enumerated. Random colorless colonies were verified to have the O157 lipopolysaccharide antigen by latex agglutination. When *E. coli* O157:H7 was not detected by standard plating, an enrichment of one gram of soil in 100mL of trypticase soy broth (50 µg/mL nalidixic acid) was incubated at 37°C and shaken at 150 rpm on an orbital shaker. At 37°C, *E. coli* O157:H7 was not detectable after three days by standard plating. The soil and subsequent plating on SMAC plates with nalidixic acid produced *E. coli* O157:H7 colonies through day fourteen. By day fourteen, *E. coli* O157:H7 was not detectable in the 25°C system by standard plating. Enrichment of the soil sample and subsequent plating on SMAC plates produced *E. coli* O157:H7 colonies through day 42. At day 56, *E. coli* O157:H7 was detected in the soil sample incubated at 4°C by standard plating. According to these results, *E. coli* O157:H7 is able to survive long periods of time in soil. Moisture content of the soil may be a factor that affects this characteristic. The survival of this organism in soil may be a route by which cattle-to-cattle transmission occurs.

**Key Words:** *E. coli* O157:H7, Shiga like toxin, Microbial Ecology

### 215 Contribution of the lean meat consumption to meet the nutrient requirement in Switzerland, M. Leonhardt and C. Wenk*, Swiss Federal Institute of Technology Zurich - Institute of Animal Sciences, Switzerland.

In the present study, the contribution of average lean meat consumption in Switzerland in 1997 to meet the requirements for selected vitamins and trace elements (thiamin, riboflavin, alpha-tocopherol, iron and zinc) was calculated. For that purpose, the nutrient content of the following meat cuts was examined: pork (chop and shoulder), beef (prime rib and shoulder), veal (chop) and chicken (breast and thigh). Pork was the best tasting source and there was no significant difference in thiamin content of longissimus dorsi and shoulder muscles. In contrast, the riboflavin content significantly differed between the muscles within species (pork and chicken) examined. With the average lean meat consumption (102 g/day), the recommendation given by the National Research Council (RDA, 1989) for daily thiamin intake was met to 29% (men) and 40% (women). Recommendation for daily riboflavin intake was met to 12% (men) and 15% (women) and for daily vitamin E intake to 4% (men) and 5% (women). Beef and pork shoulder were the best sources of iron, heme iron and zinc. With an average daily pork consumption, recommendations for daily iron intake were met to 11% (men) and 7% (women) and for zinc intake to 25% (men) and 32% (women). The requirement for absorption was met to 80% and 72.6% for men and women, respectively, and daily requirement for absorbed zinc was covered to 32-56%. In addition, the efficacy of the same vitamin E supplementation (200 mg alpha-tocopherol acetate/kg) to pig and laying hen diets, in order to increase the alpha-tocopherol contents of the respective animal products, was studied. Alpha-tocopherol accumulation differed according to the following ranking: egg yolk > liver > adipose tissue > longissimus dorsi muscle. Results showed that pork from animals fed a vitamin E enriched diet is not an important supplier of vitamin E. On the contrary, egg yolk became a good source of vitamin E for human nutrition by dietary modification.

**Key Words:** Lean meat, Nutrient requirement

### 216 Determination of chemical compounds responsible for boar taint. J. L. Xue*, J. Wang, Z. Vickers, and G. Reineccius, University of Minnesota, St. Paul, MN.

Two compounds, androstenone and skatole, are considered primarily responsible for boar taint. Previous studies indicated that other compounds are also involved in boar taint. The objective of this study was to determine the compounds for boar taint. Fat tissues were obtained from 30 entire male pigs at the shoulder area in a slaughterhouse. All pigs were from the same farm with the same genetic background. Mean carcass weight was 85.6 ± 8.7 (SD) kg. A frozen sample (2 g) in a Petri dish was heated in microwave oven for 40 sec. Then 10 sensory judges were asked to smell the fat, rate the overall intensity of taint using 9-point scores from 0 to 8 (8 = strongest taint), and indicate taint due to androstenone, skatole, or other. The sensory test was duplicated for all samples. Data was analyzed using GLM and CORR in SAS. Independent variables included sample, judge, duplication, and interactions. Four tainted samples were selected for gas chromatography (GC) and mass spectrometer (MS) assay of taint compounds. One gram of fat was used for extraction of taint compounds. One of the judges in sensory test conducted the sniffing in GC. Approximately 1 µL of the concentrated extracts was injected to the GC-MS system. No linear relationship was detected between carcass weight and taint intensity (r = 0.27, P > .1). Regression analysis detected interactions of androstenone-skatole-other (P < .05), androstenone-skatole (P < .05), androstenone-other (P < .05) on taint intensity. Three androstenone-like odors were detected. The compounds for the second and third peaks were determined as androstenone and androstenone, respectively. We failed to identify the chemical for the first peak. Concentrations of androstenone, androstene, and the unknown compound were 3.07 ± 1.27, 2.02 ± 0.79, 1.97 ± 0.74 (µg/g fat), respectively. Our study suggests that boar taint detected by sensory panel was a mixed result of androstenone, androstenone, skatole, and the unknown compound, which was likely a steroid.

**Key Words:** Boar Taint


The objective of this study was to determine the impact of myosin heavy chain (MHC) isoforms (I, IIB and IIA) on pork quality and meat quality traits. Gilts (n = 32) were randomly assigned to a 2 × 2 factorial of genotype and slaughter weight (120 and 135 kg). European Large White-Landrace (G1) pigs were used to represent the upper 5th percentile for percent lean in the U.S. and a commercial terminal-cross line (G2) was used to represent average U.S. pigs for percent lean. Each genotype × slaughter weight group consisted of 6 halothane-negative (NN) and 2 halothane-carrier (Nn) pigs. Muscle samples were subjected to an ELISA assay for determining MHC content. No significant differences in fiber type composition (MHC) were observed for any genotype × halothane group. Regression analyses were conducted for quality traits of both NN and Nn gilts. Main effects were type I (I), type IIB (IIB), type IIA (IIA), I/B, I/A, B/A, genotype and slaughter weight. Least significant effects were individually deleted from the model. Only I/B accounted for variation in drip loss of NN gilts (I/B: P < .05; r² = .18), while only genotype was significant for drip loss of Nn gilts (genotype: P < .01; r² = .70). B/A and A accounted for variation in loin eye area of NN gilts (B/A: P < .05; A: P = .10; r² = .18), while A, I/B and B/A were significant for Nn gilts (A: P < .05; I/B: P < .05; B/A: P < .05; r² = .53). Only I explained variation in 24-h pH of NN gilts (I: P = .11; r² = .09), while I/B, I/A and B/A were significant for Nn gilts (I/B: P < .01; I/A: P < .01; B/A: P < .01; r² = .97). In conclusion, fiber type composition accounts for a larger proportion of variation in the quality traits of NN compared to Nn gilts. Thus, fiber type composition appears to have a greater impact on the quality of halothane carrier compared to halothane negative gilts.

**Key Words:** Pigs, Myosin Heavy Chain, Pork Quality


Gilts (n = 78; 25 kg) were fed one of four corn-based diets (high oil corn (HOC), Optimum® high oleic high oil corn (HOHOC), conventional corn (CONV) and conventional corn supplemented with white grease (CWG)) ad libitum to 115 kg. Each diet was supplemented with either 1 % CLA oil (CLA) or 1 % sunflower oil (SFO) from 90 to 115 kg. CLA oil contains 60 % CLA isomers. At 24-h postmortem, color evaluation of loins was performed both subjectively (1 = pale, pinkish gray; 5 = dark, purplish red) and objectively (Hunt L*, a*, b*). Loin samples were selected for TBA assay to determine their level of oxidation. Lettuce and right side loin samples were vacuum packaged and assigned to frozen storage duration of either 14 or 35 days. Loin sections thawed for 36-h at 2°C and were sliced into five 2 cm chops.
The three internal chops were assigned to a 1, 3 or 5 day shelf-life duration and reevaluated for color and sampled for TBAR analysis after the assigned duration. At 24 h postmortem, color evaluations of the loins were significantly affected by corn (HOC: 2.29; HOHOC: 2.33; CONV: 2.51; CWG: 2.28 ± 0.06, P < 0.05) and CLA (CLA (CLA: 2.44; SFO: 2.27 ± 0.04, P < 0.01), but these effects were not detected by Hunter L*, a* or b* values. At day 5, corn had a significant effect on a* values (HOC: 10.12; HOHOC: 10.69; CONV: 9.56; CWG: 10.28 ± 0.26, P < 0.05). Corn type or CLA were not significant for any of the color measurements. At day 5 of shelf-life, loins frozen for 14-d received significantly higher color evaluations (2.45 vs 2.34 ± 0.03, P < 0.01), lower L* values (59.8 vs 61.2 ± 3, P < 0.01), higher a* values (10.9 vs 9.1 ± 0.2, P < 0.01) and lower b* values (16.8 vs 17.6 ± 1, P < 0.01) than loins frozen for 35-d. In conclusion, corn type or CLA have minimal effects on the color characteristics of frozen and displayed loin chops. Longer duration of frozen storage has detrimental effects on loin chop color.

Key Words: High Oil Corn, Shelf Life, Color


The objective of this research was to evaluate the effect of refrigerated and frozen storage conditions on the quality of cured cooked hams as to recommend the best freezing and thawing conditions for these products. Quality and shelf life of fresh and processed meat are both affected by the rate of chilling. Quality characteristics such as water-holding capacity, purge loss and microbial load can be affected by chilling and (or) thawing rates. Hams (n=242) were assigned to one of seven treatment groups. Treatments included a control (−1°C) as well as two freeze groups in combination with three procedures. Freeze groups were either a fast (−34°C) or slow (−18°C). Frozen hams were then divided into one of three thaw treatments, single stage (3°C), dual stage (−8°C; −2°C) or a triple stage thaw (−12°C; −6°C; 3°C). Purge, cooking loss, lean color stability, bacteria levels, salt percentage, proximate analysis and presence of pale soft exudative pork (PSE) lean were assessed for each ham of three thaw treatments, single stage (3°C), dual stage (−8°C; −2°C) or a triple stage thaw (−12°C; −6°C; 3°C). Purge, cooking loss, lean color stability, bacteria levels, salt percentage, proximate analysis and presence of pale soft exudative pork (PSE) lean were assessed for each ham. Data were analyzed using analysis of variance. Differences in cooking and thawed hams respectively. Freezing or thawing showed no effect on the least purge loss. Moisture loss during cooking was the lowest for the least purge loss. Moisture loss during cooking was the lowest for the thawed hams and displayed loin chops. Longer duration of frozen storage has detrimental effects on loin chop color.

Key Words: Freezing, Thawing, Purge

220 Pre- and post-harvest tenderization of callipyge lamb. S. K. Dutchett1, J. G. Andre2, G. T. Pritchard1, S. L. Cuvala1, K. Watson1, P. S. Kuber2, and G. D. Snowder3, 1University of Idaho, Moscow, 2Washington State University, Pullman, 3U. S. Sheep Experiment Station, Dubois.

Twenty callipyge lambs (54 kg) were used to assess the effect of pre-harvest calcium propionate administration and/or post-harvest freezing before aging on tenderness. The lambs were randomly assigned to one of the following treatments: controls (C; n = 10) and calcium gel administered (GEL; n = 10). At about three h prior to slaughter, the GEL lambs were drenched orally with 250 mL of a calcium propionate-propylene glycol gel that contained 25 g of calcium, 105 g propionate, and 100 g propylene glycol. At 24 h postmortem, carcass data were collected and chops (2.5 cm thick) were removed from both longissimus muscles. The chops from the left side were vacuum packaged and aged at 4°C for 1, 3, 7, 14, and 28 d (FRESH). The chops from the right side were vacuum packed, frozen at −20°C for 14 d, thawed and then aged for 1, 3, 7, 14, and 28 d (FROZEN). Data were analyzed using the repeated measures analysis of General Linear Model Procedure of SAS with calcium treatment, pre- and post-harvest aging, and all interactions tested. Serum total, ionized and normalized calcium levels taken at slaughter were higher (P < 0.05) for GEL than C by 22, 18 and 24%, respectively. However, Warner-Bratzler shear force values did not differ (P > 0.05) between C and GEL treatment. The two- and three-way interactions for calcium treatment with freezing treatment and/or age were non-significant (P > 0.05). The interaction between freezing treatment and postmortem age was significant (P < 0.05). Warner-Bratzler shear force values for FROZEN were lower (P < 0.05) than FRESH by 1.3 to 2.2 kg at 3, 7, 14, and 28 d of aging. Postmortem aging rate was faster (P < 0.01) at −287 vs −1.146 kg/d for FROZEN (d 1 - 14) than FRESH (d 1 - 28). Pre-harvest tenderization of callipyge was unsuccessful; however, freezing prior to aging accelerated the rate of aging and reduced shear force values to acceptable levels.

Key Words: Lamb, Callipyge, Tenderness

221 Color and tenderness of case-ready Chevon cuts as influenced by storage time. G. Kannan*, B. Kouakou, S. Gelaye, and T. H. Terrill, Agricultural Research Station, Fort Valley State University, Fort Valley, GA.

Goat meat (chevon) is currently sold either as bone-in cubed meat or as whole carcases, primarily to consumers of ethnic origin and to individuals who prefer lean red meat. The objective of this study was to evaluate the effects of storage time on color stability and tenderness of chevon fabricated into case-ready cuts. Eight-month-old Spanish does were slaughtered and the carcasses chilled for 24 h at 4°C. Carcasses were then fabricated according to a proposed MAPS barbeque style (Olson et al., 1999). Leg, shoulder, rib, and loin primal cuts were trimmed and sliced into 2.5 cm-thick steaks/chops using a band saw. The cuts were placed on styrofoam trays and wrapped with polyvinyl-chloride film. These case-ready leg and shoulder steaks and loin/rib chops were stored at 2°C for either 0, 4, 8, or 12 d. Ultimate pH and myoglobin were analyzed in the different cuts 24 h after slaughter. Percent myoglobin (MetMb), CIE Lab color coordinate values, shear values and cooking loss were measured on stored cuts. Myoglobin content and pH were not significantly different among the different cuts, although mean pH in the shoulder was high (6.3). Percent MetMb increased (P < 0.01) with storage time in all of the cuts, but the pattern of increase was not different among the different cuts. Type of cut had a significant effect (P < 0.05) on L* (lightness), a* (redness), and hue values. Shoulder cuts had the lowest L* and hue values and the highest a* values. Time had a significant effect (P < 0.01) on a* and hue values, with redness decreasing and hue angle increasing as storage time increased. Warner-Bratzler shear force values were higher (P < 0.01) for Semimembranosus muscle (leg steak) than Triceps brachii (shoulder steak) or Longissimus (rib chop) muscles, and the values for each cut did not decrease markedly over the time periods tested. Cooking loss was influenced by type of cut (P < 0.01), with losses being highest in leg, lowest in rib, and intermediate in shoulder. Cooking loss was also influenced by storage time (P < 0.05) and was higher on day 0 than other storage periods. Results indicated that different case-ready chevon cuts underwent the same amount of discoloration over time and that storage time did not markedly affect tenderness.

Key Words: Chevon, Storage time, Color

222 Effect of supplemental dietary vitamin E on the color and case-life of top loin steaks and ground chuck patties in map case-ready retail packaging systems. R. L. Stubbs1, P. K. Bates1, J. B. Morgan1, H. C. Dobele1, F. K. Rav3, and S. E. Williams2, 1Oklahoma State University, 2Roche Vitamins Inc.

Ground chuck and top loin steaks from cattle supplemented with either 0 (CON) or 500 IU (VITE) IU/head/day of α-tocopheryl acetate were packaged in a modified atmosphere case-ready beef packaging system (MAP). Random samples were taken from the strip loins and bulk ground chuck of each treatment at fabrication in order to determine the α-tocopherol concentrations in the product. Cuts were stored at 4°C ± 1°C for 0, 2, 4, 8, 10, 12, or 14 d. Following storage, products were displayed in a retail case at 2°C ± 1°C for 8 d. Twice daily, objective and subjective measures of display color properties were obtained. Lipid oxidation (TBARS) was measured on display 0, 4, and 8 for each supplementation by storage group combination. Analysis of retail samples revealed higher (P<0.01) concentration of tocopherol in VITE when compared to CON products for both top loin steaks and ground chuck patties. Lipid oxidation was significantly (P<0.01) reduced during both storage and display with VITE supplementation. CON products displayed increased

Ground chuck and top loin steaks from cattle supplemented with either 0 (CON) or 500 IU/head/day of α-tocopheryl acetate (VITE) were utilized for case-ready beef packaging systems. Random samples were taken from each sub-primal at fabrication in order to determine the α-tocopherol concentrations in the products. Cuts were stored at 4°C ± 1°C for 2, 4, 6, 8, 10, 12, and 14 d for ground chuck samples and additionally for 16, 18, 20, and 22 d for top loin samples. After storage, products were displayed in a retail case at 2 to 6°C for 8 d. Twice daily, objective and subjective measures of display color properties were obtained. Lipid oxidation (TBARS) was measured on display day 4 and 8 for each supplementation by storage group combination. A higher (P<0.03) concentration of α-tocopherol existed in VITE than in CON products for both case-ready package types. Lipid oxidation was markedly reduced (P<0.01) across the display period for both VITE top loin steaks and ground chuck patties compared to controls. Storage did not affect lipid oxidation of steaks from either TRT group, however, VITE reduced (P<0.05) lipid oxidation during the storage of ground chuck patties. CON steaks responded better (P<0.05) than VITE steaks during a 2 h bloom period after being stored more than 6 d as indicated by higher a* values. VITE steaks were shown to retain red color more consistently throughout the display period for most storage days. VITE increased (P<0.05) color retention when displayed 3 d or more. Fat color of top loin steaks was unaffected by supplementation. Maximum display life increased with VITE by approximately 3 and 1.3 d for top loin steaks and ground chuck patties, respectively. This study suggests that vitamin E would be very useful in overcoming the oxidative problems associated with case-ready retail beef systems by providing extended periods of storage and display.

224 Comparison of vitamin E and natural antioxidants on the lean color and retail case-life of ground beef. A. E. Down, K. C. Childs*, D. N. Vargas, D. S. Webb, J. B. Morgan, and H. G. Dolezal, Oklahoma State University, Stillwater, OK.

Beef trimmings from cattle supplemented with either 0 or 500 IU/head/day of α-tocopheryl acetate were obtained and divided into the following treatments: control (CON), vitamin E (VITE), DuraloX™ (DURA), a rosemary based natural antioxidant product, and Herbalox™ (HERB), a natural antioxidant product consisting of rosemary and citric acid. Natural antioxidant products DURA and HERB were added to non supplemented beef trimmings at 0.25% and 0.20% of meat weight, respectively. Products were packaged using oxygen permeable film and exhibited in a commercial display case at 2°C ± 1°C for six d. Objective and subjective measures of display color were taken twice daily. Lipid oxidation (TBARS) was measured on display day 0,4, and 8 for each supplementation by storage group combination. Packages representing CON treatment displayed increased (P<0.01) TBARS values for the overall display period compared to DURA, HERB and VITE treatments. Treatment groups VITE, DURA and HERB exhibited stable lipid properties after 4 days of display while CON treatment samples did not. Ground beef packages containing packages from VITE, DURA and HERB treatments maintained their lean color for a longer portion of the display, this was especially noticed following 3 d of display. L* mean values were significantly higher (P<.05) for VITE, DURA and HERB treatments as compared to the CON group. Mean a* values across all display days were significantly higher (P<.05) for VITE and DURA treatment groups when compared to their CON counterparts. The same treatment groups also improved overall case-life by .94, .51 and .44 days, respectively compared to CON product. This trial suggests that both vitamin E and natural antioxidants can be beneficial in maintaining lipid stability and prolonging the case-life of ground beef packages.

Key Words: Natural Antioxidants, ground, case-life

225 Effects of including AGRADO™ in finishing diets for beef cattle on retail case-life of ground beef and top loin steaks. C. E. Walenciak*, B. A. Gardner, H. G. Dolezal, and F. N. Owens, Oklahoma State University, Stillwater.

Steers (n=120) were randomized into two groups to evaluate the effects of supplementing AGRADO™ (150 ppm DM basis for 123 days), a feed additive with antioxidant properties, on case-life of ground beef and longissimus steaks and sensory characteristics of longissimus steaks. Strip loins (n=120) and shoulder clods (n=32), representing four pens of cattle and four pens of control, were collected from each of 12 pens. Steaks were coarse ground, adjusted to 85±2% lean, then fine ground onto styrofoam trays, overwrapped with oxygen permeable film, and placed in a retail case (1.6°C; 200 ft light). Two steaks (2.54 cm thick) were removed from strip loins 14 days postmortem for case-life and sensory panel evaluation. A trained evaluation panel scored ground beef and top loin steaks for lean color, % discoloration, and overall desirability at 0800 and 1600 hr for six days of display. A trained evaluator was used to determine L*, a*, b* values. Taste panel steaks were broiled in an impingement oven to 70°C internally for sensory evaluation. A 5g sample of ground beef was plated on Tryptic Soy Agar and on Violet Red Bile Agar to enumerate total plate counts and coliforms, respectively. No differences (P>0.05) were noted between treatments for L*, a*, or b* values or visual panel scores for ground beef or top loin steaks. Ground beef from AGRADO™ supplemented steers had lower (P<0.05) TBARS than control for all days of display (overall .09 vs .19 mg MGA/kg respectively). There were no differences (P>0.05) between treatments for juiciness, cooked beef fat, tenderness, connective tissue amount, or off flavors. Steaks from steers supplemented with AGRADO™ had lower (P<0.05) panel scores for flavor intensity. There were no differences (P>0.05) among treatment groups for total plate or coliform counts. Results indicate that supplementing AGRADO™ in the finishing diets of steers inhibited lipid oxidation of ground beef and decreased flavor intensity, but did not affect tenderness, juiciness, or overall desirability of longissimus steaks.

Key Words: Beef, Case-life, Lipid oxidation

226 Effects of vascular infusion of cattle after exsanguination with saccharides, sodium chloride, and phosphates, and either vitamin C, E or C+E on carcass traits and meat palatability. M. E. Dikeman*, T. E. Dobbels, E. J. Yancey, E. Katsanos, and P. B. Addis. 1 Kansas State University, Manhattan, 2 University of Minnesota, St. Paul.

Grain-finished Charolais crossbred steers (n=36) were used to evaluate the effects of vascular infusion on carcass traits and meat palatability. Twenty-seven steers were infused via the carotid artery immediately after exsanguination with 10% of live weight with a solution containing 98.52% water, 97% saccharides, 23% NaCl, and 28% phosphates (MPSC standard solution, MPSC, Inc., Eden Prairie, MN) plus either 500 ppm vitamin C (MPSC+C, n=9), 500 ppm vitamin E (MPSC+E, n=9), or 500 ppm each of vitamin C+E (MPSC+C+E, n=9). Nine steers served as non-infused controls (NI). After infusion, steers were dressed and chilled overnight. Cuts were fabricated at 48 h postmortem, muscles were vacuum packaged, and then aged until 14 d postmortem. Dressing percentages were increased (P<0.05) 3.5, 1.7 and 2.1% for MPSC+C, MPSC+E, and MPSC+C+E treatments, respectively. Liver, heart, and head weights were increased (P<0.05) by all infusion treatments. Infusion had no effect on USDA yield and quality grade factors, or percentage of purge of vacuum packaged muscles at 14 d postmortem. Infusion had no effect (P<0.05) on Warner-Bratzler shear force or descriptive attribute sensory panel evaluations of
the Longissimus thoracis (LT) and Semitendinosus (ST) muscles. However, infusion with the MPSC+C or MPSC+C+E solutions increased the metallic and soapy/chemical flavor of the LT as evaluated by a trained flavor profile sensory panel. Infusion with MPSC+E reduced beef flavor identity and bloody serumy and increased soapy/chemical of the ST. Whereas infusion with MPSC+C+E reduced metallic and soapy/chemical flavor. When LT and ST muscles were cooked, chilled and warmed over, infusion with MPSC+E increased soapy/chemical flavor, whereas MPSC+C+E decreased soapy/chemical flavor compared to NI. Infusion with MPSC+C or MPSC+C+E increased beef flavor identification and brown roasted flavor of freshly cooked ground beef, but decreased these same traits in warmed-over ground beef. Our results suggest that infusing young, grain-fed cattle with MPSC+C, MPSC+E, or MPSC+C+E should increase dressing percentage and some organ weights, have no effect on USDA quality or yield traits, have no effect on tenderness, and have inconsistent effects on the flavor profile of freshly cooked and warmed-over steaks and ground beef.

Key Words: Beef, Vascular Infusion, Meat Palatability

227 Effects of vascular infusion of cattle after exsanguination with saccharides, sodium chloride, and phosphates, plus vitamin C, E, or C+E on meat display color stability. E. J. Yancey1, M. C. Hunt1, M. E. Dikeman2, T. E. Dobbel2, and P. B. Adjis2 1Kansas State University, Manhattan, 2University of Minnesota, St. Paul.

Grain-fed crossbred Charolais steers (n=36) were selected visually for uniformity. Twenty-seven steers were infused at 10% of live weight via the carotid artery immediately after exsanguination with a solution developed by MPSC, Inc. (Eden Prairie, MN) consisting of 98.52% water, 0.97% saccharides, 0.23% sodium chloride, and 0.28% phosphates plus either 500 ppm vitamin C (MPSC+C, n=9), 500 ppm vitamin E (MPSC+E, n=9), or 500 ppm E + 500 ppm C (MPSC+C+E, n=9). Non-infused controls (NI) were slaughtered conventionally. Carcasses were fabricated at 48 h postmortem. Longissimus thoracis (LT), Psoas major (PM), and Semimembranosus (SM) portions were removed, vacuum packaged, and held at 0°C until 14 days postmortem. Steaks were cut from the LT, DT, and PM, placed on styrofoam trays, and wrapped with polyvinyl chloride film. Ground beef (GB) was formulated from the Quadrectipes to contain 15% fat, mounded into 45 kg portions, placed on styrofoam trays, and wrapped with polyvinyl chloride film. Steaks were evaluated for both uniformity and initial color on d 0 of display, and GB was evaluated for initial color on d 0 of display. Instrumental color measurements of L*, a*, and b*, and trained sensory panel color evaluations were obtained daily for 4 d (PM and GB) or 5 d (LT and SM) of display. L*, a* and b* values were not different among treatments. The LT from NI cattle was more (P<.05) uniform and more cherry red than for infused cattle on d 0. Display color scores indicated that GB from MPSC+C steers were more red (P<.05) consistently than MPSC+C throughout display, and GB from MPSC+E was more red (P<.05) than NI for the last 3 d of display. All vascular infusion treatments resulted in less color uniformity of the LT muscle on d 0 of display, and the MPSC+C+E treatment resulted in redder GB than for non-infused controls during the last 3 d of display.

Key Words: Beef, Vascular Infusion, Color

228 Effect of supplementing feedlot steers with vitamin D₃ and E on carcase traits, shelf-life attributes and longissimus muscle tenderness. D. N. Vargas¹, A. E. Down, D. S. Webb, H. Han, J. B. Morgan, and H. G. Dolezal, Oklahoma State University, Stillwater, OK, USA

Cattle (n=119) of mixed origin were divided into four dietary treatment groups: control (CON), vitamin D₃ (VITD), vitamin E (VITE) and vitamin D and E (COMBO). VITE Treatments (VITE and COMBO) were supplemented with 1,000 IU/hd/d for the final 54 d of the feeding period. Additional VITE in VITD and COMBO groups received 6 million IU/hd/d of VITD for the final 6 d immediately prior to harvest. Longissimus Lumbarum (LL) samples were divided into four sections and stored in refrigerated conditions for 7, 14, 21 or 28 d postmortem. At the end of each aging period LL sections were cut into 3.25 cm steaks for shear force determination, shelf-life analysis and sensory evaluation. Shelf-life was evaluated twice per d using a three-member trained panel and a Minolta colorimeter. Tissue oxidation was estimated at the beginning and end of each seven d retail display period using the thiobarbituric acid (TBA) assay. Mean Warner-Bratzler shear force values across all aging periods were higher (P<.05) for CON steaks compared to other treatments (CON 3.88 kg, VITD, VITE, COMBO, 3.65, 3.63, 3.57 kg, respectively). At 7 d VITD steaks had shear force values lower (P<.05) than VITE steaks and tended (P=.06) to be lower than the CON group. Regression analysis showed steaks from cattle in the VITD and COMBO groups required fewer aging days to become “very tender” (shear force ≤ 3.86 kg) relative to CON and VITE treatments (7.4 and 9.8 vs 15.8 and 11.8, respectively). Panel lean color scores were higher (P<.05) at display d 4, 5 and 6 for VITE steaks compared to other treatments. Mean a* values were higher (P<.05) for VITE and COMBO steaks when compared to CON and VITD; and b* values were higher (P<.05) for steaks from cattle in the VITE group relative to all other treatments. Mean TBA values were lower (P<.05) for VITE and COMBO groups compared to CON and VITD (.112 and .059 vs .237 and .372 mg/kg, respectively). Regression analysis predicted VITD and COMBO steaks would remain acceptable in the retail case longer (3.7 and 3.2 d vs 1.9 and 1.2 d, respectively) after reaching 3.86 kg of shear force than VITE or CON treatments. Therefore, in order to optimize the “color-tenderness relationship” of beef, supplementing finishing cattle with both vitamin D₃ and E is recommended.

Key Words: Tenderness, Shelf-life, Vitamins

229 Supplemental vitamin D₃ and beef tenderness. S. S. Swank, N. A. Elam¹, J. B. Morgan, F. N. Owens, D. R. Gill, C. A. Strasia, H. G. Dolezal, and F. K. Ray, Oklahoma State University, Stillwater, OK.

The objectives of this study were to determine 1) the effectiveness of supplemental vitamin D₃ on altering plasma and muscle calcium levels, 2) whether VITD supplementation improves Warner-Bratzler shear (WBS) force values of steaks from feedlot beef steers, and 3) the tenderness response curve in VITD supplemented longissimus muscle steaks. In Exp. 1, 20 crossbred steers were assigned randomly to one of four treatment diets consisting of either 0, 2.5, 5.0, or 7.5 million IU of VITD per day for 10-d. Blood samples were obtained daily during this supplementation period and 5-d thereafter (d 11-15). Results suggested that between d-6 through d-1 a linear increase (P<.01) in ionized plasma calcium concentrations was observed in steers supplemented with VITD. Compared to non-supplemented steers, serum calcium concentrations of the steers receiving 7.5 million IU of VITD per day were increased between 30% and 50%. In Exp. 2, longissimus dorsi muscle samples from crossbred steers (n=118), which were supplemented with either 0 or 5 million IU of VITD per day for 7-d, were obtained and aged for 7-, 14-, 21- and 28-d. Following the initial 7-d postmortem aging period, VITD supplementation lowered (P<.01) WBS (.58 kg) and increased sensory tenderness rating (.6 units) when compared to cuts originating from non-supplemented steers. In Exp.3, 44 steers were supplemented with either 0 or 7.5 million IU of VITD per day for 10-d immediately prior to harvesting. Results indicated that 1) plasma and longissimus dorsi muscle calcium concentration were higher (P<.05) for steers that received supplemental VITD; 2) compared to non-supplemented cuts, VITD supplementation improved WBS of cuts aged for 7-, 14-, and 21-d (P<.02, P<.07, and P<.13, respectively); 3) sensory panelists preferred samples from VITD supplemented steers; and 4) evidence is presented that activation of calpain proteases could be responsible for the observed tenderization due to the supplementation of VITD.

Key Words: Vitamin D₃, Calcium, Tenderness

230 Effects of feeding Vitamin D₃ on carcase characteristics of beef cattle. K. Karges*, J. B. Morgan, F. N. Owens, and D. R. Gill, Oklahoma State University, Stillwater, OK, USA

Supplemental Vitamin D₃ (Vit. D) has shown to improve tenderness in beef cuts when fed to cattle < 10 d pre-harvest. A trial was conducted to determine how supplemental Vit. D affects blood Ca, carcase traits, Warner-Bratzler shear values, and calpastatin activity of three different muscles: Longissimus, Gluteus medius and Biceps femoris. Treatments included no Vit. D (control), 250 IU or 6 million IU of vitamin D₃ daily for 10-d immediately prior to harvest. Utilizing a completely randomized design, 24 steers (545 kg) were allocated to treatments (8 pens) and fed a 90% concentrate ration twice daily (12.35% CP; 61 Mcal NEg/cwt) with Vit. D fed once daily in a pellet as a percent of the total ration. Hot carcass weights decreased (P<.05) due to feeding of Vit. D. At harvest, 3 steaks (2.54 cm) were
cut from each of the specified muscles and aged 7, 14 and 21 d. Steaks were cooked at 185°C to a final internal temperature of 70°C and shear force values were obtained. Effect of feeding and duration of feeding (6 vs 4 d) of Vit D on shear force was detected in Longissimus and Gluteus medius (P<0.05) but not in liver. D and liver.

J. L. Montgomery*

further fabricated and allocated to three treatment groups: CON, FRZ, and liver. D and allowed 4 h to equilibrate. The injected samples were of 5 and 7.5 million IU/steer/d of vitamin D


2

This study evaluated the effects of freezing (FRZ) and crust freezing (CF) in conjunction with calcium chloride (CaCl₂) injection and post-mortem aging on beef longissimus tenderness. Steers (n = 75) were fed a high concentrate diet at a commercial feedyard in the Texas Panhandle. Striploins were obtained from both carcass sides and fabricated into 2.54 cm steaks. From the left striploin, four steaks were used as a control (CON) and separated into 3, 7, 14, and 21 d aging treatments. The remaining samples were used for FRZ and CF treatments and aged for 7, 14, and 21 d, respectively. One steak from the right striploin was used as a CON for sensory analysis. The remaining portion of the longissimus samples were injected with a 200 mCl CaCl₂ solution (5% of subprimal weight) and allowed 4 h to equilibrate. The injected samples were further fabricated and allocated to three treatment groups: CON, FRZ, and CF. Treatments were analyzed for Warner-Bratzler shear force (WBS), calpastatin activity, sensory evaluation, and cooking loss. Means were separated using Fisher’s LSD. Steaks from CF groups had higher (P<0.05) WBS force values relative to other treatments. CON steaks had lower (P<0.05) WBS force values than FRZ treatments at 14 and 21 days postmortem. CaCl₂ injection significantly reduced (P<0.05) WBS force values in both CON and CF treatments relative to their non-injected counterparts. Calpastatin activity was reduced (P<0.05) in all CaCl₂ injected treatments. Sensory panelists classified approximately 20% more steaks as being tender due to CaCl₂ injection. Therefore, CF should be eliminated from daily processing due to its detrimental effect on tenderness and cooking loss when not used in conjunction with CaCl₂. Additionally, extensive freezing should not be used as a method to improve palatability, but only for preservation.

Key Words: Tenderness, Calcium Chloride, Freezing

233 Type of container and quantity of explosive in the Hydrodyne process on beef strip loin tenderness. M. B. Solomon* and J. S. Eastridge, USDA, ARS, MSRL, Beltville, MD.

The Hydrodyne process has been shown to instantaneously improve tenderness of whole muscle cuts. Hydrodyne performance between treating meat samples in 115 L disposable plastic containers (GC) was compared to using 1060 L stationary stainless steel tank (H). Five cm sections of USDA Select grade boneless strip loins were distributed among the following treatments (n=6/treatment): Control; GC (150 g explosive at 38 cm from bottom); HU4 (4 shock absorbers attached to tank and 350 g at 41 cm from bottom); HU8 (8 shock absorbers attached to tank and 350 g at 41 cm from bottom); HU16 (16 shock absorbers attached to tank and 350 g at 61 cm from bottom); HU16 (350 g at 48 cm) and HU16 (150 g at 31 cm). This section was cut into 2.5 cm thick steaks after being treated and cooked to 71 C on open hearth broilers. Control samples had shear values of 6.98 kg. Shear values as a result of hydrodynamic pressure generated in the different containers was as follows. GC=3.74 kg; HU4=4.25 kg; HU8=5.85 kg; HU16 (350g@61 cm)=6.15 kg; HU16 (350g@48 cm)=5.93 kg and HU16 (150g@31 cm)=5.82 kg. Results suggest that type of container and shock absorbing system, as well as location of explosive (distance from bottom container) play an important role in the performance of the Hydrodyne process to tenderize meat.

Key Words: Hydrodyne, Shear Force, Beef


Both strip loins from 104 U.S. Select beef carcasses, that represented a broad range (8.7 to 43.4 kg; CV = 42%) in slice shear force at 14 d postmortem, were used to determine the correlation among trained sensory panel (TSP) descriptive attribute ratings and consumer ratings of beef longissimus steaks. Consumers (n = 503) in the Denver, Colorado metropolitan area prepared and evaluated one low (< 16 kg) and one high (> 20 kg) shear force steak in their home. Consumers rated the steaks for like, tenderness, juiciness, flavor, flavor amount, and overall satisfaction (0 = extremely undesirable and 10 = extremely desirable). An 8-member TSP evaluated steak samples for tenderness, juiciness, and beef flavor intensity (1 = extremely tough, dry, or bland and 8 = extremely tender, juicy, or intense). There was a high level of autocorrelation among all consumer traits (r = .84 to .94); therefore, use of correlations among consumer traits to identify the determinants of consumer satisfaction would be misleading. A more meaningful indicator of the relative importance of the palatability traits to consumer satisfaction is the correlation of consumer traits with TSP ratings. Because tenderness was much more variable than juiciness and flavor intensity (SD 1.5, .4, and .4, respectively), consumer ratings were most highly correlated with tenderness. That is, tenderness is the primary determinant of consumer perceptions of the palatability of U.S. Select strip steaks.
**NONRUMINANT NUTRITION**

**235** Efficacy of two commercially available phytase preparations for weanling pigs fed a low-P plant-based diet. J. P. Rice*, J. S. Radcliffe, and E. T. Kornegay, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Ninety-six weanling pigs were used in a 5-wk study to compare the effectiveness of two commercially available phytase sources. Following a 7-d adjustment period, pigs were randomly assigned to treatments (one barrow and one gilt per pen) based on gender and BW. All diets were corn-soybean meal-based and formulated to contain adequate amounts of all nutrients except Ca and P (NRC, 1998). Diets 1 and 2 served as the positive (.43% A, .71% tP, and .75% Ca) and negative controls (.13% A, .43% P, .50% Ca), respectively. Diets 3 and 4 were diet 2 plus .25 and .50 g/kg of A (27,600 PTU/kg-Alltech phytase units) sources of phytase (Allzyme), respectively. Diets 5 and 6 were diet 2 plus 250 and 500 U/kg of source B phytase (Natuphos®), respectively. Pig weights and feed intake were recorded weekly. During wk 5, 6 fecal grab samples were collected (3 AM and 3 PM collections). At the end of the study, the barrow from each pen was killed for collection of metacarpals to determine bone shear force and ash. Diet and fecal samples were analyzed for Ca, P, Cr, and DM. The addition of P to the negative control diet increased ADG (P < .001), G:F (P < .004), metacarpal shear force (P < .001) and ash (P < .001), and P (P < .001) digestibility. The addition of phytase from either source increased ADG (P < .004), G:F (P < .05), metacarpal shear force (P < .002), and ash (P < .001), and Ca (P < .01) and P (P < .001) digestibilities. Based on equivalency values generated from response equations for ADG, G:F, metacarpal shear force and ash, and P digestibility, phytase supplementation to diets 4 (source A-27,600 PTU/kg) and 6 (source B-500 U/kg) was equivalent to .127 and .158% P as monocalcium/dicalcium phosphate, respectively. Although phytase from sources A and B did not significantly differ (P > .05) in their ability to improve performance, bone parameters, or mineral digestibility, equivalency values suggest that source A had a slightly higher P replacement value than source B.

**Key Words:** Pigs, Phytase, Phosphorus

**236** The effects of various concentrated immunoglobulin protein sources in phase 1 diets of early weaned pigs. J. A. Godfredson-Kisic*, T. E. Shipp1, and K. C. Ferrel1,1 DuCoa, Highland, IL, 2MFA, Inc., Columbia, MO.

Previously we reported that weaning mice fed diets supplemented with 2% porcine globulin proteins (GLOB) demonstrated similar gain and feed efficiency as mice fed diets containing 8% spray dried porcine plasma (SDPP). We also reported that the albumin fraction of plasma was not as effective in improving gain and feed conversion as whole SDPP. The objective of this study was to see if similar responses would be observed in early weaned pigs. In addition to SDPP and GLOB, we used a diet supplemented with concentrated porcine albumin protein in combination with spray dried egg, which provided an alternative source of immunoglobulin (ALB+). A total of 160 weaned barrows (134 d old, 4.2 kg BW) were blocked by weight to one of four dietary treatments, 4 pens/trt, 10 pigs/pen. Treatment diets offered were supplemented with either: 1) 8% SDPP, 2) 4% GLOB, 3) 2% GLOB, or 4) 4% ALB+. All diets were equilibrated for protein, lysine, methionine and energy. Diets were offered ad libitum for 7 d postweaning, after which, gain and feed intake were measured. On d 7 postweaning, ADG (g/day) for diets 1, 2, 3 and 4 were 113, 101, 116, 149 (P < .08), respectively. Average daily feed intake (g/day) for diets 1, 2, 3 and 4 were 130, 122, 127, 156 (P < .07), and gain/feed values were 0.88, 0.83, 0.90, 0.95 (P > .1), respectively. Significant differences were not observed among swine fed the first three diets, for gain and intake, yet swine on the fourth diet approached significant improvement. There were no significant differences among all four diets in gain/feed. This study agrees with the mouse bioassay where a diet supplemented with only 2% concentrated porcine globulin proteins was as effective in maintaining growth and feed intake in early weaned pigs, as a diet containing 8% SDPP. Additionally, ALB+ improved gain, intake and maintained feed conversion in comparison to diets with SDPP and GLOB.

**Key Words:** Beef, Consumer, Tenderness

**237** Dose response of Novo SP938 microbial phytase in weanling pigs fed a low-P corn-soybean meal diet. J. H. Skaggs* and E. T. Kornegay, Virginia Polytechnic Institute and State University, Blacksburg, VA.

The objective was to determine the dose response of supplemental Novo SP938 phytase for enhancing performance, bone mineralization and digestibility of Ca and P for weanling pigs (n = 96, 8.2 kg BW initially) fed a low-P, 19.5% CP corn-soybean meal diet for 5 wk. Dietary treatments were: 1) positive control (.7% Ca & .6% P), 2) negative control (.45% Ca & .39% P), and 3-6) treatment 2 + 250, 500, 750, or 1,000 U/kg phytase as a liquid. Body weight and pen feed consumption were recorded weekly. Fecal samples were collected during wk 5 for determination of Ca and P digestibility by the indirect method (.05% Cr2O3). At slaughter after wk 5, both tenth ribs were taken for assessment of bone mineralization. Linear increases (P < .001) in ADG, ADFI, and G:F from wk 3 to 5 were observed as the level of phytase or P increased. Tenth rib shear force, energy, ash weight, and ash percentage increased linearly (P < .10 to .001) as the phytase or P level increased. Digestibility of P and Ca linearly increased (P < .001) as the level of phytase or P increased with the two highest levels of phytase (750 and 1,000 U/kg) being equal to or greater than the positive control values. Concentration of P and Ca in fecal DM linearly decreased (P < .001) as the phytase level increased. Based on linear response equations for added P and nonlinear response equations for added phytase for ADG, rib ash percentage and P digestibility, the average P equivalency of 500 U/kg of phytase was 1.06 g of P as monocalcium/dicalcium phosphate. In summary, Novo SP938 phytase effectively improved performance, bone mineralization, P and Ca digestibility, and decreased P and Ca concentration in the feces.

**Key Words:** Pigs, Phytase, Phosphorus

**238** Efficacy and safety of Novo SP938 microbial phytase supplementation of a corn-soybean meal diet fed to growing pigs. A. F. Harper*, J. H. Skaggs, H. P. Veit, and E. T. Kornegay, Virginia Polytechnic Institute and State University, Blacksburg, VA.

The efficacy and safety of Novo SP938 phytase in growing pigs (n=126, 26.5 kg BW initially) fed a 15.7% CP corn-soybean meal diet was evaluated in a 6 wk trial. Dietary treatments were: 1) positive control (.54% Ca and .47% P), 2) negative control (.39% Ca and .34% P), and 3-6) treatment 2 + 250, 500, 1,000 or 10,000 U/kg phytase as a liquid. Body weight and pen feed consumption were recorded weekly. Fecal samples were collected during wk 6 for determination of Ca and P digestibility by the indirect method (.05% Cr2O3). The right foot of all pigs was removed at slaughter for evaluation of bone mineralization. Cumulative ADG and G:F increased (P < .01) and ADFI increased during wk 4-6 (P < .05) as the level of phytase increased with ADG and G:F of the highest phytase level equal to positive control values. Third metacarpal shear force, energy, ash weight, and ash percentage increased (P < .001) as the level of phytase increased. Digestibility of P and Ca increased (P < .001) as phytase levels increased with values for 1,000 and 10,000 U/kg being equal to or greater than the positive control values. Concentrations of P and Ca in the fecal DM decreased (P < .01) as...
phosphate increased. Pathological and histopathological examination of liver, kidney, and tibia revealed no adverse effects of treatments. In summary, Novo SP938 phytase supplementation effectively improved performance, bone mineralization, P and Ca digestibility, and decreased P and Ca concentration in the feces of pigs fed a low-P corn-soybean meal diet. The addition of 10,000 U/kg of Novo SP938 phytase did not cause any ill effects on the health of the pigs, but continued to produce positive improvements in performance, bone mineralization, and mineral digestibility.

Key Words: Pigs, Phytase, Phosphorus

240 Phytase addition to normal corn- and low phytic acid corn-soybean meal diets for chicks and pigs. J. L. Pierce and G. L. Cromwell, University of Kentucky, Lexington, KY.

Two near-isogenic hybrid corn types (Optimum Quality Grains), one with the mutant lpa1 gene, were evaluated in corn-soybean meal diets for chicks and pigs. The normal (N) and low-phytic acid (LP) corn analyzed 25.2% total P and 20.1% phytic acid P, respectively, and 10 vs 50% (chicks) and 20 vs 75% (pigs) of the P was assumed to be bioavailable. In Exp. 1, 3 d-old chicks (5 reps, 6/pen, 71 g BW) were fed one of ten diets (21.5% CP, 1.0% Ca) containing N-corn (Diets 1-5) or LP-corn (Diets 6-10) for 14 d. Non-phytate P was .45, .35, .35, .25, .25% in Diets 1-5 and Diets 6-10. Phytase (Natuphos, BASF) was added at 1,200 units/kg to Diets 1-5.8, 5, 8, and 10. Weight gain and tibia strength were similar for chicks fed the two corn types at equal dietary non-phytate P, and were improved (P < .01) by phytase additions to either corn (487, 470, 497, 439, 484 and 488, 470, 478, 446, 476 g; 16.9, 13.1, 17.3, 6.7, 12.3 and 17.7, 14.3, 16.7, 9.1, 13.5 kg). Phosphorus excretion was reduced by feeding LP-corn (P < .05) and by adding phytase (P < .01) (174, 144, 130, 123, 114 and 137, 109, 97, 94, 73 mg/d). In Exp. 2, 6 reps of 2 pigs/pen (18 kg) were fed diets (.95% lysine, 60% Ca) containing N- (Diets 1-3) or LP-corn (Diets 4-6) for 42 d. Total P in the 6 diets was .55, .45, .45, .35, .35% and bioavailable P was .29, .19, .19, .19, .19%. Phytase was included in Diets 3 and 6 at 600 units/kg. Gain and feed/gain were: 808, 690, 699 and 813, 735, 835 g/d; 2.06, 2.43, 2.28 and 2.05, 2.19, 2.15. Phytase addition to the low P diets increased (P < .01) femur strength of pigs similar to that of pigs fed the higher P diets for both N- (272, 231, 265 kg) and LP-corn (282, 232, 283 kg). Fecal P excretion was reduced by feeding LP-corn (P < .01) and by adding phytase (P < .05) (6.80, 5.95, 5.24 and 4.43, 3.75, 3.34 g/d). These results indicate that phytase is as effective in LP-corn diets as in N-corn diets, P excretion can be reduced by 25 to 35% by substituting LP-corn for N-corn, and P excretion can be reduced by 50% by combining phytase and LP-corn in corn-soy diets for chicks and pigs.

Key Words: Pigs, Chick, Phytase

241 Phytase effects on ileal amino acid digestibility and nitrogen balance in finishing pigs fed a low-protein plant-based diet. Z. Zhang and E. T. Kornevay, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Crossbred pigs (n = 120, equal barrows and gilts in 20 pens of six each) were used to investigate the effects of supplemental Natuphos® phytase on ileal digestibility of amino acid (AA) and crude protein (CP) and N balance when a low-protein plant-based diet was fed. During the finishing period (67 to 109 kg), diets 1, 2 and 3 contained 12, 11 and 10% CP (.47% Ca and .4% P) with no added phytase, respectively, and diets 4 and 5 contained 10% CP with either 250 or 500 U/kg phytase, respectively. Similar diets with higher CP (2 percentage units) and Ca:P (1 percentage unit) levels were fed during the grower period (32 to 67 kg).

At the end of grower phase, one barrow and one gilt were removed from each pen; the 12 barrows that were removed for diets 1, 3 and 5 were used in a N balance trial. At the end of the finisher phase, 12 barrows from diets 1-3, and 5 were used in a N balance trial. Ileal contents were taken (slaughter technique) from all barrows for amino acid analysis. Pig BW and pen feed intake were measured weekly. Fecal collections were taken during the last 10 d of the grower and finisher phases. Daily gain linearly increased (P < .05) as protein or phytase was added to the lowest protein level. Fecal N digestibility and retention coefficients increased (P < .05) as CP or phytase were added to the low CP diet. The digestibility of all amino acids, linearly increased (P < .10 to .01) as the dietary CP level increased or as phytase was added, except glycine for CP, and proline and glycine for phytase. Fecal P and Ca digestibilities improved with added phytase (P < .05). Based on linear responses of added CP or phytase on ileal amino acid digestibilities (averaged), the equivalency of 500 U/kg of phytase was estimated to be .76 percentage units of CP. Nitrogen excretion was estimated to be reduced 5.1% when phytase was added to pig diets at a level of 500 U/kg.

Key Words: Pig, Amino acids, Phytase

242 Effects of microbial phytase on amino acid and mineral digestibilities in pigs fitted with steered ileo-cecal valve cannulas and fed a low protein, corn-soybean meal based diet. J. S. Radcliffe, E. T. Kornevay, and R. S. Pleasant, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Ten crossbred barrows (48.3 kg initial wt.) fitted with steered ileo-cecal valve (SICV) cannulas were used to investigate the effects of supplemental microbial phytase on the apparent ileal digestibilities (AID) of Ca, P, N, DM, and amino acids, and the apparent total tract digestibilities (ATTD) of Ca, P, N, and DM. All dietary treatments were corn-soybean meal-based and contained .44% Ca and .40% P. Diets 1, 2, and 3 contained 12, 11, and 10% CP, respectively. Diets 4 and 5 were diet 3 plus 250 and 500 U/kg Natuphos® phytase, respectively. Pigs were randomly allotted to one of the five dietary treatments in a paired 5 x 5 Latin square with an extra period to test for carry over effects. Each 14-d period consisted of a 7-d adjustment followed by a 3-d total collection, a 12 h ileal digesta collection, a 3-d readjustment, and a second 12 h ileal digesta collection. Pigs were individually housed in metabolic pens (1.2 m x 1.2 m). Water was supplied ad libitum and feed given at a level of 9% of the pigs metabolic BW (BW ^ 0.75)/d. Increasing dietary CP increased (P < .05) the AID of CP and all amino acids measured with the exception of proline. In addition, the ATTD and retention of N also increased (P < .01) with increasing CP levels. Supplementation diets with phytase increased the AID of Ca (P < .01), CP (P < .001), and all amino acids (P < .10) measured with the exception of leucine, serine, proline, methionine and tyrosine. Protein and phytase response equations were generated for those amino acids significantly affected by both CP level and phytase supplementation. Based on these equations 500 U/kg of phytase can replace .52 percentage units of the dietary CP which includes a .03 percentage unit improvement in lysine digestibility.
243 Bioavailability of phosphorus in meat and bone meal subjected to varying processing pressures for pigs. L. W. O. Souza, A. S. Moretti, F. M. Tucci1, and P. M. Leal1, 1FAAP, 2Faculdade de Medicina Veterinária e Zootecnia, Universidade de Sao Paulo, 3Faculdade de Engenharia Agrícola, UNICAMP.

Processing conditions of meat and bone meal (MBM) affect amino acid availability, but their effects on P availability are not known. Two experiments assessed blended (beef and pork) MBM (23.1% ash, 49.7% CP, 2 CP, 4.7% Ca, 3.7% P) subjected to additional processing pressures of 0, 30, or 60 psi for 20 min. Exp. 1 was a 5-d blind trial involving 8 reps of barrows (63 kg BW). A corn-soybean meal basal diet (.80% lysine, .31% Ca, .31% P) was used. In diets 2-5, monosodium phosphate (MSP) and CaCO3 or MBM processed at 0, 30, or 60 psi were added to provide .125 and .26% added P and Ca. No differences (P = .30) were found, although MSP had numerically higher true P absorption than MBM (87.6 vs 85.1, 78.5, 81.3%, respectively). Further processing of MBM did not affect (P = .22) P balance. In Exp. 2, 36 individually-penned pigs (6 reps, 15.6 kg BW) were fed a low-P, corn-soybean meal basal diet (.95% lysine, .33% Ca, .31% P) or the basal diet with .10 and .20% added P from MSP or .20% added P from MBM (0, 30, or 60 psi) for 35 d. Ca was maintained at .70% in all diets. Average daily gain and feedgain (F:G) were: 565, 737, 791, 816, 803, 804 g/d; 210, 199, 190, 181, 185, 1.84. Femur strength and metacarpal-metatarsal-statural strength and ash were: 80, 167, 265, 205, 218, 244 kg; 20.1, 21.4, 2.51, 2.50, 2.63 g. Average daily gain and F:G improved (P < .01) with P addition from either source, and P additions from MBM improved growth and bone traits linearly (P < .01). Growth was unaffected (P = .12) by P source (diet 3 vs 4-6); however, bone strength and ash were lower (P < .05) for MBM than for MSP. Processing pressure of MBM affected femur strength (linear, P < .02), but had no effect on the other traits (P = .25). Bone traits were regressed on added P intake for each P source. Based on slope-ratio (MSP = 100%) the bioavailability of P of Averaged 80, 81, and 91% (P = .17, SE = 5.4) for the 0, 30, and 60 psi MBM. These results indicate that the availability of P in MBM is relatively high for pigs, and that extremes in processing pressure have only slight effects on bone traits.

Key Words: Pig, Phosphorus, Meat and bone meal

244 Bioavailability of phosphorus assessment in commercial dicalcium phosphates and rock phosphates for growing swine. L. W. O. Souza1, F. R. Lima3, A. S. Moretti, F. M. Tucci1, and P. M. Leal1, 1FAAP, 2Faculdade de Medicina Veterinária e Zootecnia, Universidade de Sao Paulo, 3Faculdade de Engenharia Agrícola, UNICAMP.

One hundred ninety-two pigs were used in a trial to assess the relative bioavailability of phosphorus (RBP) in six phosphate sources. Phosphates were three feed grade phosphates (FP), two made in Brazil (MSP and CaCO3) or MBM. One USA made (IMC Agrico.), and three rock phosphates were three feed grade phosphates (FP), two made in Brazil (Torga and Serrana), and one USA made (IMC Agrico.), and three rock phosphate samples (RP) originated from two mine sites in Brazil (Araxa and Tapira), and one mine site in Israel (Arad). Levels of Ca, P, and F in RP were 29, 12, and 1.7% (Araxa), 33, 14, and 1.4% (Tapira), and 30, 14, and 3.6% (Arad), respectively. Pigs were fed a corn-soybean meal basal diet (18% CP, 0.95% Lysine, 0.75% Ca, 0.37% P) or the basal diet with 0.15% P from a standard purified grade calcium phosphate dibasic (SP), or with 0.15% P from experimental FP or RP. Each diet was fed to six pen replicates of four pigs per pen (two barrows and two gilts) for 35 d (14.4 to 33.9 kg). Weight gain (WG), feed gain (FG), plasma P, bone ash (BA), and breaking strength of metacarpals and metatarsals (BS-MM), and femurs (BS-F) were improved (P < 0.01) by SP, FP, and RP. However, performance and bone parameters were depressed (P < 0.01) in SP compared to FP dietary supplementation. WG and feed intake (FI) decreased by 9% (.536 vs 590 g/d, and 1.276 vs 1.492 g/d, respectively), BA decreased by 9.9% (.273 vs .303%), BS-MM by 17% (.166 vs 20.0kg), and BS-F by 26.2% (131 vs 177kg). WG, BA, BS-MM, and BS-F were regressed on P added, and slope-ratios were calculated to assess RBP in the FP and RP sources. The average bioavailability of P in the FP and RP sources, relative to SP (given a value of 100), were 89 and 49% (WG), 112 and 49% (BA), and 78% and 28% (BS-MM), and 101 and 52% (BS-F), respectively. From these results, low bioavailable P, and toxicity related to animal performance and bone parameters, should be expected if rock phosphates are used, instead of feed grade phosphates, to feed pigs. Sponsored by FAPESP: 1996/12675-5

Key Words: Phosphorus availability, Rock phosphate, Swine

245 Effects of corn and(or) soybean meal on nitrogen and phosphorus excretion of growing pigs. B. W. Senne*, S. D. Carter, L. A. Pettay, and J. A. Shrivar, Oklahoma State University, Stillwater.

Six groups of four littermate barrows (initial BW 29.4 kg) were used to determine N and P excretion of pigs fed corn, soybean meal (48% CP; SBM), or a combination of corn and SBM. Treatments were: (1) fortified cornstarch-casein (control; 2.22%N, .33% P); (2) corn-casein (2.74% N, .40% P); (3) cornstarch-SBM (3.24% N, .49% P); and (4) corn-SBM (3.49% N, .67% P). All diets were formulated to .82% digestible lysine and .31% available P. Crystalline Lys, Thr, Met, and Trp were added to provide an ideal ratio to lysine in Diet 1. A constant ratio of Ca:available P (1.9:1) was maintained across treatments. Diets were fed for 5 d to allow for total collection of urine and feces. Daily N and P intakes were, respectively: 26.9, 38.2, 39.9, 46.8 g and 4.1, 5.6, 6.1, and 9.1 g. Daily DM excretion (12, 94, 49, and 140 g) was lowest (P < .01) for pigs fed the control diet followed by those fed SBM, corn, and corn-SBM. Fecal N, urinary N, and total N excretion for the 4 diets were, respectively: .33, 3.04, 2.55, and 5.90 g/d; 1.22, 2.72, 4.54, and 7.36 g/d; and 1.55, 5.88, 7.26, and 13.26 g/d. N absorption (% of intake) was greater for pigs fed the control diet (P < .01); no differences existed between the corn and SBM diets; however, pigs fed corn-SBM had the lowest absorption of P (P < .01). P retention (% of intake) was highest for pigs fed the control diet (P < .01), and there were no differences among pigs fed corn, SBM, or corn-SBM. These results suggest that corn contributes more to DM excretion than SBM. However, in a typical corn-SBM diet for growing pigs, the amount of N and P excretion attributed to corn or SBM is similar.

Key Words: Pigs, Excretion, Nitrogen

246 Effects of fiber addition (10% soybean hulls) to a reduced crude protein diet supplemented with synthetic amino acid mixtures versus a standard commercial diet on pig performance, pit composition, odor and ammonia levels in swine buildings. D. C. Kendall*, B. T. Richert, A. L. Sutton, J. W. Frank, S. A. DeCamp, K. A. Bowers, D. Kelly, and M. Cobb, Purdue University, West Lafayette, IN.

One-hundred and sixty grow-finish pigs (Initial BW = 60.3 kg) were placed in two identical, environmentally controlled rooms. There were 4 replications (40 pigs/rep) with treatments rotated between rooms. Pigs in both rooms were fed a standard corn-soybean diet for 3 weeks (13.1% CP, 170 Lysine; Lys), pigs in each room were then fed either a corn-soybean diet (12.4% CP, .65% Lys; HCP) with supplemental Lys (.15%) or a reduced CP diet with the addition of 10% soybean hulls (9.7% CP, .65% Lys; RCPF) with supplemental Lys (.372%), Trpophan (.005%), and Threonine (.042%) for 6 weeks. Pigs were weighed and feed consumption recorded at 0, 3, 6, and 9 weeks. Aerial ammonia concentration (AAC), pit samples, and odor samples were taken at 3, 6 and 9 weeks. Pigs were ultrasonically scanned for backfat thickness at the tenth rib on weeks 3 and 9. In the first two replications, there was no difference in ADG or ADFI (kg/day, P > .10) between pigs fed HCP and RCPF (.79 vs .76; 2.79 vs 2.86, respectively) and there were no differences in backfat at week 9 between pigs fed HCP and RCPF (19.1 vs 18.4 mm; P > .10). In the other two replications pigs fed corn, SBM, or corn-SBM. These results suggest that corn contributes more to DM excretion than SBM. However, in a typical corn-SBM diet for growing pigs, the amount of N and P excretion attributed to corn or SBM is similar.

Key Words: Pigs, Excretion, Nitrogen
collected for oflactometry analysis showed no differences in dilution ratio between HCP and RCPF at week 9 (508 vs. 502; P>.10), and hydrogen sulfide readings were lower for pigs fed RCPF diets (.34 vs. .25 ppm; P<.05). This research suggests that reducing the dietary CP and adding 10% soybean hulls to diets will lower AAC, aerial hydrogen sulfide, pit nitrogen, and pit pH. The variability in growth performance when pigs were fed high levels of soybean hulls requires further study.

Key Words: Fibre, Ammonia, Pigs


High concentrations of dietary zinc (Zn) have been shown to increase growth performance in the weanling pig. Therefore, to determine the optimum pharmacological concentration of Zn oxide (ZnO) necessary to enhance growth in the nursery pig, 7 cooperating experiment stations conducted a 4-wk nursery trial. Utilizing the standard management procedures of each station, 1,069 pigs (11 to 25 d of age, 3.4 to 10.3 kg initial wt.) were randomly allotted by weight and sex to 5 dietary treatments. The complex, two-phase diet sequence contained added Zn from ZnO: 0 (control), 500, 1,000, 2,000 or 3,000 ppm. The study was conducted in a randomized complete block design. A minimum of 2 replications were completed at each station. At 6 stations, blood samples were collected at the end of the trial for determination of plasma Zn and Cu. Pigs fed 3,000 or 2,000 ppm Zn had higher (P < .05) feed intakes than pigs fed the 500 ppm or control diets. Feed intakes of pigs fed 3,000, 2,000, 1,000, 500 ppm and control diets were .61, .62, .58, .56 and .57, respectively. Average daily gain was greater (P < .05) for pigs fed 3,000 and 2,000 ppm Zn than for those fed 1,000 or 500 ppm or the control diet. Daily gain was .38, .39, .36, .35 and .35 kg for pigs fed Zn from 3,000 ppm to the control diet, respectively. Feed efficiency was improved (P < .05) in pigs fed 2,000 or 3,000 ppm Zn compared to pigs fed the control diet. Feed efficiencies (G/F) for pigs fed 3,000, 2,000, 1,000, 500 ppm Zn and the control diet were .65, .66, .64, .64 and .62, respectively. Even though this was only a 4-wk study, plasma Zn was elevated and plasma Cu reduced by feeding 3,000 or 2,000 ppm of dietary Zn. However, because of the difference in magnitude for these traits within station, there was a station x treatment interaction (P < .0001). In this experiment, 2,000 ppm Zn (supplied by ZnO) increased feed intake and growth and improved feed efficiency in the nursery pig under diverse management conditions to the same extent as 3,000 ppm Zn. Therefore, 2,000 ppm Zn was the optimum dietary concentration to enhance growth in the nursery pig.

Key Words: Nursery pig, Zinc


One hundred ninety-two pigs (6.2 kg and 18 d of age; PIC) were used in a 27 d growth assay to determine the interactive effects of Zn source and feed grade antibiotic on growth performance of weanling pigs. Experimental treatments were arranged in a 2 x 3 factorial design with main effects of antibiotic (none or 55 ppm carboxad) and Zn source (none, 250 ppm Zn from a zinc amino acid complex (ZnAA), or 3,000 ppm Zn from ZnO). Pigs were blocked by initial weight and allotted randomly to each dietary treatment with eight pigs per pen and six replications per treatment. All diets contained 165 ppm Zn (ZnO) from the trace mineral premix. Diets were fed in meal form in three phases: d 0 to 7, d 7 to 14, and d 14 to 27. There were no Zn source x antibiotic interactions (P < .2) observed throughout the entire experiment. Antibiotic only increased (P < .05) ADG from d 14 to 27. Pigs fed ZnO had greater (P < .05) ADG compared to pigs fed other treatments from d 7 to 14 and d 0 to 14. Pigs fed ZnO also had increased (P < .03) ADFI compared to ZnAA (d 7 to 14) and no additional Zn (d 7 to 14 and 0 to 14). Gain to feed ratio (G/F) was highest (P < .004) for pigs fed diets containing ZnO compared to pigs fed no additional Zn from d 7 to 14 and d 0 to 14. Pigs fed diets containing ZnAA had higher (P < .04) G/F compared to pigs fed no additional Zn from d 0 to 14. For the entire trial, pigs fed ZnO had increased (P < .04) ADG compared to those diets containing no additional Zn, with pigs fed ZnAA having intermediate responses. In addition, pigs fed ZnO from d 7 to 14 had higher (P < .03) ADFI compared to pigs fed diets containing either ZnAA or no additional Zn. These results suggest 3,000 ppm Zn from ZnO should be added to diets fed to pigs from d 0 to 14 after weaning. Antibiotic addition tended to influence growth performance toward the end of the experiment.

Key Words: Weanling Pigs, Zinc, Antibiotic


An experiment involving 144 pigs (17 to 22 d of age; 6.1 kg BW) was conducted to determine the interactive effects of diet complexity and added Zn on performance of weanling pigs. Pigs were blocked by weight, penned six/pen in a conventional nursery, and fed a phase 1 diet (1.35% lys) for 10 d, followed by a phase 2 diet (1.15% lys) for 4 wk, and a common phase 3 diet (1.14% lys) for 2 wk. Treatments were arranged in a 3 x 2 factorial with three diets (complex, intermediate, and simple), and two Zn levels [0 and 100 ppm Zn from Availa-Zn zinc amino acid complex (ZnAA), Zinpro Corp., Eden Prairie, MN]. The phase 1 complex diet contained 7% soybean meal (SBM), 10% soy protein concentrate (SPC), 2% plasma protein, 1.3% blood meal, 2% peptide plus, 5% select menhaden fishmeal (FM), and 20% lactose; the intermediate diet contained 15% SBM, 15% SPC, 2% FM, 7% lactose, and 35% the amount of vitamins and trace minerals added to the complex diet; and the simple diet contained 39.5% SBM with no vitamins, minerals or antibiotics added. Diets were pelleted and pigs were allowed access to feed on an ad libitum basis. During phases 1, 2 and 3, increased diet complexity improved (diet effect, P < .01) ADG and ADFI. Gain:feed during phase 1 was improved with the addition of ZnAA to the intermediate and complex diet, but not in the simple diet (interaction, P < .05). During phase 2, pigs fed the intermediate and complex diets had greater (P < .01) G:F than those fed the simple diet. During the overall experiment, there was a tendency for an improvement in ADFG (interaction, P < .1) and ADG (interaction, P = .12) with the addition of ZnAA to the intermediate and complex diets, but not in the addition of Zn to the simple diet. In general, the results of this study indicate that complex diets were clearly superior to simple diets in improving performance of weanling pigs, and that 100 ppm Zn from ZnAA improves performance of pigs fed the intermediate and complex diets, but not the simple diet.

Key Words: Pig Performance, Diet Complexity, Zinc
251 Effect of dietary zinc on growth performance and immune response of endotoxemic growing pigs. E. S. Roberts1, E. van Heugten2, G. Almond1, and J. W. Spears3. 1 College of Veterinary Medicine, 2 Department of Animal Science, North Carolina State University, Raleigh, NC.

A 2 × 3 factorial arrangement of treatments was used in a randomized complete block design to determine the effects of dietary zinc (Zn) level on performance, plasma Zn, alkaline phosphatase activity (ALP), and immune response of acutely endotoxemic growing pigs (n = 96, initial mean BW was 24.94 kg). Factors included 1) endotoxin (LPS) treatment or control and 2) supplemental (suppl) Zn at 10, 50, or 150 ppm. Diets were fed beginning in the nursery phase and continuing into the growing phase. The basal diet was corn-soybean based with 17% crude protein, 1% lysine, 30 ppm zinc, and was formulated to meet or exceed NRC requirements for all other nutrients. Pigs were acclimated for 12 d (d 0 - d 12) in the grower before LPS treatment. Escherichia coli lipopolysaccharide (LPS) at 10 µg/kg was injected intramuscularly on d 13 of the experiment. Gain, feed intake, and feed efficiency were unaffected by supplemental Zn. Feed intake decreased (P < .05) and gain:feed was greater (P < .10) from d 13 to d 16 for pigs injected with LPS; this was not affected by supplemental Zn. Plasma Zn and ALP increased linearly with increasing Zn levels (P < .10). The febrile response to LPS peaked at 6 h post-exposure and pigs were afebrile within 12 h. Maximum core body temperature was greater (P < .05) in pigs receiving 50 and 150 ppm supplemental Zn than in pigs with 10 ppm added Zn to the diet. In vivo cellular immune response, measured on d 13 by skin thickness response to phytohemagglutinin, was increased after 6 h (P < .01) in pigs fed 10 ppm supplemental Zn and exposed to LPS compared to all other treatments. Lymphocyte proliferation was not affected by supplemental Zn. Adequate dietary zinc is required for normal cell-mediated immunity and phagocyte function; however, supplemental Zn in excess of NRC recommendations resulted in an enhanced febrile response to intravenous endotoxin. These data suggest that there is no benefit, rather a possible detriment, to immune function with excess dietary zinc.

Key Words: Pigs, Zinc, Immune response

252 Skeletal mineralization of nursing pigs fed diets with pharmacological additions of zinc. T. D. Crenshaw and D. K. Schneider, University of Wisconsin, Madison, WI.

Zinc oxide supplemented at pharmacological concentrations (3000 ppm) approaches toxicity. Zn toxicosis is altered by dietary Ca concentrations. Since bone is the major storage site for Zn, the objective of this experiment was to determine if pharmacological Zn concentrations of LPS in nursing diets reduced skeletal mineralization. Weaned (25 d, 8.5 kg) pigs (PIC, Camborough × Line 19) were randomly allotted within weight blocks to 1 of 4 diets. Thirty six pigs were housed with 1 (3 pens/trt) or 2 (3 pens/trt) pigs per pen and allowed continuous access to feed and water for 28 d. Individually penned pigs (n = 3 /trt) were scanned by dual energy x-ray absorptiometry (DEXA) on d 0 and 28 to measure total body, bone mineral content (BMC). Bone and liver samples were collected (n = 6/treatment) after pigs were scanned. Pigs were fed Phase I diets (1.4% lysine) for 14 d then Phase II diets (1.2% lys) till d 28. Treatments involved a 2 × 2 factorial arrangement of Ca (+Ca, 1.0%; -Ca 0.60%) and Zn (+Zn, 124 ppm; +Zn 3,124 ppm) concentrations. +Zn increased gain and FI in +Ca pigs but depressed responses in -Ca pigs (P < .06). BMC gain over 28 d was greater (P < .02) in pigs fed +Ca than -Ca diets, but Zn did not alter responses (P > .2). Metatarsal bone Zn content was dependent on dietary Ca (Ca × Zn interaction, P < .02). +Zn increased bone Zn more in pigs fed -Ca (367 vs 1086 µg Zn/g ash) than in pigs fed +Ca (322 vs 765 µg Zn/g ash). The percentage ash was slightly less in +Ca pigs fed +Zn (46 ± 46.6%) and slightly increased in -Ca pigs fed +Zn (42.8 ± 43.6%; interaction P = .25). However, the ash response might be explained by changes in growth rates among groups rather than a direct effect of Zn on bone mineralization. In conclusion, bone levels were altered by dietary Ca and Zn, but no evidence of toxicosis was detected in mineralization of metatarsal bones.

Key Words: Zinc, Calcium, Bone

253 Effects of length of feeding conjugated linoleic acid (CLA) on growth and body composition of pigs. J. C. Sparks*, B. R. Wiegand, F. C. Parrish, and D. R. Zimmerman, Iowa State University, Ames, IA.

Ninety-two pigs weighing 28 kg were fed isocaloric diets containing 1.25% CLA oil (60% CLA isomers) for the last 0, 29, 58, or 87 kg of BW gain to evaluate the effects on growth and carcass composition. Pigs were slaughtered at an average BW of 115 kg. Real time ultrasound (RTU) was used to determine backfat depth (BFD) and loin muscle area (LMA) at the 10th rib when the pigs weighed about 28, 57, 86, and 115 kg. At slaughter, BFD at the 1st rib, 10th rib, and last lumbar and LMA at the 10th rib were measured, and a five point subjective score was used to evaluate marbling, firmness, and color of the loin muscle at 48 h post mortem. ADG and ADFI were not affected by CLA. Gain:feed ratio over the entire experiment increased quadratically (P < .05) in response to length of feeding CLA, with pigs fed CLA for 29 and 58 kg of BW gain having the greatest gain:feed ratios. RTU revealed no treatment differences at 28 and 57 kg BW. At a BW of 86 kg, pigs that had been fed CLA had less (P < .01) BFD than those that had not received CLA. At slaughter, RTU showed a linear decrease in BFD (P < .004) and a linear increase in LMA (P < .01) with length of feeding CLA. However, BFD (P < .07) and LMA (P < .11) had strong trends for quadratic responses. Measurements on carcasses revealed a linear decrease in BFD at the 1st rib (P < .05), 10th rib (P < .01), and last lumbar (P < .02), and a linear increase in LMA (P < .01) in response to increased days of feeding CLA. However, there were also strong trends for quadratic response with P < .15, .08, and .17 for 10th rib, last lumbar, and LMA, respectively. These quadratic responses were indicative of diminishing effects as period of feeding CLA lengthened. There were no treatment differences in color score. Marbling (P < .03) and firmness (P < .07) scores increased linearly with increased length of CLA feeding. In summary, responses to CLA were near maximum if fed during the last 58 kg of BW gain.

Key Words: CLA, Pigs, Growth


Terminal cross gilts (23 kg; n = 160) of two genetic populations (G1 and G2) were assigned to a 2 × 2 × 5 factorial arrangement of genotype, diet and slaughter weight (46 kg, 68 kg, 91 kg, 114 kg or 136 kg). Pigs were fed conventional corn-soybean meal based diets supplemented with either 1 % CLA oil (CLA) or 1 % sunflower oil (SFO) ad libitum until reaching their assigned slaughter weight. CLA oil contains 60 % CLA isomers. Composition and quality data (n = 96) was collected at 91, 114 and 136 kg. G1 gilts had lost 10.8% rib backfat (1.55 vs 1.93 ± .05 cm, P < .01), larger loin eye areas (47.6 ± 45.1 ± .9 cm2, P < .05), higher % fat free lean (55.2 ± 52.9 ± .5 %, P < .01), lower ADG (89.9 ± .91 ± .01 kg/day, P < .05), lower color evaluations (1 = pale, pinkish gray; 5 = dark, purplish red; 2.07 vs 2.23 ± .05, P < .05) and lower marbling evaluations (1 = devoid to practically devoid; 5 = moderately abundant or greater; 1.65 ± 1.94 ± .07, P < .01) of the loin at the 10th rib. There were no significant effects of genotype on consumption, feed conversion, loin firmness, belly firmness or Hunter L*, a* and b* values. Gilts fed CLA had lost 10.8% rib backfat (1.63 ± 1.85 ± .05 cm, P < .05), higher % fat free lean (54.8 ± 53.3 ± .5 %, P < .05), firmer bellies (1 = very soft; 5 = very firm; 2.63 vs 1.93 ± .07, P < .01), higher loin color evaluations (2.28 ± 2.02 ± .05, P < .01), higher loin marbling evaluations (1 = devoid to practically devoid; 5 = moderately abundant or greater; 1.65 ± 1.94 ± .07, P < .01) of the loin at the 10th rib. There were no significant effects of genotype on consumption, feed conversion, loin firmness, belly firmness or Hunter L*, a* and b* values. There were no significant genotype × CLA interactions. In conclusion, CLA enhanced the pork quality, belly firmness and % lean of both genotypes.

Key Words: Pigs, CLA, Pork quality

Gilts (n=224) were randomly assigned to a 4×3 factorial arrangement of diet and duration of CLA supplementation. Pigs (25 kg) were fed one of four corn-based diets (high oil corn (HOC)). Optimun™ high oleic high linoleic corn (HOHOC), conventional corn (CONV) and commercial corn supplemented with choice white grease (CWG) ad libitum to 115 kg. HOC, HOHOC and CWG diets were isocaloric. CLA treatments included no CLA (1% sunflower oil; SFO), finishing with 1.0% CLA from 90 to 115 kg (CLA1) and finishing with 1.0% CLA from 65 to 115 kg (CLA2). CLA oil contains 60% CLA isomers. Corn type affected belly firmness (SFO: 1.58; CONV: 2.27; HOHOC: 2.32; CONV: 2.28; CWG: 2.20 ± .05 kg/day, P < .01) and feed conversion (HOC: 2.64; HOHOC: 2.62; CONV: 2.77; CWG: 2.53 ± .05, P < .05). Gilts fed HOHOC had higher belly firmness scores (1 = very soft; 3 = very firm; HOC: 1.88; HOHOC: 2.55). Gilts fed HOHOC had higher belly firmness scores (1 = very soft; 3 = very firm; HOC: 1.79; HOHOC: 2.13; CONV: 2.03; CWG: 1.95 ± .08, P < .05) than gilts fed HOC. Corn type did not affect loin eye area, 10th rib backfat depth, ADG, drip loss, or fat free lean, subjective measures of loin color, firmness and marbling, or Hunter L*, a* or b* values. Corn type affected marbling scores (1 = very soft; 5 = very firm; SFO: 2.07; HOHOC: 2.26; CONV: 2.32; CWG: 2.40 ± .04, P < .01) and marbling evaluations (1 = devoid to practically devoid; 5 = moderately abundant or greater: SFO: 1.45; CLA1: 1.14; CLA2: 1.52 ± .05, P < .01). The duration of CLA supplementation appears to be related to increased loin eye area, enhanced color and decreased 10th rib backfat depth. CLA did not affect ADG, feed conversion, % fat free lean or Hunter L*, a* and b* values. Corn × CLA interactions were not significant. In conclusion, CLA enhanced fresh pork quality and belly firmness. Gilts fed HOHOC had firmer bellies than gilts fed HOC.

Key Words: Pigs, High oil corn, CLA


Early-weaned pigs (n=64) averaging 5.3 ± 0.3 kg were utilized to evaluate effects of two (dirty and clean) environments and four (0, .67, 1.33 or 2%) dietary CLA-60 levels on growth performance, whole body composition, plasma urea nitrogen (PUN) and serum alpha-1-acylglycoprotein (AGP). A factorial (2x4) arrangement within a split plot design with 8 reps of 5 pigs/pen were fed the same diets from 24 to 111 kg BW with lysine reduced from 1.00 to .85 and .70% at 52 and 78 kg BW. All pigs were scanned at 102 kg BW. ADG and F/G were affected (P<0.01) by dietary energy, but not by CLA. PUN showed a linear decreasing trend on d 14 (P<0.01) and a higher ADFI (20.8, 21.0, 20.5, and 21.3 kg/day by treatments). The duration of CLA supplementation appears to be related to increased loin eye area, enhanced color and decreased 10th rib backfat depth. CLA did not affect ADG, feed conversion, % fat free lean or Hunter L*, a* and b* values. Corn × CLA interactions were not significant. In conclusion, CLA enhanced fresh pork quality and belly firmness. Gilts fed HOHOC had firmer bellies than gilts fed HOC.

Key Words: Pigs, High oil corn, CLA

257  Efficacy of betaine as a carcass modifier in finishing pigs fed normal and reduced energy diets. G. L. Cromwell*, M. D. Lindemann, J. R. Randolph, H. J. Monegue, K. M. Laurent, and J. E. Hammelman, University of Kentucky, Lexington, KY.

Three experiments were conducted to determine if energy density of the diet influences the efficacy of betaine as a carcass modifier. Two dietary energy levels (3.320 vs 3.175 kcal ME/kg) were achieved by feeding a fortified corn-soybean meal diet (CS) or a similar diet with 20% wheat middlings (CSM). The middlings were substituted for corn and soybean meal on a lysine basis. Betaine was included at 1.14 g/kg of diet by adding .125% Betainine. Gilts (n = 224) were randomly assigned to a 4×3 factorial arrangement of diet and duration of CLA supplementation. Pigs (25 kg) were fed one of four corn-based diets (high oil corn (HOC)). Optimun™ high oleic high linoleic corn (HOHOC), conventional corn (CONV) and commercial corn supplemented with choice white grease (CWG) ad libitum to 115 kg. HOC, HOHOC and CWG diets were isocaloric. CLA treatments included no CLA (1% sunflower oil; SFO), finishing with 1.0% CLA from 90 to 115 kg (CLA1) and finishing with 1.0% CLA from 65 to 115 kg (CLA2). CLA oil contains 60% CLA isomers. Corn type affected marbling scores (1 = very soft; 5 = very firm; SFO: 2.07; HOHOC: 2.26; CONV: 2.32; CWG: 2.40 ± .04, P < .01) and marbling evaluations (1 = devoid to practically devoid; 5 = moderately abundant or greater: SFO: 1.45; CLA1: 1.14; CLA2: 1.52 ± .05, P < .01). The duration of CLA supplementation appears to be related to increased loin eye area, enhanced color and decreased 10th rib backfat depth. CLA did not affect ADG, feed conversion, % fat free lean or Hunter L*, a* and b* values. Corn × CLA interactions were not significant. In conclusion, CLA enhanced fresh pork quality and belly firmness. Gilts fed HOHOC had firmer bellies than gilts fed HOC.

Key Words: Pigs, High oil corn, CLA

258  Evaluation of chromium tripicolinate addition and dietary energy level on carcass composition and accretion rates of growing pigs. C. P. A. van de Ligt*, M. D. Lindemann, and G. L. Cromwell, University of Kentucky, Lexington, KY.

Two trials (T1 and T2) evaluated potential interactions of chromium tripicolinate addition with dietary energy levels (T1) and sources (T2). In T1 and T2, respectively, 36 and 40 PIC barrows (25.4 and 23.6 kg mean BW) were used. Pigs were blocked by weight and randomly allotted to six (T1) or eight (T2) treatments in a 2 × 3 or 2 × 4 factorial arrangement of supplemental Cr (0 and 200 ppb) and energy level (70, 80, and 90% of ME requirement) or energy sources (basal, starch, choice white grease [CWG], and corn oil [CO]). A corn-soybean meal basal diet supplied all daily protein, mineral and vitamin needs and 70% of the ME need in two meals that approximated 70% of ad libitum feed intake. In T1, additional energy was added to 80 and 90% by a blend (95/5; wt/wt) of corn starch and CO. In T2, additional energy was added to 90% by either the starch blend, CWG, or CO. Meals were adjusted weekly based on BW. Pigs were slaughtered at 70.1 kg mean BW. No effect of Cr or Cr × ME level was observed (P = .10) in T1. ME levels (70, 80, and 90%) had a linear effect (P < .02) on carcass protein (20.8, 20.1, 19.8%), lipid (13.1, 16.4, 18.3%), and water (61.5, 59.5, 57.2%). Accretion rates were linear (P < .05) for ash (21.1, 23.9, 26.4 g/d), protein (99, 113, 118 g/d), lipid (82, 125, 152 g/d), and water (260, 295, 298 g/d). In T2, Cr (0 and 200 ppb) affected (P < .05) carcass ash (3.80, 3.61%) and ash accretion rate (26.9, 24.4 g/d). The basal diet (70% ME) vs others (90% ME) affected (P < .001) carcass ash (4.0, 3.6%), protein (21.3, 19.4%), lipid (13.5, 19.7%), and water (61.0, 56.8%). Accretion differed for basal vs others (P < .01) in ash (23.0, 26.4 g/d), protein (109, 127 g/d), lipid (66, 147 g/d), and water (293, 356 g/d) and between CO and both starch and CWG in ash accretion (P < .05; 28.4, 25.6, and 25.6 g/d, respectively). Energy level affected carcass composition and accretion rates while chromium tripicolinate addition only had an effect on carcass ash and ash accretion rate in T2.

Key Words: Pigs, Chromium, Energy
259 Effects of dietary lysine and porcine somatotropin on the amino acid composition of whole body protein and accretion rate of whole body lysine in growing pigs. W. W. Dozier III*, G. L. Groupel†, J. Lewis†, and R. M. Diedrichsen‡, 1University of Kentucky, Lexington, KY, 2University of Nebraska, Lincoln, NE.

The effects of pST and dietary lysine (near-ideal blend of amino acids (AA)) on the AA composition of empty, whole body (WB) protein and on WB accretion in growing pigs were assessed. Twenty-five pigs (22.5 kg BW) were individually penned and assigned to 8 treatments (4 diets: 0 vs 2 mg pST (im)/d; JAS 75(Suppl.1):78, 182, 1997). A basal diet (1.50% total lysine) consisted of fortified corn-soybean meal with added lysine (3.33%), threonine (2.22%), methionine (3.30%), and tryptophan (0.03%). Lysine was reduced to 1.25, 1.00, and .75% in 3 diets by diluting the basal with starch, cellulose, and sand. At 60 kg BW, the WB (carcass, head, viscera, blood, nails, hair) was ground and analyzed for protein and AA. Initial composition was determined on 6 additional pigs. The AA in WB protein averaged (mean of initial and final) 6.5% lysine, 3.5% threonine, 3.0% methionine-cysteine, 4.6% valine, 3.4% isoleucine, and .85% tryptophan. Administration of pST increased (P < .001) accretion rates of WB protein and lysine. Increasing dietary lysine increased (quadratic, P < .05) accretion rates of WB protein and lysine in pST-treated pigs (124, 158, 167, 166 and 8.57, 10.30, 11.11, 10.17 g/d), but not in untreated pigs (127, 128, 126, 129 and 8.15, 7.90, 8.30, 7.98 g/d). Lysine in the accreted WB protein was linearly (P < .001) affected by diet in pST-treated pigs (6.9, 6.5, 6.6, 6.1%) but not in controls (6.5, 6.2, 6.6, 6.2%). Based on true ideal digestible lysine intakes of 14.2, 19.1, 23.6, and 24.8 g/d for pST-treated pigs and 16.2, 19.1, 24.4, and 26.7 for controls, the efficiencies of lysine utilization for WB lysine accretion (adjusted for maintenance) were 62, 55, 48, and 42% compared with 52, 42, 34, and 30%, respectively; both were linearly affected (P < .01) by dietary lysine. The results indicate that the dietary lysine needed to achieve maximum WB lysine accretion is markedly increased by pST administration.

Key Words: Pigs, Somatotropin, Amino acids

260 Effects of immunization against GnRH on growth performance, carcass characteristics, and meat quality of intact male pigs. C. A. Maloney‡, R. H. Hines‡, J. D. Hancock§, D. W. Dean§, J. M. DeRouchey§, D. J. Lee§, J. S. Park§, D. H. Kroft†, and T. E. Adams‡, 1Kansas State University, Manhattan, KS, 2University of California, Davis, CA.

Eight barrows and 32 boars (average initial BW of 29 kg) were used in an 82-d growth assay to determine the effects of immunization against GnRH on growth performance, carcass characteristics, and meat quality of intact male pigs. There was one pig per pen and eight pens per treatment. The barrows and boars were fed the same diets (1.4% lysine for 29 to 58 kg BW, 1.25% lysine for 58 to 91 kg BW, and 1.1% lysine for 91 to 117 kg BW) throughout the experiment. Barrows were immunized at 82, 56, and 28-d prior to slaughter with a single, 2 mL, subcutaneous injection of GnRH and keyhole limpin hemocyanin in a 1:1 ratio with Freund’s complete adjuvant. Overall (from 29 to 117 kg), barrows consumed more feed (P < .001), were less efficient (P < .001), and had greater average backfat thickness (P < .001) than boars. However, barrows also had greater dressing percentage (P < .02) and produced loin chops with greater marbling (P < .05) and a tendency for greater water holding capacity (P < .08) than boars. Immunization against GnRH did not affect ADG or gain/feed (P > .21), but decreased prostate (P < .008) weights and tended to decrease bulbourethral (P < .06) and testis (P < .07) weights compared to the control boars. Decreasing the time between injection and slaughter from 82 to 26-d resulted in greater gain/feed and less carcass fatness (linear effects, P < .001 and .01, respectively). The longer time interval improved dressing percentage (linear effect, P < .04) and decreased testicular (linear effect, P < .01) and reproductive gland (linear effects, P < .02) weights. Our results indicate that immunization against GnRH is an effective means of reducing sex characteristics (testis weights and gland size) for intact male pigs.

261 Amino acid supplementation for sows nursing large litters. R. C. Ewan*, G. W. Libal‡, and C. R. Hamilton†, 1Iowa State University, Ames, IA, 2South Dakota State University, Brookings, SD.

A cooperative study was conducted at two stations of the members of the North Central Regional Committee on Swine Nutrition (NCR-42) to determine the response of lactating sows to dietary amino acid supplementation. Primiparous sows (49) were selected at breeding and fed a corn-soybean meal diet (14.3% CP) at 1.8 kg/d during gestation. At farrowing, sows were allotted to one of four dietary lactation treatments: 1) Control corn-soybean meal diet formulated to contain .6% lysine, 2) a corn-soybean meal diet formulated to contain .9% lysine, 3) treatment 1 with the addition of .3% lysine HCl and 4) treatment 1 supplemented with .3% lysine HCl, .06% L-tryptophan and .16% L-threonine. Sows were weighed at breeding, farrowing, within 24 h after farrowing, on d 7, 14, and 21 during lactation and at weaning. Litter size was adjusted to at least 10 pigs per litter within 3 d of farrowing. Individual pig weights were obtained at birth, 7, 14, and 21 d of lactation and at weaning. During lactation, sows were fed three times daily to provide ad libitum access to feed and feed intake was determined on a weekly basis. The days to first estrus were recorded and sows were continued on the experimental treatments for three reproductive cycles. Sows on treatment 3 were heavier than sows on the other treatments at all weigh periods. Birth weights of the pigs were similar among treatments. On d 7, pigs of treatment 3 were heavier than pigs of sows on the other treatments (P < .05). On d 14, 21 and at weaning at 23 d of age, pigs of sows on treatments 2, 3, and 4 were heavier (P < .05) than pigs of the sows on treatment 1. During lactation, ADFI was similar among the treatment groups (6.5 kg) but daily lysine intake increased from 39.7 g/d for treatment 1 to 57.5 g/d for treatment 2 (P < .05) and further increased (P < .05) for treatment 3 (64.1 g/d) and 4 (62.3 g/d). Supplementation lysine from soybean meal or from synthetic lysine improved nursing pig performance. Supplemental tryptophan and threonine did not provide an additional response.

Key Words: Sows, Lactation, Lysine


A cooperative experiment was conducted at four stations (AL, SC, TX and VA) to evaluate the lysine requirement of sows nursing large litters. Stations could begin with gilts or sows but all females remained on their treatments for three parities unless culled for failure to breed, structural unsoundness, or inadequate litter size. Pigs were transferred among litters to achieve minimum litter sizes of 9 and 10 pigs on d-3 of lactation for gilts and sows, respectively. During lactation, females had ad libitum access to diets formulated to contain .60, .75 or .90% lysine by altering the proportions of corn and soybean meal. All sows were fed 1.8 kg of the .60% lysine diet during gestation. Pigs were weaned at about 28 d of age. Data from 479 litters were collected. Dietary treatments did not affect litter size after transfer (10.8), litter size at 21 d (9.6), sow feed intake to d 21 (5.4 kg/d) or days to postweaning estrus (5.9 d). Increasing dietary lysine resulted in a linear decrease (P < .01) in sow weight loss from farrowing to d 21 of lactation (.6, -.4, -.2 kg), but most of this response was due to gilts (-10.8, -.9, -.4 kg, P < .01) not sows (-3.2, -.3, -.1 kg, P > .10). Average pig weights at 21 d were increased linearly (5.2, 5.4, 5.5 kg/pig, P < .01) by increasing dietary lysine, but a treatment x station interaction (P < .05) occurred. At one station (n=254), a linear increase was found, whereas there was no response to .90% lysine at two stations (n=186). At one station (n=39), there was a response to .90% lysine but not .75% lysine. Increasing dietary lysine in the first farrowing tended (P = .07) to increase total (10.5, 160)
10.8, 11.2) and live (9.7, 9.9, 10.2) pigs born/litter in subsequent farrowings. Overall, these data suggest that sows and gilts nursing large litters need at least 30% lysine in corn-soybean meal based diets for maximum reproductive performance.

Key Words: Lysine, Sow, Protein

263 Lysine requirement for maximal lactation and subsequent reproductive performance of multiparous sows. H. Yang1, J. E. Pettigrew2, L. J. Johnston1, G. C. Shurson1, and R. D. Walker1, 1University of Minnesota, St. Paul, 2Pettigrew Consulting International, Louisiana, MO.

The objective of this study is to evaluate the effects of lysine intake during lactation on lactation and subsequent reproductive performance of older sows (PIC C-22). Parity (PA) 2 sows (n = 141; 189 kg BW; 12 mm backfat) and PA 3 sows (n = 103; 204 kg BW; 11.5 mm backfat) were assigned randomly at farrowing to one of five diets (A, B, C, D, E) containing 60, 68.5, 110, 1.35, and 1.6% lysine, respectively, from intact protein sources. All diets contained corn, SBM, 5% corn gluten meal, 5% soybean oil, 2.1 Mcal NE/kg and exceeded NRC (1988) requirements for all other nutrients. Diets were made isoenergetic by including 0 to 8% rice hulls. Each sow nursed 11 pigs and was provided ad libitum access to feed during the 19-d lactation. Increasing dietary lysine resulted in a significant linear reduction in ADFI of sows (PA 2: 6.5, 6.5, 6.2, 5.9, 5.8 kg; P < .01; PA 3: 6.8, 6.6, 6.5, 6.6, 6.2 kg; P < .05 for diets A, B, C, D, E, respectively). Lysine intake had a quadratic effect on litter ADG (PA 2: 2.21, 2.36, 2.31, 2.40, 2.29 kg; PA 3: 2.32, 2.49, 2.42, 2.47, 2.39 kg for diets A, B, C, D, E, respectively; P < .05). Litter ADG did not increase when dietary lysine increased above 85%. Lysine intake had no effect on sow BW and backfat change (-7.5 to 5.0 kg; -1.1 to -3.3 mm in PA 2; 2.6 to 6.7 kg; -5.5 to -8.8 mm in PA 3), piglet mortality (5.1 and the lysine requirement was approximately 55 and 56 g/d for PA 2 and 3, respectively) at PA 4. These results suggest that the lysine requirement for subsequent reproduction is not higher than that for milk production, and the lysine requirement was approximately 55 and 56 g/d for PA 2 and 3 lactating sows, respectively, in this study.

Key Words: Lysine, Sows, Litter size

264 A dynamic model to describe nutrient flow and requirement in lactating sows. S. W. Kim1, M. Grossman, and R. A. Easter, University of Illinois, Urbana, IL.

The objective of this study was to construct a dynamic model to describe nutrient flow and to predict nutrient requirements in lactating sows. Information used for the model included: apparent ileal digestibility of various protein sources in lactating sows, maternal mobilization of nutrients as measured by intake or litter size, nutrient need for mammary gland growth and milk production as influenced by intake or litter size, and the growth of nursing pigs in response to maternal nutrient intake, litter size, and the location of suckled mammary glands. Linear or nonlinear regression models were developed to relate information from eight projects to a dynamic model that simulates nutrient flow during lactation period. The model responds differently to inputs such as day of lactation, daily nutrient intake, litter size, and the location of the suckled mammary gland when used to predict body composition, maternal weight changes during lactation, mammary gland growth during lactation, and growth of nursing pigs. The model also predicts ideal nutrient requirements based on various scenarios of pig and mammary gland growth. This model, for example, predicts that sows need 16.5 Mcal ME and 947 g protein daily when nursing 10 pigs for maximum average daily gain (190.9 g per pig) and maximum mammary gland growth (560.4 g per gland) achieved during a 21-d lactation. At d 21, estimated changes of protein and fat amounts in the maternal carcass were 270 g and -1930 g, liver 31.3 g and -270 g, and gastrointestinal tract 64.2 g and -37.2 g, uterus -385.0 g and -5.4 g, and other organs 21.7 g and 182.47 g, respectively. The amount of ileal digestible protein provided by the corn-soybean meal-based diet was 62.0 g for the 22 kg weaning weight on d 21 of lactation averaged 5.56 kg. There was a 2.2 g protein gain and a 179.4 g fat loss from the sow excluding mammary glands during 21 d of lactation. There was a 311.7 g protein gain and a 513.0 g fat gain in mammary glands during 21 d of lactation. Total litter weight gain was 40.1 kg. This model estimates the prediction of nutrient requirements in lactating sows and the quantification of nutrient mobilization from the sow’s body for milk production.

Key Words: Dynamic Model, Lactating sows, Nutrient requirements

265 Relationship between plasma arterio-venous differences of nutrients across the porcine mammary gland and circulating insulin, prolactin, and IGF-1 concentrations. X. F. Guan1, J. E. Pettigrew2, C. Farmer3, P. K. Ku1, R. J. Tempelman1, and N. L. Trottier1, 1Michigan State University, East Lansing, MI, 2University of Minnesota, St. Paul, MN, 3Agriculture and Agri-Food Canada, Research Center, Lennoville.

The objective of this study was to establish the relationship between plasma mammary arterio-venous (A-V) differences of glucose and essential amino acids (EAA) and circulating insulin, prolactin and insulin-like growth factor-1 (IGF-1). Sixteen sows (Landrace x Yorkshire) were provided ad libitum access to one of 4 diets (4 sows/diet). All diets were isocaloric (3.4 Mcal ME/kg) and contained different levels of protein (7.8, 13.0, 18.2, and 23.5%) having similar ratios of amino acids. On d 4 or 5 of lactation, sows were fitted with carotid arterial and main mammary vein catheters. On d 10, 14, 18, and 22 of lactation, matched sets of arterial and venous blood were collected every 30 min for 6 h. Plasma samples were analyzed for glucose, insulin, prolactin, and IGF-1. Correlations between these variables (adjusted for effects of dietary treatment and day of lactation) were computed by multivariate linear model analyses. Arterial insulin concentrations were closely associated with arterial glucose (r = .75; P < .01) and EAA (r = .38; P < .05), but prolactin and IGF-1 showed no correlation with these nutrients. Concentrations of nutrients and hormones in the mammary vein were highly correlated (r < .01) to their respective arterial concentrations (glucose, r = .96; EAA, r = .86; insulin, r = .99; prolactin, r = .83; IGF-1, r = .82). Mammary A-V differences of glucose and EAA were positively correlated with their arterial levels (r = .80, P < .01; r = .42, P < .05), and with arterial insulin concentration (glucose, r = .46; P < .01; EAA, r = .31, P < .05) but no relationships were found with arterial prolactin or IGF-1. In conclusion, mammary A-V differences of glucose and EAA during lactation were dependent on their arterial concentrations and insulin, outside of the influence of treatment and time.

Key Words: Porcine mammary gland, Arterio-venous difference, Nutrients

266 Effects of dietary caloric ratios of protein to carbohydrate on plasma amino acid concentration differences of insulin and glucose across the porcine mammary gland. X. F. Guan1, P. E. Pettigrew2, P. K. Ku1, and N. L. Trottier1, 1Michigan State University, East Lansing, MI, 2University of Minnesota, St. Paul, MN.

The objective of this study was to evaluate the effect of dietary caloric ratios of protein to carbohydrate (P:C) on plasma amino acid concentration differences (AVc) of insulin and glucose across the porcine mammary gland. A corn-SBM basal was diluted with corn starch and sugar to provide 4 isocaloric (3.4 Mcal ME/kg) diets with an identical pattern of amino acids. Dietary caloric P:C ratios (based on ME) were .539, .365, .232, and .125, respectively. Sixteen sows were provided ad libitum access to 1 of 4 diets (4 sows/diet). On d 10, 14, 18, and 22 of lactation, arterial and mammary venous blood were collected simultaneously every 30 min for 6 h. Plasma samples were analyzed for insulin and glucose. Previously estimated milk yield was the highest at a P:C ratio of .232. Interactions between the caloric ratios and day of lactation were significant for plasma arterial concentrations (A-) of glucose (P < .01) and insulin (P < .05), and for plasma AVc of glucose (P < .01). Both plasma glucose A- and AVc peaked on d 18 of lactation and at the P:C ratio of .232 (Table). Plasma insulin A- was the highest between d 14 and 22 of lactation and at the P:C ratio of .232. Plasma insulin AVc peaked from d 14 and d 22 of lactation and at the P:C ratio of .232 (P < .05). Therefore, the ideal dietary caloric ratio of protein to carbohydrate is .232 for milk production in lactating sows.

One hundred fifty-three sows (parities one to four) were used to determine the effects of dietary electrolyte balance (Na + K - Cl) on lactation performance. The sows were fed corn-soy diet for the first 10 days of gestation. The sows were then randomized to receive one of five dietary treatments: 1) normal corn-soy diet for gestation; 2) control diet with supplemental NaHCO3; 3) diet 1 with supplemental soybean meal and fat to make it isocaloric; 4) diet 1 with supplemental soybean meal and fat to make it isocaloric and have the required body weight and subcutaneous fat thickness by the onset of the third physiological heat; and 5) 2.54% NaHCO3.

The sows were started on diets 2-5 days prior to parturition. Five hundred one sows were used in a 28d lactation experiment. Mean d2 litter size after adjustment was 10.0 pigs. Dietary treatments were: 1) normal corn-soy diet for gestation; 2) control diet with supplemental NaHCO3; 3) diet 1 with supplemental soybean meal and fat to make it isocaloric and have the required body weight and subcutaneous fat thickness by the onset of the third physiological heat.

Key Words: Swine, Neutral detergent fiber, Digestibility


**Key Words:** Sows, Lactation, Electrolyte Balance

**271** Effect of providing sows natural or synthetic vitamin E at two dietary levels over a 5-parity period. D. C. Mahan*1, Y. Y. Kim1, and R. L. Stuart2,1 The Ohio State University, Columbus, OH, 2Stuart Products, Inc.

A study using a total of 48 gilts evaluated the effects of synthetic DL-α-tocopheryl acetate (DL-α-TAC) and natural D-α-tocopherol acetate (D-α-TAC) with each added at 30 or 60 IU/kg diet and provided from 40 kg body weight through 5-parities (171 farrowings). The study was a RCBD design conducted in 2 replicates with sows nested within dietary treatment for a 5-parity period. Sow weights, backfat thickness, litter performance, incidence of MMA were evaluated at each parity. Pigs were bled at periodic intervals during gestation and at weaning with the serum analyzed for α-tocopherol. Colostrum, milk collected from the sow, and the serum collected from 3 pigs per litter at weaning, and liver tissue from 5 pigs at weaning in parity 5, were analyzed for α-tocopherol. There was no effect (P > 0.15) of vitamin E source or level on litter size, or for the various sow weights, feed intakes, or incidences of MMA. Feeding D-α-TAC resulted in higher (P < 0.01) sow serum, colostrum, and milk α-tocopherol contents at each measurement period, compared with the DL-α-TAC source, and as the dietary vitamin E levels increased. Although sow tissue α-tocopherol tended to be somewhat higher at the end of the 5-parity period when D-α-TAC was fed, there was no significant effect (P > 0.15) of vitamin E source. There was, however, an increase (P < 0.01) in sow liver, adipose, lung, and heart α-tocopherol contents when the higher dietary vitamin E level had been fed. Serum and liver α-tocopherol contents were higher (P < 0.01) in the pigs at weaning when sows had been fed D-α-TAC compared with the DL-α-TAC source. Although the supplemental vitamin E sources were provided on an equivalent IU basis, these results suggest that the bioavailability of D-α-TAC was more than the 1.36 value ascribed to it compared to DL-α-TAC.

**Key Words:** Vitamin E, Reproduction, Pig

**272** Performance of starter pigs fed reduced calcium and phosphorus diets with microbial phytase included at different coefficients of variation. B. W. Cousins*1, M. B. Coelho1, B. W. Moenching2, J. D. Crenshaw2, and D. P. Holzgrafe2,1 BASF Corporation, 2MoorMan's, Inc.

A 21-day experiment was conducted to evaluate the effect of dietary microbial phytase (Natuphos) added at the same concentration (300 FTU/kg) but with three different addition rate coefficients of variation (CV) on performance and metacarpal bone measurements in starter pigs (10 kg BW). A total of 96 pigs were allotted by litter, weight and sex to one of four dietary treatments. Treatments consisted of: 1) a basal corn-soybean meal diet (C); 2) as 1 plus phytase added at a low CV (L); 3) as 1 plus phytase added at a medium CV (M); and 4) as 1 plus phytase added at a high CV (H). The basal diet was formulated to contain 0.70% Ca and 0.55% P. All other nutrients were formulated to meet or exceed the requirements (1988 NRC) of 10 kg pigs. To achieve the different CV application rates of phytase, 909 kg batches for each diet were produced and divided into 40 equal portions. Each portion was mixed with different concentrations of phytase, then fed in predetermined sequences during the experiment to create the intended CV. Calculated cumulative consumption of phytase and %CV, based on analyzed phytase content of the diets and daily measurements of feed disappearance was 320 FTU/kg, 25.9%; 303 FTU/kg, 42.4%; and 287 FTU/kg, 54.7% for the L, M, and H treatments, respectively. Regression analysis of the phytase treatments revealed non-significant linear or quadratic (P ≥ 0.10) differences between the L, M, and H CV treatments for gain, feed intake, gain/feed and metacarpal bone measurements. Pigs fed C grew slower, consumed less feed, had reduced feed efficiency, and less energy was required (P ≤ 0.05) to break the metacarpal bones than the average of the pigs fed the L, M, and H CV treatments. Pigs fed the H CV application rate tended (P ≥ 0.10) to gain slower and have a poorer feed efficiency than either the phytase treated L CV or the M CV treatments. These results of this experiment suggest that a CV application rate of phytase up to 25% can be tolerated by 10 kg pigs without adverse effects on performance or metacarpal bone integrity.

**Key Words:** Pigs, Phytase, Coefficient of Variation

**273** Effect of different levels of potato chip scraps on the performance of nursery pigs. S. Rahnema* and R. Borton, Agricultural Technical Institute, Ohio State University, Wooster, OH.

One hundred thirty eight pigs (avg. wt. 6.94 kg) were used in an experiment to determine the effect of feeding potato chip scraps (PCS) as a source of energy on the performance of nursery pigs. Nursery pigs were blocked by sex and weight and randomly assigned to three treatments in a randomized complete block design experiment. Each treatment consisted of four pens of 11 to 12 pigs each. In treatment one (control), 46 pigs were fed a diet consisting of soybean meal and corn supplemented to meet NRC requirements. In treatments two and three, 15% and 20% of the corn respectively, were replaced with 15% and 20% of PCS. After seven days of adaptation to the pens and diets, a performance trial was conducted over a 42-d period to measure feed intake (FI), total gain (TG), average daily gain (ADG), and gain to feed ratio (G/F) for these pigs. Individual pig weights and pen feed consumption were determined on a weekly basis. Total gain and ADG were not affected by the replacement of corn with PCS. Feed intake was linearly reduced (P < 0.02) as the level of PCS was increased in the diet. Gain to feed ratio was linearly increased (P < 0.01) with increasing the level of SPC in the diet. No quadratic effect was noted for any of the parameters that were measured in this study. This experiment demonstrates that PCS can be an effective and even somewhat beneficial in the diet of nursery pigs.

**Key Words:** Nursery pigs, Potato chips, Performance

**274** Effects of chemical hydrogenation of dietary fat on apparent lipid digestibility by finishing swine. L. A. Averette*, M. T. See, and J. Odle, North Carolina State University, Raleigh, NC.

Diet high in unsaturated fat result in soft carcass fat depots which may be sub-optimal for subsequent pork processing, especially in lean genotype pigs. Increasing the saturated fatty acid content of added dietary fat (AF) can improve pork quality, provided the fat is adequately digested. However, saturated fats are not currently available in large volumes or at competitive prices. Therefore, we evaluated chemically hydrogenated fat. In three experiments chronic oxide was added to feed for 7d to measure the apparent digestibility of AF that was fully hydrogenated (FH), partially-hydrogenated (PH) and PH products blended with other fat sources. In trial 1, diets containing 5% AF comprised of 100, 66.7, 33.3 or 0% FH (Iodine value, IV = 0) animal fat with the balance contributed by soy oil, were fed to 24 gilts (n = 6/trt). Digestibility decreased linearly (72.6, 61.2, 26.0, and -12.0 ± 7.4%; P < .0001) as the amount of FH fat in the diet increased, suggesting the FH fat had a digestibility near 0. Trial 2 evaluated (4 x 2 factorial; n = 6/trt) diets containing 5% fat blended to achieve an IV of 20, 30, 40, or 50 compared to PH tallow with identical IV values. Digestibility of diets formulated with PH tallow was greater than those containing blended fat (73.3 vs 67.2 ± 1.4%; P < .01), particularly at lower IV values (P < .1). In trial three, digestibility was measured in 96 pigs (n = 24/trt) fed 5% choice white grease partially-hydrogenated to an IV of 80, 60, 40, or 20. Decreasing iodine value did not alter digestibility (69.7, 68.2, 69.2, and 66.2 ± 1.3%; P > .1). Improvements in digestibility were mirrored by improvements in feed efficiency. We speculate that chemical hydrogenation alters the intermolecular distribution of fatty acids.
acids among triacylglycerols, thereby impacting digestibility. These experiments indicate that partial-hydrogenation is superior to blending unsaturated fat with saturated fat sources and that digestibility is not affected by reducing the IV of a partially-hydrogenated fat.

Key Words: Pig, Digestibility, Fat

275 Adipic acid (AA) increases plasma lysine, but does not reduce lysine requirements in weanling pigs. T. van Kempen*, North Carolina State University, Raleigh, NC

Cerdan et al. (1988) showed that rats dosed with AA had increased liver lysine. This may have been caused by an inhibition of the lysine degradation cascade as AA shows great structural similarity to products of the lysine degradation cascade. Research was undertaken to I) evaluate if AA affected plasma amino acid concentrations in pigs, and to II) evaluate if the requirements for the affected amino acids were reduced. In trial I, 14 individually housed pigs (barrows, 15 kg) were fed either a standard nursery diet, or the same diet fortified with 1% AA. Six days after the start of diet supplementation, plasma samples were obtained for the analysis of free amino acids. The results of this analysis showed that lysine was elevated with 18% (P = .07) and threonine with 15% (P = .17). In trial II, 56 individually housed barrows (9-13 kg) were divided into the following seven control (supplied 90% of the digestible amino acids based on the NRC, 1998), or this same diet with either lys, thr, or try reduced to 70% of the NRC (1998) with or without AA. Growth performance was monitored over a 15-d period. The results of this trial showed that animals fed the lysine deficient diet had a lower (P < .05) feed efficiency than the controls (0.510 and 0.578, respectively). AA supplementation further reduced feed efficiency (0.475, P < .05 compared to controls, P = 12 compared to the lysine deficient animals). Animals fed the threonine and tryptophan deficient diets had suppressed feed efficiency (0.558 and 0.555, respectively), but this depression was not significant (P = .38 and .32, respectively). Supplementation of these diets with AA further reduced feed efficiency (0.519, P = .12, and 0.524, P = .19, respectively). Surprisingly, it was not possible to induce threonine and tryptophan deficiency using the above diets. Nevertheless, the data obtained confirm that AA does affect amino acid metabolism, but not such that it reduced the requirement of the amino acid.

Key Words: Lysine, Requirement, Swine


The objective was to determine the effects of using high oil corn (HOC) in a nursery phase feeding program and monitor growth performance through to market. Two groups of 300 crossbred pigs were weaned, segregated by sex and weight into small, medium and heavy groups, and allotted to 12 nursery pens. Pigs received one of two dietary treatments; (1) a transitional phase I diet for 7 d; a corn-based phase II diet for 14 d and a phase III diet (NCIII) for 7 d; (2) a HOC-based phase II diet for 21 d and the NCIII diet for 7 d. BW, ADFI and F/G ratios were measured weekly during the nursery period. Pigs were transferred to a grow/finish barn on d 28, and BW and ultrasound measurements were taken for back fat (BF) and loin eye area (LEA) at the 10th and 21 (P = .0137) and 28 (P = .0134). LEA for pigs fed the three-phase diet was greater than pigs fed the HOC two-phase diet at d 21 (P = .0034) and 28 (P = .0128). ADG for heavy pigs was greater (P = .0001) than that of medium and light weight pigs, and no treatment x weight group interactions were observed (P = .2043). Pigs fed the three-phase diet had lower F/G ratios than pigs fed the HOC two-phase diet at d 21 (P = .0137) and 28 (P = .0134). LEA for pigs fed the three-phase diet was greater than pigs fed the HOC two-phase diet when measured at d 28 as 21 (P = .0565) and last rib (P = .0370). There were no effects of dietary treatment on BF. Even though pigs were fed alike in the grow/finish period, ADG of nursery pigs on the three-phase diet was greater than pigs fed the HOC two-phase diet at d 21 (P = .0137) and 28 (P = .0134). LEA for pigs fed the three-phase diet was greater than pigs fed the HOC two-phase diet when measured on d 28 as 21 (P = .0565) and last rib (P = .0370). There were no effects of dietary treatment on BF. Even though pigs were fed alike in the grow/finish period, ADG of nursery pigs on the three-phase diet was greater (P = .0106) than that of pigs fed the HOC two-phase nursery diet. Throughout the grow/finish period there was a tendency (P = .0728) for pigs fed the three-phase nursery diet to be leaner than pigs fed the HOC two-phase nursery diet. These results suggest that removal of the transitional phase I diet, and the substitution of HOC for corn in a phase II diet, does not support maximal BW and lean gains of pigs in the nursery and subsequent grow/finish periods.

Key Words: Nursery pigs, High oil corn, Phase feeding

277 Potential for identity preserved plasma protein and ProBlend™-65 in phase 1 off-site nursery diets. C. V. Maxwell1, C. S. Wright1, B. Z. de Roos1, M. E. Davia1, Z. B. Johnson1, B. R. Dunsford2, and J. D. Hahn2

An experiment involving 216 weaning barrows (18 ± 2 d of age; Premium Standard) was conducted to determine the efficacy of identity preserved plasma protein (IPP; plasma protein obtained from Premium Standard pigs) or porcine plasma as the source of plasma used in producing ProBlend™-65 (PB). At weaning, pigs were blocked based on initial BW and penned in groups of six (six pens per treatment) in an off-site nursery facility. Treatments (TRT) were: 1) a negative control (NC) phase 1 diet containing 19.5% soybean meal (SBM), and devoid of plasma protein or PB, 2) the NC diet with 4.0% IPP and 10.0% SBM (IPP was added at the expense of SBM on an equal lysine basis), 3) as 2 with identity preserved PB replacing IPP, 4) as 2 with generic PB replacing IPP, 5) as 2 with generic porcine plasma replacing IPP, and 6) as 2 with Appetein replacing IPP. Substitutions in all diets were made on an equal lysine basis at the expense of corn. The diets were equalized in total lysine (1.58%), and lactose (14.7%) content, and formulated to meet the ideal protein ratio. Experimental diets were fed from d 0 to 10; then all pigs were fed common phase 2 (1.4% lys) and phase 3 (1.25% lys) diets for 14 d each. During Phase 1, ADG for TRT 1 to 6 was 166, 247, 249, 240, 272, and 255 g, respectively (NC vs others, P < .01). Gain/feed for TRT 1 to 6 was .38, .53, .52, .50, .56, and .55, respectively (NC vs others, P < .01). During phase 2, pigs previously fed the NC diet had a higher ADG (P < .01) and G/F (P < .01) than those previously fed the plasma based diets. During phase 3 and for the overall study, pigs previously fed identity preserved PB tended to have a higher ADG than those fed generic PB whereas pigs fed generic porcine plasma grew faster than those fed IPP (interaction, P < .1 and P < .08, respectively). Results from this study suggest that any advantage of identity preserved plasma protein over generic plasma protein as the plasma source for nursery diets is minimal.

Key Words: Pigs, Protein Source, Performance

278 Nutri-Sure® vs steam rolled oats in starter diets for weanling pigs. G. L. Cromwell, H. J. Monegue*, and M. D. Lindemann, University of Kentucky, Lexington, KY

Steam rolled oats (SRO) are routinely used in starter diets in some herds because of their palatability and perceived protection against diarrhea. Two trials were conducted to assess a nutrient-certified product consisting of cooked breakfast cereal fines (Nutri-Sure® [NS]; International Ingredient Corp., St. Louis, MO) as an alternative to SRO. Nutri-Sure contains approximately 7% CP, 21% lysine, 3% fat, 2% fiber, and 18% sucrose. In Exp. 1, 96 pigs (8 reps of 4 pigs/pen; 5.9 kg BW, 20.2 d) were fed fortified Phase I diets (1.4% lys) of mainly corn, soybean meal, 15% dried whey, and 3% dried plasma for 7 d. During Phase II (21 d), lysine and whey were reduced to 1.2 and 7.5%, respectively, and soy meal, 15% dried whey, and 3% dried plasma for 7 d. During Phase II (21 d), lysine and whey were reduced to 1.2 and 7.5%, respectively, and plasma was removed. All diets had 55 mg carbachol and 250 mg Cu/kg. Treatments were (1) basal diet, (2) basal + 10% SRO, and basal + 10% NS. Average daily gain, ADFI, and feed/gain (F/G) for wk 1 were 145, 159, 150 g/d; 213, 236, 209 g/d; and 1.48, 1.51, 1.40, respectively. Over the entire 28-d test, pigs fed NS tended to gain faster and consume more feed (P < .10) than those fed the basal diet (327, 336, 354 g/d; 504, 522, 549 g/d), but F/G was not affected (1.55, 1.57, 1.55). In Exp. 2, 72 pigs in 2 treatment groups (9 reps of 4 pigs/pen; 6.8 kg, 20.6 d) were given a choice of (1) the basal or NS diets and (2) the SRO or NS diets for 28 d. Diets were the same as in Exp. 1. Feeders were switched 3 times/wk in each pen. Average daily gain, ADFI, and F/G were not different (P = .20) for the 2 groups (368, 400 g/d; 599, 645 g/d; 1.66, 1.62) but performance tended to favor the SRO-NS group over the basal-NS group. Preference (% of intake) for the NS diet was greater (P < .01) than for the basal diet during wk 1, 2 and 3 (23 vs 77%, 19 vs 82%, 25 vs 75%) and over the entire 4-wk period (33 vs 67%), but not during wk 4 (45 vs 50%). Preference was similar for the SRO vs NS diets during wk 1, 2, 3, 4, 13 (48 vs 52%, 47 vs 53%, 51 vs 49%, 52 vs 48%) and overall (50 vs 50%). These results indicate that Nutri-Sure® is at
least equal and perhaps superior to steam rolled oats when included at 10% in starter diets for weanling pigs.

Key Words: Pigs, Cereal, Rolled Oats

280 Effect of copper source on performance of weanling pigs. B. Z. de Rodas1, C. V. Maxwell1, M. E. Davis1, D. C. Brown1, Z. B. Johnson1, and T. M. Falker2. 1University of Arkansas, Fayetteville, AR, 2Zinpro Corp., Eden Prairie, MN.

An experiment involving 120 pigs (19 d of age; 5.9 kg BW) was conducted to determine the effect of copper source on performance of weanling pigs. Pigs were blocked based on initial BW and penned by weight of five (6 pens/treatment) in a conventional nursery. Treatments (TRT) were: 1) control diet containing all trace minerals from standard inorganic sources, 2) as 1 with 250 ppm Cu from CuSO4, 3) as 1 with 100 ppm Cu from Availa-C copper amino acid complex (CuAAM, Zinpro Corp.), 4) as 1 with 100 ppm Cu from CuPLEX copper lysine (CuLys; Zinpro Corp.), and 5) all diets were fed in the pelleted form in three phases: d 0 to 10 (1.52% lys), 10 to 24 (1.35% lys), and 24 to 38 (1.15% lys). Dietary copper concentrations were maintained throughout the 38 d trial, and copper source replaced corn in the control diet. During d 0 to 24 postweaning (phases 1 and 2 combined), ADG, ADFI, and G:F for TRT 1 to 4 were 315, 384, 360, 370 g/d; 413, 482, 439, 473 g/d; and 76, 80, 82, 79, respectively. Copper supplementation, regardless of Cu source, resulted in improved (P < .05) ADG. Feed intake was greater (P < .05) in pigs receiving CuSO4 and CuLys than in those receiving the control diet. Gain/feed, however, was not affected by dietary treatments. During d 24 to 38 and during the overall experiment, pigs fed CuSO4 or CuLys had greater (P < .1) feed intake than those fed the control diet. Pigs fed the control diet, however, had greater (P < .05) gain/feed than those fed the diets with added Cu during d 24 to 38 postweaning. These data indicate that during the first 24-d postweaning, Cu supplementation, regardless of Cu source, resulted in increases in ADG and ADFI. One hundred parts per million Cu from CuLys or CuAAM were as effective as 250 ppm Cu from CuSO4 in improving gain during d 0 to 24 postweaning.

Key Words: Pigs, Copper Source, Performance

281 Liquid diets accelerate growth of early-weaned pigs and effects are maintained until market weight. J. H. Kim1, J. Odle2,2, K. N. Heo1, K. I. Han1, and R. J. Harrell1. 1Seoul National Univ., Suweon, Korea, 2North Carolina State University, Raleigh.

Piglets (N=240, 11 d old, 3.93 kg) were allotted to one of four treatments in a 2X2 factorial design to examine the effects of diet physical form and nursery environment during 14 d post-weaning on growth to market weight. During the treatment period, pigs were housed (10/pen) with either a conventional hot nursery (designated C, ambient temp. = 24 C) or a segregated temperature nursery (designated S, ambient temp. = 30 C, with accompanying hot-box hovers maintained at 32 C). Pigs in each environment were fed nutritionally identical diets (>24% CP, 1.97% Lys, and 60 % Met) in either liquid (L) or dry-pellet (D) form. Subsequently, all pigs were fed identical dry diets, and were housed within common grower-finisher facilities (penned by sex, 5/pen). At the end of treatment period (d 14), pigs fed the L diet were 21% heavier than pigs fed the D diet (9.22 vs. 7.60; P<.0001). Similarly, gain, feed intake and gain/feed of liquid-fed pigs were 44%, 18% and 22% greater respectively than observed for pigs fed the D diet (P<.0001). No main effect of environment was observed (P>10); however, an interaction with diet type was observed during the early-nursery period (P<.01). Pigs fed the L diet showed better performance. Pigs fed the D diet were favored in the S nursery. No differences in growth performance or in ultrasound carcass measurements were detected during the growing-finishing period (P>.10). However, the advantage in body weight of liquid-fed pigs gained during the first 2 wk post-weaning was maintained to the end of the trial (113.85 vs. 110.57; P<.05). Pigs that were fed the early-nursery diet in liquid form reached 110 kg 4.7 d faster than the dry-fed controls (P<.001). The results suggest that liquid feeding during early life can markedly accelerate piglet growth performance and that the growth advantage is maintained until market weight.

Key Words: Liquid feeding, Nursery environment, Pigs

282 Effects of amino acid substitutions for whey protein concentrate on weanling pig performance. J. Chung1, S. D. Carter, and J. C. Whisenhunt, Oklahoma State University, Stillwater, OK.

A total of 120 pigs (21 d, 6.64 kg BW) was used to evaluate the efficacy of replacing whey protein concentrate (WPC, 77% CP) with crystalline amino acids on growth performance and plasma urea nitrogen (PUN) of weanling pigs. Pigs were blocked by BW, sex and litter and allotted randomly to 5 dietary treatments (4 pens/trt of 6 pigs/pen). Diet 1 (control) consisted of corn, soybean meal, dried whey, plasma protein (3.5%), blood meal (1.5%), and WPC (9.6%). In Diet 2, WPC was replaced with Lys, Thr, Met, Trp, Ile, and Val on an ideal basis. Diet 3 was as Diet 2 with Gly, Glu, and Asp (NEAA) added to approximate NEAA ratio in the feed. Diets 4 and 5 were as Diet 3 with additions of Trp, Phe, and Tyr (TPT) or Pro, His, and Arg (PHA), respectively, to approximate ratios to lysine in the control diet. Experimental diets were fed during Phase 1 (d 0-14); then all pigs were switched to a common Phase 2 (1.35% Lys) and 3 (1.15% Lys) diet. ADG, ADFI, and G:F for Phase 1 were, respectively, 328, 281, 259, 265, and 266 g/d; 345, 350, 324, 307, and 311 g; and .951, .807, .800, .860, and .854. Pigs fed the control diet grew faster and were more efficient (P < .01) than pigs fed Diet 2. Addition of NEAA, TPT, or PHA to Diet 2 did not affect (P > .10) growth performance. PUN were determined at the end of Phase 1 and were, respectively: 7.94, 1.18, 4.32, 6.18, and 6.45 mg/dL. PUN were markedly lower (P < .01) for pigs fed Diet 2 as compared with pigs fed the control. Addition of NEAA to Diet 2 increased (P < .01) PUN, but the greatest increase (P < .01) in PUN was observed with addition of either TPT or PHA to Diet 3. Over the entire 42-d period, ADG and G:F did not differ between pigs fed Diet 1 and 2. However, ADG and G:F remained lower for pigs fed NEAA, TPT, and PHA as compared to those fed Diets 1 and 2 during Phase 1. These results suggest that replacement of WPC with an ideal blend of AA in early pig performance during Phase 1 of the nursery period. Addition of NEAA, TPT, or PHA to an ideal blend of AA did not improve growth performance.

Key Words: Amino acids, Pigs, Growth performance

Key Words: Pigs, Protein Source, Performance
283 Comparison between wet and dry feeding for group fed first stage pigs. P. G. Lawlor* and P. B. Lynch, Teagasc, Moorepark Research Centre, Fermoy, Co. Cork, Ireland.

Liquid feed systems for newly weaned pigs have been installed on several pig units in Ireland. The objective of these experiments was to examine the effects of liquid feeding first stage pigs on performance to slaughter. In experiment 1, 24 pens of 16 pigs weighing 8.4 kg were blocked on sex and weight and randomly assigned to 2 treatments (1) dry feed and (2) wet feed. Pigs on both treatments were fed 2 kg starter (212 g/kg crude protein, 66 g/kg oil, 19 g/kg crude fibre) and 5 kg link (234 g/kg crude protein, 75 g/kg oil, 19 g/kg, crude fibre) followed by weaner diet to d-27. In experiment 2, 20 pens of 16 pigs weighing 7.8 kg were blocked on sex and weight and randomly assigned to 2 treatments (1) pelleted dry and (2) wet feed. Pigs on both treatments were fed 3 kg starter (327 g/kg crude protein, 92.5 g/kg oil, 36 g/kg crude fibre) and 6 kg link (270 g/kg crude protein, 71 g/kg oil, 31 g/kg, crude fibre) followed by weaner diet to d-27. In both experiments liquid feed was prepared daily as a 2 : 1 (water : meal) mix. Standard weaner (213 g/kg crude protein, 34 g/kg oil, 34 g/kg crude fibre) and finisher diets (187 g/kg crude protein, 28 g/kg oil, 37 g/kg, crude fibre) were fed in both experiments. In experiment 1, liquid fed pigs had a poorer average daily gain (ADG) (296 vs 338 g/day, SE 10, P < 0.01) from d 0 to 27 and feed conversion efficiency (FCE) (1.68 vs 1.51, SE 0.02, P < 0.01) from d 0 to 55. Finisher ADG, FCE or carcass quality were not affected by treatment (P > 0.05). In experiment 2, liquid feeding reduced ADG (352 vs 384 g/day, SE 10, P < 0.05) from d 0 to 27 and FCE (1.78 vs 1.64, SE 0.02, P < 0.01). It is concluded that liquid feeding first stage pigs reduced feed intake, weanling growth performance and feed wastage. Pigs were allotted to 24 pens based on body weight, gender, and litter of origin and received one of 5 treatments for growing pigs (Hampshire-Yorkshire-Duroc). The cottonseed meal analyzed 14.4% CP, .34 lys, .37 thr, .20 met, and .44 ile. In Exp 1, treatments were: (1) basal diet, wheat, vitamins and minerals (.33 lys, .36 thr), (2) +lys (.76 lys, .36 thr), (3) +lys+thr (.76 lys, .51 thr), (4) +lyn+lys+met (.76 lys, .51 thr), (5) control, wheat-soybean meal diet (.76 lys, .60 thr). Each diet was fed to six replications of one pig from 25.5 to 42.6 kg. Gain, feed intake, lys intake, thr intake, and feed/gain were: 295, 490, 831, 757 g/d; 1.52, 1.69, 1.78, 1.69 kg/d; 5.9, 13.9, 14.6, 14.7 kg/d; 5.5, 6.1, 9.1, 10.1 g/d; 5.9, 3.4, 2.20, 2.35, 2.49, respectively. Lys addition increased ADG (P < 0.05), feed intake (P < 0.05), lys intake, and improved feed/gain (P < 0.01). Addition of thr, resulted in further increase in daily gain, thr intake, and feed/gain (P < 0.01); but, met inclusion decreased weight gain, and feed efficiency (P < 0.01). Pigs fed the control diet grew slower and less efficient than those fed the lys-thr added diet. In Exp 2, treatments were: (1) basal diet (wheat, lys, vitamins, and minerals), .51 lys, .36 thr, (2) +lys (76 lys, .36 thr), (3) +lys+thr (76 lys, .51 thr), (4) +lys+lys+met (76 lys, .51 thr), (5) control, wheat-soybean meal diet (76 lys, .60 thr). Each diet was fed to six replications of one pig from 25.5 to 42.6 kg. Gain, feed intake, lys intake, thr intake, and feed/gain were: 640, 734, 602, 651, 764 g/d; 1.73, 1.65, 1.81, 1.70, 1.70, 1.80 kg/d; 13.8, 13.2, 14.5, 13.6, 14.4 g/d; 6.2, 6.5, 9.2, 8.7, 9.2 g/d; 2.73, 2.39, 3.06, 2.70, 2.89, respectively. Addition of thr tended to increase daily gain and improved feed/gain (P < 0.10). Pigs fed the basal diet added with thr had a higher weight gain and better feed efficiency (P < 0.05) than those fed the control diet. These data suggest that all the soybean meal can be replaced by crystalline lys and thr in wheat-based diets without affecting the performance of growing pigs.

Key Words: Weaning pigs, Proline solubles, Fish solubles

286 Amino acid supplementation of wheat-based diets for growing pigs. M. Cervantes*, J. González, N. Torrenera, and S. Espinoza, Instituto de Ciencias Agrícolas, Universidad Autónoma de Baja California, Calexico, CA.

Two 28-d experiments were conducted to assess the value of adding crystalline amino acids to wheat-based diets on performance of growing pigs (Hampshire-Yorkshire-Duroc). The wheat (soft winter) analyzed 11.6% CP, .34 lys, .37 thr, .20 met, and .44 ile. In Exp 1, treatments were: (1) basal diet, wheat, vitamins and minerals (.33 lys, .36 thr), (2) +lys (.76 lys, .36 thr), (3) +lys+thr (.76 lys, .51 thr), (4) +lys+lys+met (.76 lys, .51 thr), (5) control, wheat-soybean meal diet (.76 lys, .60 thr). Each diet was fed to six replications of one pig from 25.5 to 42.6 kg. Gain, feed intake, lys intake, thr intake, and feed/gain were: 295, 490, 831, 757 g/d; 1.52, 1.69, 1.78, 1.69 kg/d; 5.9, 13.9, 14.6, 14.7 g/d; 5.5, 6.1, 9.1, 10.1 g/d; 5.9, 3.4, 2.20, 2.35, 2.49, respectively. Lys addition increased ADG (P < 0.05), feed intake (P < 0.05), lys intake, and improved feed/gain (P < 0.01). Addition of thr, resulted in further increase in daily gain, thr intake, and feed/gain (P < 0.01); but, met inclusion decreased weight gain, and feed efficiency (P < 0.01). Pigs fed the control diet grew slower and less efficient than those fed the lys-thr added diet. In Exp 2, treatments were: (1) basal diet (wheat, lys, vitamins, and minerals), .51 lys, .36 thr, (2) +lys (76 lys, .36 thr), (3) +lys+thr (76 lys, .51 thr), (4) +lys+lys+met (76 lys, .51 thr), (5) control, wheat-soybean meal diet (76 lys, .60 thr). Each diet was fed to six replications of one pig from 25.5 to 42.6 kg. Gain, feed intake, lys intake, thr intake, and feed/gain were: 640, 734, 602, 651, 764 g/d; 1.73, 1.65, 1.81, 1.70, 1.70, 1.80 kg/d; 13.8, 13.2, 14.5, 13.6, 14.4 g/d; 6.2, 6.5, 9.2, 8.7, 9.2 g/d; 2.73, 2.39, 3.06, 2.70, 2.89, respectively. Addition of thr tended to increase daily gain and improved feed/gain (P < 0.10). Pigs fed the basal diet added with thr had a higher weight gain and better feed efficiency (P < 0.05) than those fed the control diet. These data suggest that all the soybean meal can be replaced by crystalline lys and thr in wheat-based diets without affecting the performance of growing pigs.

Key Words: Pigs, Amino acids, Wheat

287 Evaluation of dietary level of cottonseed meal on performance and carcass traits of growing pigs. M. Cervantes¹, J. González, N. Torrenera, and S. Espinoza, Instituto de Ciencias Agrícolas, Universidad Autónoma de Baja California, Calexico, CA. 2Colegio de Postgraduados, Montecillo, Mx.

Two experiments were conducted to evaluate the effect of adding cottonseed meal to grain sorghum- or wheat-soybean meal diets on performance and carcass traits of finishing pigs (Hampshire-Yorkshire-Duroc). The cottonseed meal analyzed 39.8% CP, 1.81 lys, 1.48 thr, .70 met, .44 ile, 1.28 lys, and 1.98% val. In Exp 1, diets were: (1) basal, wheat-soybean meal, vitamins and minerals (.70 lys, .2), (2), (3), and (4) cottonseed meal replaced soybean meal at 15, 30, and 45%, respectively. Diets 2, 3, and 4 were contained added crystalline lysine and thr to equal their levels in Diet 1. Each diet was fed to four replications of two pigs from 52.0 to 95 kg.

Key Words: Pigs, Amino acids, Wheat
Gain, feed intake, and feed/gain, backfat, and loin area were: 873, 809, 869, 812 g/d; 2.38, 2.39, 2.40, 2.50 kg/d; 2.72, 3.11, 2.76, 3.08; 1.98, 1.94, 1.72, 2.22 cm; 27.8, 29.9, 29.8, 29.4 cm², respectively. The inclusion of cottonseed meal, up to 45% as proportion of the soybean meal, did not affect the daily gain, feed intake, feed/gain, backfat depth, or loin area (P > .10). In Exp. 2, the treatments were: (1) basal, ground sorghum-soybean meal; vitamins, and minerals (70% lys), (2), (3), and (4) cottonseed meal replaced soybean meal at 25, 50, and 75%, respectively. Gain, feed intake, and feed/gain were: 928, 972, 899, 898 g/d; 2.89, 3.00, 2.85, 2.80 kg/d; 3.11, 3.09, 3.18, 3.12, respectively. Likewise Exp. 1, daily gain, feed intake, and feed efficiency of finishing pigs were not affected by the inclusion of any level of cottonseed meal on the expenses of soybean meal, in grain sorghum-soybean meal diets. These data suggest that up to 75% of dietary soybean meal can be replaced by cottonseed meal without affecting the performance of finishing pigs.

Key Words: Pigs, Cottonseed meal, Soybean meal

288 Effect of different levels of potato chip scraps on the performance of growing and finishing pigs. S. Rahnema* and R. Burton, Agricultural Technical Institute, Ohio State University, Wooster, OH.

One hundred thirty eight pigs (avg. wt 28.32 kg) were used in an experiment to determine the effect of feeding potato chip scraps (PCS) as a source of energy on the performance of growing and finishing pigs. Pigs were blocked by sex and weight and randomly assigned to three treatments in a randomized complete block design experiment. Each treatment consisted of four pens of 22 to 23 pigs each. In treatment one (control), 45 pigs were fed a diet consisting of soybean meal and corn supplemented to meet NRC requirements. In treatment two and three, 15% and 20% of the corn, respectively, was replaced with 15% and 20% of potato chip scraps. After the nursery phase, pigs were moved to growing and finishing pens and a performance trial was conducted over a 91- to 98-d period to measure feed intake (FI), total gain (TG), average daily gain (ADG), and gain to feed ratio (G/F). Individual pig weights and pen feed consumption were determined on a weekly basis. Since the pigs were of the same final weight, differences were not affected by treatments. However, pigs on the 20% PCS required 7 d longer to reach the final weight. Feed intake was reduced (P < .007) across all treatments. Feed intake was reduced (P < .007) and G/F increased (P < .01) linearly due to an increase in the level of PCS in the diets. Similarly ADG was increased (P < .01) linearly due to an increase in the percentage of SPC in the diets. This experiment demonstrates that PCS can be effective and even somewhat beneficial in the diet of nursery pigs.

Key Words: Growing-finishing pigs, Potato chips, Performance


This study was conducted to investigate the effects of lysine to digestible energy (DE) ratio on growth performance, nutrient digestibilities and blood urea nitrogen (BUN) for estimating the optimal lysine:DE ratio in grower diet. A total of 138 pigs (LexYSD, 16.78 kg average body weight, 69 barrows and 69 gilts) were randomly allotted into six treatments by a 2x3 factorial design and eighteen cannulated pigs (9 barrows and 9 gilts) were employed in digestive trial to investigate apparent digestibilities and ileal digestibilities of nutrients. Three diets were formulated with a crude protein level of 19%, a DE level of 3.5 Mcal/kg, and three lysine:DE ratios of 3.2 (low), 3.5 (middle), and 3.8 (high). H g lysine/Mcal DE per kg diet for both barrows and gilts. Increasing dietary lysine:DE ratio, body weight gain (ADG) of barrows decreased though there was no significant difference observed among treatments (P > .05), however, the tendency in gilts was reverse compared with barrows. For barrows, the significant differences (P < .05) of lysine:DE ratio on feed intake (ADFI) and feed efficiency (G/F) were observed for overall period. For gilts, ADFI was higher during d 36 to 49, while F/G was better during d 0 to 14 (P < .05). For overall period, the optimal G/F was in groups with low and high lysine:DE ratio for barrows and gilts, respectively. The higher apparent digestibilities and apparent ileal digestibilities of nutrients could be achieved when diets provided contained low and high lysine:DE ratios for barrows and gilts, respectively. Data of blood urea nitrogen was negatively related to growth rate. It is concluded that the optimal lysine:DE ratios were 3.2 and 3.8 g lysine/Mcal DE per kg diet for growing barrows and gilts (16.5 kg of body weight), respectively.

Key Words: Lysine:DE Ratio, Growth Performance, Barrow and Gilt

290 Effects of α-Galactosidase enzyme on ileal digestibility and large intestine fermentation in finishing pigs fed a cereal-soybean meal-peat diet. F. Baccellini, J. Morales1, J. F. Perez2, and J. Gasca2.

Ileal digestibility and cecum fermentation were studied in finishing pigs after a two months production experiment in which supplementing the diet with α-galactosidase (Biogalactosidase, Quest; 290 Units/kg) improved average daily gain, feed/gain conversion ratio and overall apparent digestibility. Eighteen crossbred pigs were selected at an average live weight of 86 kg. The basal diet contained ground corn, 44%; ground barley, 18%; soybean meal, 10%; peas, 25% and 0.2% chronic oxide as a digestibility marker, either unsupplemented or supplemented with the enzyme. After 14 d of feeding the experimental diets the animals were slaughtered and samples of the ileum and cecum digesta were obtained. Ileal estibility of the DM and different components of the non-starch polysaccharides (NSP), and rectal digestibility of DM and CP were estimated. Concentration of volatile fatty acids (VFA) and purine bases were measured in caecum digesta. The use of the enzyme improved the digestibility in ileum (DM, 633 vs 465 g/kg, P < .05) and rectum (DM, 864 vs 818; and CP, 817 vs 731 g/kg, P < .05). Ileal digestibility of NSP, monosaccharides were also higher for galactose, rhamnose, mannose and fucose (P < .05) in the enzyme supplemented diet. Cecum concentrations of VFA (mmol/g) were lower in the enzyme diet for total (121 vs 134, P = .15), butyric (15.5 vs 19.6, P = .09), valeric (1.76 vs 3.12, P < .01) and branched-chain-VFA (isovaleric + isobutyric acids, 2.24 vs 3.32, P < .01). Volatile fatty acids profile for the enzyme treatment was also lower (P < .01) for the branched-chain and higher for propionic (P < .05). Concentration of total purine bases in cecum digesta was lower in the enzyme treatment (9.1 vs 13.6 mmol/gDM, P < .001). The results showed that adding α-galactosidase enzyme to cereals-soybean meal-peat diet improves its digestibility and reduces the amount of fermentable substrate arriving to the large intestine in finishing pigs.

Key Words: Pig, Galactosidase, Digestibility

291 Molasses/fat combination as a nutrient source for swine and ducks. S. L. Selin, M. E. Einstein, O. Adeola, and B. G. Harmon, Purdue University, West Lafayette, IN.

The study consisted of two separate experiments, a duck metabolizable energy (ME) assay, and a swine grow-finish trial to evaluate the potential utility of a molasses/fat supplement. Thirty-six male White Pekin ducks were assigned based on a randomized complete block design to one of three treatments: (1) feed-deprived; (2) cornstarch; and (3) molasses/fat supplement for the purpose of determining bioavailable energy of the supplement. To assess the affects of the molasses/fat supplement on pig performance, 144, 25 kg pigs (1:1, barrows:gilts) were used. The pigs were allotted to four treatments with six pigs per pen, and six pens per treatment. The four diets were: [1] 16.3% CP, 9% lysine, 3.2 kcal/g ME, corn/meal diet with 10% corn starch; [2] 16.3% CP, 9% [y3ine, 3.2 kcal/g ME, corn/meal diet with 10% molasses/fat supplement; [3] Diet 1 + 17% L-lysine HCl; and [4] Diet 2 + 17% L-lysine HCl. Lysine was reduced by 18% in the finisher diets compared to the grower diets. Pens were switched from grower to finisher diets at an average pig weight of 52 kg. Carcass analysis was performed when an average pig weight of 112 kg was attained. The ME of the molasses/fat supplement was superior to cornstarch (5.91 vs. 4.10 kcal/g) on a dry matter basis. On an as-fed basis, the ME of the molasses/fat supplement was superior to cornstarch (5.91 vs. 4.10 kcal/g) on a dry matter basis. Carcass data, (loin eye area, backfat, fat free lean index, and carcass yield), were similar (P > .05) across the four treatments. The addition of L-lysine HCl to Diets 3 and 4 did not alter (P > .05) carcass composition or performance. Based on the results of the study, the molasses/fat liquid
supplement can be substituted for up to 10% of the diet and maintain or increase daily gain and feed intake.

Key Words: Molasses/fat product, Pigs, Ducks


Seventy-two entire male pigs (28 ± 1.0 kg) were used to study the effects of 3 wheat inclusion levels with or without expander processing on grower-finisher pig performance in a 3 x 2 factorial arrangement of treatments. Productive performance and nutrient digestibility (n = 4) were determined in individually fed pigs offered pelleted diets ad libitum containing a high wheat diet (550 g/kg wheat, 62 g/kg soybean meal (SBM), 100 g/kg rape meal seed meal (RSM), 150 g/kg peas (PS), 100 g/kg wheat feed (WF) and 18 g/kg beef tallow), medium wheat (410 g/kg wheat, 20 g/kg SBM, 125 g/kg RSM, 200 g/kg PS, 150 g/kg WF, 45 g/kg corn meal and 26 g/kg beef tallow) and low wheat (180 g/kg wheat, 125 g/kg RSM, 250 g/kg PS, 177 g/kg WF, 150 g/kg corn meal and 35 g/kg beef tallow). The expanded diets were processed at 105 °C for 5 seconds at 25 bars. All diets were formulated to have similar concentrations of digestible energy and ideal protein. Starch content of 440, 400 and 310 g/kg and crude fibre content of 48, 58 and 74 g/kg were recorded for the high, medium and low wheat diets, respectively. Neither level of wheat or expansion had an effect (P > .05) on the apparent nutrient digestibility of the diets, however, expansion did tend to decrease the digestibility of DM and energy (P < .01). The reduction in wheat inclusion levels decreased (P < .05) average daily gain (ADG) (0.899 vs 0.887 vs 0.854 kg/day, SE = .014) from 28 kg to slaughter weight range. Expansion had no effect on any growth criteria.

Key Words: Pigs, Expanders, Wheat

293 A nutrient database for distiller’s dried grains with solubles produced from new ethanol plants in Minnesota and South Dakota. M. H. Whitney*, M. J. Spiels, and G. C. Shurson, University of Minnesota, St. Paul, MN.

A study was conducted to evaluate the nutrient content and variability of distiller’s dried grains with solubles (DDGS) originating from new (less than 5 yrs old) ethanol plants in MN and SD. Ten plants (8-MN, 2-SD) participated in the study, submitting a total of 88 samples. Samples of DDGS were collected every two months during 1997 (n=38) and 1998 (n=50) and were sent to the University of Missouri for amino acid analysis, and Iowa Testing Laboratories, Inc., for DM, CP, crude fiber, crude fat, ash, ADF, NDF, Ca, P, Mg, Na, K, Mn, Cu, and Fe analysis. Digestible energy (DE), ME, and NFE levels were also calculated. Means and coefficients of variation for each nutrient among all plants during 1997-98 were: DM (89.3 ± 1.6%), CP (30.5 ± 5.6%), crude fat (10.7 ± 1.2%), crude fiber (8.8 ± 7.9%), ash (5.7 ± 14.8%), NFE (44.3 ± 6.0%), ADF (16.0 ± 15.3%), NDF (43.2 ± 7.8%), DE (1796 kcal/kg, 2.1%), ME (1627 kcal/kg, 2.2%), Thr (11.3 ± 5.8%), Val (1.51 ± 6.7%), Met (5.45 ± 13.3%), Ile (1.14 ± 8.0%), Leu (3.58 ± 5.9%), Phe (1.48 ± 6.3%), His (0.76 ± 7.8%), Lys (0.82 ± 18.2%), Arg (1.18 ± 9.3%), Trp (0.24 ± 9.8%), Ca (0.06 ± 57.3%), and P (0.89 ± 12.2%), respectively. Among the amino acids analyzed, Lys was the most variable (CV=18.2%), followed by Met (CV=13.3%) and Trp (9.8%). Nutrient levels of MN-SD DDGS were higher in crude fat, ADF, DE, ME, Lys, Met, Thr, and Trp and lower for DM, ADF, Ash, and P than NRC (1998) values. Values differed between year sampled (1997 vs 1998) for Val (1.48 ± 1.52%) (P < .10). DM (89.63 vs 89.09%), crude fat (10.7 ± 1.2%) (P < .05), ADF (38.74 vs 8.65%), and NFE (11.51 vs 12.20%) (P < .05); and Lys (0.77 vs 0.85%) (P < .10). These results suggest that gross energy and total lysine, methionine, threonine and tryptophan levels are higher in DDGS from MN and SD ethanol plants compared to published NRC (1998) values.

Key Words: Distiller’s Dried Grains with Solubles, Nutrients

294 Energy, nitrogen, and phosphorus digestibility of growing and finishing swine diets containing distiller’s dried grains with solubles. M. J. Spiels*, G. C. Shurson, and M. H. Whitney, University of Minnesota, St. Paul, MN.

Two nutrient balance trials were conducted to determine the digestibility of energy, nitrogen, and phosphorus of Minnesota-South Dakota (MNSD) produced distiller’s dried grains with solubles (DDGS) in grower and finisher swine diets. Sixteen pigs weighing 28.6 ± 2.2 kg in Exp 1, and 16 pigs weighing 84.4 ± 6.2 kg in Exp 2, were randomly assigned to one of four corn-soybean meal based dietary treatments: control (0% DDGS), 10% DDGS, 20% DDGS and 30% DDGS. Total Lys and P levels were constant across dietary treatments within each experiment. Pigs were housed in individual metabolism crates for 10 d and limit fed an average of 1031 g/d and 1676 g/d of their respective experimental diets in Exp 1 and Exp 2, respectively. Urine and feces were collected on d 8 to 10. Feed, feces, and urine were analyzed for N, P, and GE content. Increasing DDGS level in the diet tended to increase GE and N intake in both experiments. Dietary DE and ME were lower (P < .05) for the control diet (3638 and 3611 kcal/kg, respectively), compared to the 10, 20, and 30% DDGS diets (3862 and 3841, 3824 and 3796, 3787 and 3757 kcal/kg, respectively) in Exp 1. In Exp 2, DE and ME were greater (P < .10) in the 10% DDGS diet (3876 and 3831) compared to 30% DDGS (3628 and 3579). Nitrogen retention (%) did not differ between treatments (P > .05) in both experiments, but N retention tended to increase with increasing amounts of DDGS in the diet. Feeding 20% DDGS increased % P retention compared to the control and 30% DDGS diets (P < .10) in Exp 1, and feeding the 10% DDGS diet increased % P retention compared to the control diet in Exp 2. Adding increasing amounts of DDGS to the diet tended to decrease P excretion in both experiments. These results suggest that feeding 10 to 20% MNSD DDGS will increase dietary DE and ME, improve P retention and reduce P excretion, and maintain N retention while tending to increase N excretion when fed to grow-finishing pigs.

Key Words: Pigs, Distiller’s dried grains with solubles, Digestibility

295 Effects of two sources of dietary L-carnitine on nitrogen and energy balance in growing pigs. J. W. Frank*, B. T. Richert1, S. A. DeCamp1, C. Thomas1, and K. Q. Owen2, 1Purdue University, West Lafayette, IN, 2Lonza, Inc., Fair Lawn, NJ.

Two experiments were conducted to determine the effects of dietary L-carnitine on nitrogen and energy balance in growing pigs. For the trial carnified (P = 97 to 103% L-carnitine) and carniking (K = 50% L-carnitine product) were used as the source of carnitine sources. In the first experiment, 24 barrows (initial BW = 34 kg) were fed in metabolism creates for 14 days and fed one of 3 diets. Pigs were fed limit fed a 8.5% lysine diet at 0.5x BW. Carnitine products were included to provide 50 ppm L-carnitine and replaced cornstarch in the control diet (C). All pigs were fed twice daily and were allowed ad libitum access to water. Pig weights and serum samples were collected on d 0, 7, and 14. Serum samples were analyzed for urea nitrogen concentration and carcass levels. During the last 4 d of the trial, total fecal, orts, and 10% of urine volume were collected and frozen twice daily. Experiment 2 was identical to experiment 1; however, twelve barrows (4 pigs/treatment) with an initial BW = 23.7 kg received a 95% lysine diet. In addition, serum samples were not analyzed for carnitine concentrations. In experiments 1 and 2, dietary carnitine did not significantly affect energy or nitrogen utilization in growing pigs (P > .10). In addition, there were no significant differences between the two L-carnitine sources (P > .10). The results for the blood urea nitrogen concentrations showed no significant differences in d 7 or d 14 samples (P > .10). Experiment 1, K and P pigs had greater total (7.48 and 8.02 vs 5.35 µmoles/ml) and free (6.55 and 7.05 vs 4.33 µmoles/ml) L-carnitine concentrations in their serum on d 14 than C pigs (P < .006 and P < .01; respectively). The data from these experiments suggest that L-carnitine supplementation did not affect the energy or nitrogen metabolism of the growing pig. The growing pig absorbed both sources of supplemental L-carnitine with equal efficacy.

Key Words: Carnitine, Nitrogen balance, Pigs
296 Effects of dietary thiamin, folacin, or niacin regimen on growth in high lean pigs. T. R. Lutz\textsuperscript{1}, T. S. Stahly, D. R. Cook, and R. C. Ewan, Iowa State University, Ames, IA.

In three separate trials, pigs from a high lean strain were reared via a segregated early weaning scheme (weaned 8 to 14 d of age, physically isolated from other pigs), penned individually and given ad libitum access to a basal diet supplemented with 600% of the NRC estimated requirement for all vitamins except choline and the respective test vitamin. In each trial, pigs were allotted within litter to dietary treatment and fed from 8.5 ± 1.5 to 26 ± 3 kg BW. In trial 1, pigs (10 pens/trt) were fed a pelleted basal diet (2.05 ppm thiamin) supplemented with thiamin equivalent to 0, 130, 260, 390, and 520% of the NRC (1998) estimated requirement for 10 to 20 kg BW pigs. Thiamin regimen did not affect (P > 0.10) nutrient digestibility. In trial 2, pigs (12 pens/trt) were fed a pelleted rice basal diet (4.52 ppm folacin) supplemented with 0, 100, 200, 300, and 400% of the folacin requirement. Folacin regimen did not affect (P > 0.10) nutrient digestibility. The increase in dietary CF linearly decreased (P < 0.05) feed intake, ADG, or Fa (84, 76, 79 g/d). Based on these data, the dietary needs of high lean, high health pigs (8 to 26 kg BW) for thiamin, folacin, and niacin, respectively, are estimated to be 205, 173 and 75% of the current estimated requirements for 10 to 20 kg BW pigs (NRC, 1998).

Key Words: Thiamin, Folacin, Niacin.

297 The influence of crude fibre level and fat supplementation on grower-finisher pig performance. J. V. O’Doherty\textsuperscript{1}, S. G. McGlynn, D. Murphy, and J. J. Callan, University College Dublin, Ireland.

Seventy-two entire male pigs (38 ± 1.0 kg) were used to study the effects of increased crude fibre (CF) level in the diet, and maintaining the digestible energy (DE) content of the diet by increased dietary fat inclusion, on pig performance in a 3 x 2 factorial arrangement of treatments. Productive performance and nutrient digestibility (n = 4) were determined in individually fed pigs offered expander processed pelleted diets ad libitum, and containing 3 levels of CF (50, 65 and 80 g/kg) and 2 levels of CF fat supplemented (15 and 25% lysine ratio) starter and grower diets, and CF at 100 g/kg. All diets were formulated to have similar concentrations of DE (3.22 MJ/kg) and lysine (10 g/kg) and the fat source was a 60:40 blend of tallow and palm oil. There was no CF x fat interaction in any comparison. The inclusion of 50 g/kg fat in the diet reduced (P < 0.05) feed intake (2.28 vs 2.43, SE = .039), average daily gain (ADG) (0.877 vs 0.927, SE = .017), and carcass ADG (0.655 vs 0.700, SE = .011). The increase in dietary CF level linearly decreased (P < 0.05) feed intake, ADG, carcass ADG and kill out proportion. Carcass characteristics were unaffected by treatments. The increase in dietary CF linearly decreased (P < 0.05) dietary protein digestibility. There was a (P < 0.01) CF x fat interaction (P < 0.01) in dry matter (DM), oil and energy digestibility. The increase in CF level linearly decreased (P < 0.05) the DM, energy and oil digestibility while the inclusion of 50 g/kg fat decreased (P < 0.01) DM and energy digestibility and increased (P < 0.05) oil digestibility. However, the inclusion of 50 g/kg fat in the diet reduced (P < 0.01) DM and energy digestibility of the diets at the 50 g/kg and 65 g/kg CF level, however, fat inclusion level had no effect at 80 g/kg CF. The inclusion of 50 g/kg fat in the diet increased (P < 0.01) oil digestibility at the 50 g/kg and 65 g/kg CF levels, however, fat inclusion had no effect at the 80 g/kg CF inclusion. In conclusion, increasing both the CF level and supplemental fat had a negative effect on pig growth performance and nutrient digestibility.

Key Words: Pig, Fiber, Fat.

298 Effects of adding wheat midds to low crude protein, amino acid supplemented diets for finishing pigs. J. A. Shriver\textsuperscript{1}, S. D. Carter, B. W. Senne, and L. A. Petney, Oklahoma State University, Stillwater, OK.

Ninety-six pigs, initially weighing 28 kg, were utilized to evaluate the effects of adding wheat midds to low crude protein, amino acid (LPAA) supplemented diets on growth performance, carcase traits, and plasma urea nitrogen (PUN) of finishing pigs. Pigs were blocked by BW, sex, and litter and allotted randomly to 4 dietary treatments (6 reps of 4 pigs/pen). Dietary treatments were: (1) fortified corn-soybean meal control, (2) as 1 with CP lowered by 4 percentage units and supplemented with Lys, Thr, Met, and Trp, (3) as 2 plus 10% wheat midds, and (4) as 2 with 20% wheat midds. Wheat midds (.64% Lys) were added to the LPAA diets at the expense of corn and soybean meal. Lysine HCt was added to make all diets isonitrogenic, and Thr, Met, and Trp added were fed to Diets 2-4 on an ideal basis. Diet 1 was formulated to 18, 16, and 14% CP (.95, .80, and .65% Lys) for 28-54, 55-83, and 82-111 kg, respectively. Diets 2-4 were formulated to 14, 12, and 11% CP for the three phases, respectively. ADG and G:F were, respectively: 75, .70, and .72 kg; and .302, .305, .306, and .309. Lowering CP and adding AA reduced (P < .10) ADG, but addition of 10 or 20% wheat midds did not affect growth rate. Lowering CP and adding AA or the addition of wheat midds to LPAA did not affect (P > .10) G:F. At 111 kg, pigs were killed to determine carcase traits. LMA, 10th rib fat depth, and % lean were, respectively: 46.5, 41.6, 43.3, and 41.4 cm², 2.24, 2.07, 2.40, and 2.22 cm; and 53.4, 52.8, 51.9, and 52.1%. Pigs fed the LPAA diets had similar (P < .10) LMA, but 10th rib fat depth and % lean were not affected (P > .10) by diet. Pigs were bled at the end of each phase for determination of PUN. Reducing CP and adding AA reduced (P < .01) PUN, but addition of wheat midds did not affect (P > .10) PUN. These data suggest that reducing CP by 4 percentage units and adding AA reduces growth rate of finishing pigs; however, the addition of 10 or 20% wheat midds to a LPAA diet had little effect on growth performance, carcase traits, or plasma urea nitrogen.

Key Words: Pigs, Amino Acids, Wheat midds.

299 Effect of wheat quality and quantity in the diet on the growth performance of finishing pigs. P. B. Lynch\textsuperscript{1} and P. G. Lawlor\textsuperscript{1,2}.\textsuperscript{1} Teagasc, Moorepark Research Centre, Fermoy, Co. Cork, Ireland.

There has been increased interest in formulating diets with high inclusion levels of wheat. The objective of these experiments was to examine the effect of wheat quality and quantity in the diet on finisher pig performance. In experiment 1, 72 pigs of c. 38 kg were blocked on sex and weight and randomly assigned to 3 wheat- soya diets formulated with (1) high quality (HQ), (2) good quality (GQ), and (3) poor quality wheat (PQ). HQ, GQ and PQ had hectolitre weights of 74.4, 73.3 g and 67.0 g respectively and their yeast and mould count was 4.5 ± 104, 38 ± 104, and 65 ± 104 /g respectively. In experiment 2, 12 pens of 3 pigs (c. 35 kg) were blocked on sex and weight and randomly assigned to 3 dietary treatments with different levels of wheat (1) 700 g/kg, (2) 500 g/kg, and (3) 300 g/kg. All diets were formulated to 11.2 g/kg lysine and 13.6 Mj/kg and fed dry as a 5 mm pellets. In experiment 1 carcass ADG was 5.55 ± 0.05, 5.54 and 5.79 g/d for HQ, GQ and PQ respectively. In experiment 2 treatment had no significant effect on DFI, ADG or FCE (p > 0.05). P2 Fat depth was 13.5, 11.7, and 11.1 mm (s.e. 0.7, p < 0.05) for treatments 1, 2 and 3 respectively. It is concluded that ADG and FCE can be improved by selecting higher quality wheat. Pigs fed low quality wheat can in some cases maintain a good ADG by increasing their intake. P2 fat depth increases as wheat inclusion in the diet increases from 300 g/kg to 700 g/kg.

Key Words: Wheat, Finishing pigs, Quality.

300 Effects of dietary tannic acid on feed intake, daily gain, and salivary glands of young pigs. J. A. Ford, Jr.\textsuperscript{1,1}, I. Osaka\textsuperscript{2,1}, and W. L. Hurley\textsuperscript{1}.\textsuperscript{1} University of Illinois at Urbana-Champaign. 2Hokkaido-Shintoku Animal Science Institute, Hakkaido, Japan.

Dietary tannins adversely affect protein digestibility. Objectives of the current study were to determine the effects of dietary tannic acid on feed intake, daily gain, and salivary gland weights of young pigs. Twenty-four barrows (PIC C-22 X PIC 346), at about five weeks of age and 10 kg body weight (BW), were randomly placed into one of six groups (N = 4 per group). Groups were fed a standard growing diet (corn-soybean mix with added minerals and vitamins) containing added tannic acid (TA) at 0, .125, .25, .5, 1.0, or 2.0 %, Barrows were placed in individual pens.
for a seven-day pretreatment period, followed by five days of receiving dietary treatment. Feed intake and body weights were recorded daily. Salivary glands were collected at slaughter on d 13, and weights of the parotid and submandibular glands recorded. Total intake of TA for the dietary treatment period was 0, 6.8, 10.5, 23.9, 46.2, and 87.2 g for the 0, 125, 25, 5, 1.0 and 2.0 % added TA groups, respectively. Regression analysis showed that the rate of increase of feed intake for the dietary treatment period declined as intake of TA increased (P = .02). No significant differences in average daily gain were observed during the 5 d dietary treatment period. Parotid gland weights increased as dietary TA increased (P = .003). Parotid gland weights of pigs in the 0 % and 2.0 % added TA groups were 12.9 ± 4.2 g and 59.8 ± 7.5 g, respectively. When expressed as a percentage of BW the parotid gland weights increased as dietary TA increased (P = .003). Parotid gland weights were .09 ± .02 % and .38 ± .03 % of BW for the 0 % and 2.0 % added TA groups, respectively. In contrast, no significant differences in weights of submandibular glands were observed. Increased dietary intake of TA did not affect average daily gain or submandibular gland weight, but resulted in a significant increase in parotid gland weight. The pig parotid gland is specifically sensitive to the level of dietary tannin.

Key Words: Barrows, Tannic Acid, Salivary Glands

301 Effects of sorghum starch type, endosperm hardness, and processing technologies on growth performance of broiler chicks and nutrient digestibility in finishing pigs. H. Cao*, J. D. Hancock, B. W. Senne, J. M. Jiang, R. H. Hines, and K. C. Behnke, Kansas State University, Manhattan KS.

Two experiments were conducted to determine the effects of sorghum genotype and processing technologies on chicks of different digestibility proteins in pigs. Six sorghums were grouped into soft (851111), medium (279 & PL-1), hard (Segolane and 475), and waxy (XFG739) categories. Energy requirements were less to grind and steam flake Segolane than the other sorghums. Also, waxy sorghum required the less energy to steam flake than the other sorghums. In a 21-d growth assay with 690 (average initial BW of 90 g) broiler chicks, the sorghums were coarsely ground to 1,000 mm, finely ground to 450 mm, steam-flaked at 70°C, and extruded at 110°C. The processed grains were added to diets that were sorghum-soybean meal-based and formulated to 1.32% lysine. Grinding improved ADG (P < .01) and gain/feed (P < .04) compared to thermal processing, but thermal processing gave better retention of DM, N, and GE (P < .03). Also, retention of nutrients was greater with fine grinding vs coarse grinding (P < .05) and extrusion vs steam flaking (P < .08). No sorghum genotype effects were observed for growth performance, but chicks fed soft sorghum had greater (P < .01) nutrient retention than chicks fed the medium and hard endosperm sorghums. There were sorghum genotype x processing method interactions, with gain/feed for chicks fed the medium and hard genotypes responding more to fine grinding (vs coarse grinding) than did chicks fed the soft sorghum (P < .05). Also, GE retention of the waxy sorghum responded more to fine grinding (vs coarse grinding) and less to extrusion (vs steam flaking) than the other sorghums (P < .04). When ground to a single particle size (550 mm) and fed to finishing pigs (average initial BW of 64.5 kg), digestibility of DM (P < .01) and GE (P < .07) were less for waxy sorghums than the other genotypes. Also, the hard sorghums were more digestible (P < .06) than the medium hardness sorghums. In conclusion, retention of DM and GE were greater in finishing pigs fed hard vs soft sorghums but the opposite was true in broiler chicks. Furthermore, the interactions observed in the chick growth assay suggested that specific genotype x processing method combinations must be identified to yield sorghum-based diets of optimal nutritional value.

Key Words: Sorghum processing, Chick, Pig

302 The effects of dietary feather meal concentration on growth performance, feed intake, and carcass characteristics. K.-W. Su*, M. C. Brumm, P. S. Miller, and H.-Y. Chen, 1University of Nebraska, Lincoln, NE.

Thirty-six individually penned crossbred barrows and gilts were used in a finishing experiment (initial wt = 58.6 kg) with 6 replications to determine the effects of dietary feather meal (FM) additions on ADG, ADFI, and carcass characteristics. The experiment was a 2 (10 and 20%) FM x 2 (60 and 75 kg starting weight (BW)) that FM feeding was initiated) factorial treatment design with control barrow (CB) and gilt (CG) groups fed no FM. Diets for CB were formulated to contain .59 and .49 true ileal digestible lysine and CG and FM diets were formulated to contain .68 and .57 true ileal digestible lysine from 60 to 86 and 86 to 110 kg, respectively. There was no difference in ADG (P > .1) among treatment groups. Barrows fed 20% FM from 75 kg had decreased ADFI similar to that of CG (2.75 vs 2.72 kg, P > .1). Barrows consumed less feed the first week after the 20% FM diets was initiated and gradually increased thereafter. However, barrows fed 20% FM diet consumed less feed than CB. Feed intake was affected (P > .1) in pigs fed 10% FM diets compared to CB. Control gilts had improved feed efficiency and lean gain compared to CB (2.01 vs 2.35 and 302 vs 234 g/d, P < .05). Barrows fed 20% FM from 75 kg tended to have reduced backfat depth vs CB (23.0 vs 27.0% P < .07). Barrows fed 20% FM from 75 kg had carcass lean percentages similar to CG (48.6 vs 49.7 %, P > .1) and greater than CB (48.6 vs 45.7 %, P < .05). Feather meal increased plasma urea concentrations (PUC) of the FM groups compared to CB and CG one week after FM treatment was initiated (P < .05). For the last two weeks before slaughter, barrows fed 20% FM from 75 kg tended to have greater PUC/shit (P < .1). Barrows fed 20% FM from 60 kg were 62.5, 63.6 vs 56.1 mg/100mL w, t (P > .1). Feeding 20% FM to barrows from 75 kg decreased ADFI, backfat depth, and improved carcass lean percentage.

Key Words: Barrows, Feather meal, Feed intake


An experiment was conducted to evaluate the effects of soybean hulls (SH) containing varying ratios of insoluble:soluble fiber on ileal and total tract nutrient digestibilities by dogs. Six ileal-canulated dogs were fed seven diets in a 6 x 7 Youden square arrangement. Seven diets included five SH-containing diets with insoluble:soluble fiber ratios of 1.9, 2.7, 3.2, 5.2, or 7.2 and two control diets containing either beet pulp (BP) as a fiber source or 0% supplemental fiber. Diets contained poultry by-product meal (44.5% of DM), brewer’s rice (36.1% of DM in the 0% fiber diet), and poultry fat (15.7% of DM) as the main ingredient. There was a substitution of 7.5% BP for dog’s rations in the BP and SH-containing diets. Ileal digestibilities of DM, OM, CP, total dietary fiber, fat, and GE were lower (P < .05) for dogs fed diets containing supplemental fiber (avg. 65.1, 71.6, 65.2, -17.5, 93.1, and 76.5%, respectively) compared to dogs fed the 0% fiber diet (79.3, 84.2, 74.4, 16.7, 95.6, and 86.2%, respectively). Fiber inclusion had a modest negative effect (P < .05) on total tract DM, OM, fat, and GE digestibilities (avg. 72.3, 79.3, 92.6, and 81.7%, respectively) compared to the 0% fiber diet (78.5, 85.7, 94.1, and 86.1%, respectively). Dogs fed the diet containing BP had higher (P < .05) total tract digestibilities of OM, CP, and GE (82.1, 76.2, and 83.7%, respectively) compared with dogs fed diets containing SH (avg. 78.8, 72.3, and 81.3%, respectively). Ileal digestibilities of DM and OM by dogs fed the SH treatments responded quadratically (P < .05) to increasing insoluble:soluble fiber ratios, with digestibility coefficients decreasing as the insoluble:soluble fiber ratio approached 3.2. Highest ileal digestibilities were observed for treatments with insoluble:soluble fiber ratios of 1.9 and 7.2. The ratio of insoluble:soluble fiber in SH affects DM and OM digestibilities at the ileum, indicating that optimization of this ratio is desirable.

Key Words: Dog, Soybean hulls, Fiber

304 Soybean hulls as an energy source for weanling horses. E. A. Ott* and J. Kviptetl, University of Florida, Gainesville, FL.

Soybean hulls have been used as a feed ingredient for horses for many years. However, they have generally been used as a fiber source. The NRC (1989) gives soybean hulls an energy value of 1.88 Mcal/kg DM, which is comparable to a medium quality grass hay. Recent evidence suggests that soybean hulls have a higher energy value than assigned. Two feeding trials were conducted to evaluate the energy value of soybean hulls by using them to replace oats in a concentrate for weanling horses. In Exp. 1, sixteen Thoroughbred and Quarter Horse foals were weaned at 112 d of age and started on the experiment at 143.2 days of age. The foals were assigned at random within breed and gender subgroups to either the oats or soybean hull based concentrate. The
soybean hulls replaced oats at 25% of the concentrate. The concentrations were fed individually to appetite for two, 1.5 hr feeding periods daily. C. bermudagrass (Cynodon dactylon) hay (12.8% CP) was group fed at 1.0 kg/100 kg BW daily. Weights and measurements of the foals were made at 14 d intervals for 112 d and the foals were radiographed for bone mineralization at the start of the study. In Exp. 2, used thirteen weanlings starting at 143.8 d of age, and was identical to Exp. 1 except for the source of the hay. In Exp. 1, no differences in feed or nutrient intake, weight gain or body length measurements gains were detected (P > .05) except for body length gain which was greater for the foals on the oat based concentrate (P = .04). The foals gained 73 and 70 kg/day on the oat and soybean hull concentrates, respectively. Bone mineral deposition was not different between groups (P > .05). Results suggest that soybean hulls have an energy value for horses that is more similar to oats than medium quality grass hay. At protein intakes below requirements, soybean hulls do not appear to be as valuable to the foal as oats.

Key Words: Soybean hulls, Horses, Weanlings

305 Ontogeny of L-threonine transport into porcine jejunal brush border membrane vesicles. Ming Z. Fan1,2, Layi Adeola2, and Eli K. Asem2,1 University of Guelph, Guelph, Ontario, Canada, 2 Purdue University, West Lafayette, Indiana.

Luminal L-threonine is transcellularly transported across enterocyte brush border membrane (BBM) via Na-dependent B- and Na-independent L-system transporters. We examined the postnatal ontogenesis of BBM threonine uptake kinetics in developing pigs at the ages of 8, 28, 35 and 70 days. Initial threonine uptake rates in BBM vesicles were measured by fast filtration (22°C, L-[3-H]threonine plus non-labelled L-threonine, ranging from 0.03 to 2.0 μM). The initial uptake of threonine into BBM vesicles was kinetically partitioned into the components of Na-dependent, Na-independent and diffusion uptake. For Na-dependent component, the maximal uptake rate (Jmax, pmol/mg/s) and transporter affinity (Km, mM) were: Jmax/Km, 4.8 ± 0.22 (8-day); 14.0 ± 2.0/0.44 ± 0.22 (28-day); 12.9 ± 1.9/0.64 ± 0.23 (35-day); 18.8 ± 2.4/0.62 ± 0.26 (70-day). The apparent permeability coefficients (Kdiff, pmol/L/mg mmol/s) were 0.74 ± 0.15 (8-day); 2.54 ± 0.27 (28-day); 3.31 ± 0.29 (35-day); 7.55 ± 0.42 (70-day). In conclusion, kinetics of BBM threonine uptake displayed postnatal developmental changes in the pig.

Key Words: L-Threonine, Transport, Pigs

306 The use of steered ileo-cecal valve cannulated pigs in nutrition research. J. S. Radcliffe, R. S. Pleasant, and E. T. Kornegay, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Collection of ileal digesta to evaluate amino acid digestibility has become increasingly desirable in swine nutrition research. Recently, Mroz et al. (J. Anim. Sci. 74:403-412) developed a method for placing a steered ileo-cecal valve (SICV) cannula into pigs which allows for total collection of ileal digesta and normal flow of digesta during non-collection periods. This technique was modified and used with 46 crossbred barrows across four trials. Changes include: incising through the muscle layers in the laparotomy site instead of gridding through them, use of a heparinized saline lavage, a suture in place of a guide ring, and fixing the outer cannula barrel in place with a hose clamp. The current technique involves a right flank laparotomy, parallel and distal to the last rib, with the pigs under general anesthesia. The inner ring (2.0 mm thick, 35.0 mm i.d.) is introduced into the ileal lumen through an enterotomy proximal to the attachment of the ileo-cecal band. The string attached to the inner ring is threaded through the ileo-cecal valve into the cecum using a silastic suture which encases the string. Next, the outer ring (2.0 mm thick, 34 mm o.d.) is fixed in place around the ileum, distal to the inner ring and just proximal to the ileo-cecal valve. The inner cannula barrel (barrel: 120 mm length, 25 mm i.d., 32 mm o.d.; flange: 70 mm o.d.) is introduced into the cecal lumen via an enterotomy into the taenia coli and secured in place with a series of purse string sutures. The inner cannula barrel is exteriorized through a stab incision of the cecal wall and tied in place. In Exp. 2, it is plugged using a cylindrical stopper (24 mm o.d., 60 mm length) and held in place by the outer cannula barrel (barrel: 43 mm length, 33 mm i.d., 41 mm o.d.; flange: 80 mm o.d.). These changes led to less post-surgical complications, and less adhesions seen upon necropsy at the end of each experiment. Based on the four trials, this technique has proven to be a reliable technique for collecting and evaluating ileal digesta.

Key Words: Pigs, Cannula, Ileum


The use of the laboratory rat as a model animal for the determination of apparent ileal amino acid (AA) digestibility in the growing pig, using the slaughter method, was evaluated. Twenty male Sprague-Dawley rats (190 g body weight) were allotted into two groups and housed individually in stainless steel wire-bottomed cages in a room maintained at 25°C with a 12 h light/dark cycle. Six male hybrid pigs (30 kg body weight) were also housed individually in open pens without bedding material at 25°C. Rats and pigs were fed diets containing fish meal as the sole protein source. Chronic oxime was included in the diets as an indigestible marker. Ileal contents from the terminal 20 cm of ileum were collected after slaughter of the rats and pigs. Ileal and diets samples were analyzed for chromium by atomic absorption and for AAs by liquid chromatography to calculate digestibility. Mean apparent AA digestibility for rats and pigs were, respectively: ASP 0.67, 0.81; GLU 0.64, 0.82; SER 0.95, 0.77; HIS 0.73, 0.76; GLY 0.62, 0.64; THR 0.88, 0.84; ARG 0.92, 0.71; ALA 0.73, 0.77; TIRY 0.92, 0.71; MET 0.81, 0.83; VAL 0.64, 0.82; ISO 0.63, 0.88; LEU 0.75, 0.87; LYS 0.88, 0.91. The data were subjected to a one-way analysis of variance and differences between means were examined using a t-student test. There were no differences for HIS, GLY, THR, ALA, MET and LYS, showing that interspecies comparisons made under defined conditions indicated close agreement between rats and pigs for apparent ileal digestibility for those AAs. It is concluded that the growing rat is a satisfactory model for determining ileal digestibility for some AAs in fish meal in the growing pig.

Key Words: Amino acid, Ileal digestibility, Pig

308 Fermentability of selected fibers by dog and cat fecal microflora. U. A. Jamikorn1,2, D. L. Harmon1, D. J. Davenport2, L. B. Deffenbaugh2, and K. L. Gross1, Dept. of Animal Sciences, University of Kentucky, Lexington, KY, 2 Hill’s Pet Nutrition, Topeka, KS.

Fermentability of selected fibers; beet pulp, cellulose, oat fiber I (OFI), oat fiber II (OFII), peanut hulls, peptic, isolated soy fiber (ISF), and soymill run (SMR) were evaluated using batch culture fermentations with inoculum prepared from dog or cat feces. Feces from three dogs or three cats were pooled within species and diluted 1:10 (wt:vol) in clostridial glycerin-salt solution for use as microbial inoculum. Fermentations were conducted in 50 mL test tubes containing 300 mg substrate, 29 mL buffered medium and 1 mL of the inoculum. After a 24-h incubation at 39°C, a 1 mL aliquot was removed for VFA analysis and 4 volumes of ethanol were added to precipitate soluble fibers to determine organic matter disappearance (OMD). Fiber fermentability, as determined from total VFA production of dog fecal microflora (FM), was; peptic > ISF > beet pulp > SMR > peanut hulls > others. Fiber fermentability, as determined from total VFA production by cat FM was; SMR = ISF > others. Propionate and butyrate production by dog FM were greatest (P < .05) for peptic (7.5, and 15.3 mmol, respectively). Acetate production by dog FM was greatest (P < .05) for ISF (16.7 mmol). Acetate, propionate, and butyrate production by cat FM were greatest (P < .05) for SMR (3.8, 0.5, and 0.9 mmol, respectively). When expressed as mmol/g OM fermented, in vitro fermentation of cellulose by dog FM resulted in the greatest (P < .05) acetate production (731.1)
and OFII yielded the greatest (P < .05) propionate and butyrate production (272.3 and 264.2, respectively). In vitro fermentation of SMR by cat FM yielded the greatest production of acetate, propionate, and butyrate (53.4, 8.4, and 14.1 mmol/g OM fermented, respectively). Because of the critical role of VFA in maintaining gut health, VFA production may be used as an indicator of fermentability. Over estimations occur for OMD, probably the result of fibrous substrates containing large amounts of soluble carbohydrates.

Key Words: Digestion, Fermentation, Fiber


Thirty-two select-line (SL) and 32 control-line (CL) Duroc pigs weighing 20 kg were used to assess the effect of dietary amino acid (AA) restrictions during the grower (G) phase and AA content of finisher (F) diets on growth performance and carcass traits. Pens containing two gilts and two castrated males were randomly assigned within the genotype to two G (.421 and .765 g lysine/MJ DE) and two F (.421 and .612 g lysine/MJ DE) corn-soybean meals in a 2 x 2 factorial arrangement of treatments. At 50 kg, blood samples were collected for blood urea nitrogen (BUN) analysis, and ultrasound backfat (UBF) was measured before diet change. At 112 kg, blood samples were collected again before slaughter. Pigs were allowed ad libitum access to feed and water. Genotype had no effect on growth rate during the G or F phase, but to optimize overall growth, the SL pigs should be offered the high-AA G diet (genotype x G diet, P < .05). The SL pigs had better carcass traits (P < .05) and utilized AA more efficiently for lean accretion than the CL pigs, indicated by lower BUN (P = .07). Pigs fed the high-AA G diet grew faster and more efficiently during the G phase and had lower UBF than those fed the low-AA diet (P < .01). Pigs fed the low-AA G and F diet sequence and high-AA G and F diet sequence grew faster and more efficiently during the F phase than those fed other diet combinations (G x F, P < .01), but they had inferior carcass traits (G x F, P = .07), indicating that improved growth performance was a result of an increased rate of fat rather than lean accretion rate. There was no evidence of compensatory weight gain during the F phase for pigs subjected to AA restrictions during the G phase, but they had a similar lean accretion rate compared to those fed adequately. Therefore, it is possible that the compensatory response of lean tissue growth may have occurred at the expense of fat tissue growth.

Key Words: Pigs, Genotype, Amino acid restrictions

310 Effects of inclusion levels of vitamin and mineral premixes on growth performance, pork stability, and nutrient digestibility in finishing pigs. B. J. Chae1, S. C. Choi1,2, W. T. Cho2, and I. K. Han2,1 Kangwon National University, Chuncheon, Korea, 2Seoul National University, Suwon, Korea.

A total of 120 finishing pigs (LxYd, average initial body weight of 50 kg) were employed for a 7-week feeding trial to determine the effect of inclusion levels of vitamin and mineral premixes on growth performance, pork stability, and nutrient digestibility in finishing pigs. Vitamin and mineral premixes were separately made by the NRC (1998) requirements at the inclusion level of 1%, respectively, in the diet. Treatments were 100% (Control), 150%, 200%, and 250% of NRC (1998) requirements. The average daily gain and feed conversion were increased (P < .05) in pigs fed the diet containing vitamin and mineral premixes at the inclusion level of 200% than others except the 250% group, but feed intake was reduced (P < .05) when pigs fed the diet vitamin and mineral premixes at the inclusion level of 250% as compared to other groups. There was a trend toward improving pork stability as the inclusion levels of vitamin and mineral premixes were increased during storage. Thiobarbituric acid reactive substance (TBARS) and peroxide values (POV) were lower (P < .05) in the pork (M. trapezius caudalis) from pigs receiving vitamin and mineral premixes at the inclusion levels of 200 and 250% than when sealed and stored (1°C) for a 2-week period. The digestibility of calcium was improved (P < .05) in diets containing vitamin and mineral premixes 200 and 250% compared to vitamin and mineral premixes 100 and 150% groups. In conclusion, it would appear that inclusion of vitamin and mineral premixes at the level of 200% of NRC (1998) requirements gave positive effects on growth performance and pork stability in finishing pigs.

Key Words: Vitamin and Mineral Premix, Growth, Pork Stability

311 Broiler meat containing fishy aromatics after seaweal clams viscera was withdrawn from the diet. J. E. Wohlt1, C. A. Graybush, and P. K. Zajac, Rutgers-The State University of New Jersey, New Brunswick, NJ.

In previous studies, broiler growth was not decreased when dried sea clam viscera (SCV) replaced soybean meal (SBM), but feeding certain dietary levels of SCV results in fishy aromatics being detected in breast (5.0% SCV) and thigh (2.5% and 5.0% SCV) meat. Withdrawing SCV from the diet 3 wk prior to marketing birds may eliminate fishy aromatics in meat. Thus 72 day old male broiler chicks were assigned randomly to 4 dietary treatments (6 birds/cage, 3 cages/treatment): 1) commercial diet, 2) research diet (RD)+SBM, 3) RD+2.5% SCV, 4) RD+2.5% SCV withdrawn after 3 wk. Diets contained 21% CP wk 1 to 3 and 19% CP wk 4 to 6. SCV replaced SBM in the RD. Twelve birds (1 bird/cage, 3 birds/treatment) were sacrificed and breast and thigh meats evaluated for 4 aromatic flavor spectrums: chicken complex (boiled chicken), sweet white (white meat), gamey dark (dark and gamey meats), and liver/bile/fishy (fish or mollusk meats and/or organs) using a 15 point intensity scale (0–none to 15—very strong). Treatment had no effect on average daily gain or feed to gain: 42.8, 38.4, 42.5, 40.2, g/d 1.87, 1.92, 1.85, 1.92 for birds fed diets 1 to 4. Aromatics for sweet white meat were higher (P < .05) in breast than thigh meat (5.6 vs. 3.4), but not affected by diet. Aromatics for gamey dark were higher (P <.05) in thigh then breast meat (3.9 vs. 1.4), again diet having no effect. Thigh meat from birds fed 2.5%SCV or having SCV withdrawn from the diet had high (P <.05) liver/bile/fishy aromatics than thigh meat of birds fed the commercial or RD containing SBM (1.1 and 1.5 vs. 0.3 and 0.4). Even though SCV was withdrawn for 3 wk, wk 4 to 6 representing one-half the growth period, this period was insufficient to prevent detectable fishy aromatics in thigh meat. Rapid growth of broilers in combination with minimal turnover of protein and water in thigh meat may result in the retention of fishy aromatics. Lower dietary levels of SCV must be tested in future studies.

Key Words: Clam viscera, Broiler, Meat aromatics


Corn-soybean diets were formulated to contain a constant lysine:crude protein ratio and an ideal protein amino acid pattern at 12% or 14% crude protein (CP). lysine content averaged 6.5% of CP. Fifty crossbred barrows and gilts (Large White x Landrace x Duroc or Hampshire) weighing 37 ± 1.1 kg were randomly assigned to one of four treatment groups or an initial comparative slaughter group. Equal numbers of barrows and gilts were fed ad libitum diets containing 0 or 20% cane molasses (CM) and 12 or 14% crude protein (2 x 2 factorial arrangement) until they reached 95 kg live weight. Feeding molasses increased intake from 2.33 to 2.86 kg/d when diets contained 12% CP but had no effect when diets contained 14% CP (P <.016 for interaction). Similarly, ADG was increased from .72 to .82 kg/d (P <.01) when diets contained 12% CP, but had no effect when diets contained 14% CP (.83 vs .87 kg/d). Feeding CM had no effect on carcass weight, dressing percentage, degree of muscling, backfat thickness, or individual muscle weights of the ham and loin. Hot carcass weights, degree of muscling and ham weights were less (P <.047) with 12% vs 14% CP. Loin eye area and backfat thickness were not affected by the CP level or CM. Total muscle accretion rates in the ham and loin were 16% greater (P <.01) when 14% CP was fed, but neither level of CP nor addition of CM altered adipose tissue accretion rates in the ham or loin. Longissimus color ratings were lower (lighter) with the 12% CP level, but marbling and firmness were not altered. Results demonstrate that feeding up to 20% molasses in finishing diets formulated to achieve an ideal protein amino acid composition of the diet has no detrimental effect on pork carcass composition or quality.

Key Words: Cane Molasses, Growth, Pork Quality

Two trials were conducted to study the effect of inclusion, and the ileal amino acid digestibility of two blood-derived meal sources in pig diets. In trial one (T1), one hundred twenty male piglets were at 20 d of age and weighing an average 5.7 kg were blocked by litter and body weight and used in a 2 x 3 factorial experimental design. From 0 to 14 d of age, all the treatments were divided into three groups (eight replicates of five piglets each). The only difference among treatments in this phase was the feeding of blood-derived meal: 5% of spray-dried animal plasma (SDP), 5% of a high quality spray-dried blood meal (HQBMB, Biosol A92, DAKA a.m.b.a.), or 5% of a regular blood meal (BM, DAKA a.m.b.a.), respectively. In the second trial (T2), six males (46.3 kg) were surgically modified with an end to end ileo-rectal anastomosis and ileal digestibility of amino acids was measured for the HQBM and BM samples. The experimental products were mixed with a basal protein-free diet to obtain feeds with 18.7 and 19.5% crude protein for the HQBM and BM diets, respectively. Each diet was tested on all the animals using a 2 x 3 quantitative collection period preceded by a 5 d adaptation period. In T1, no differences among treatments were detected from 0 to 14 d for any of the traits studied. From 14 to 28 d, diets containing BM allowed the same growth rate (495 vs 485 g/d; P > .10), but poorer feed conversion (1.29 vs 1.35, P = .10) than BM diets. The ileal digestibility of all the amino acids except for isoleucine were greater for HQBM than for BM (P < .05). The digestibility coefficients for lysine, threonine, methionine, cystine, and tryptophan were 99.4, 99.2, 99.3, 98.7, 95.7 for HQBM, and 98.3, 97.8, 98.5, 96.0, 91.9 for BM, respectively. It is concluded that both HQBM and BM can be used successfully in pig feeds, although feed conversion tended to be impaired when BM was used in substitution of FMMT.

Key Words: Blood meal, Pigs


Three experiments were conducted to evaluate the use of Perfect Pro® (PP) as a source of protein. In each experiment, treatments were replicated with four (Exp. 1 and 2) or seven (Exp. 3) pens of two to five pigs each. Each experiment lasted for 3 to 4 weeks for the combined Phase I (1.5% Lys in Exp. 1 and 2, and 1.6% Lys in Exp. 3) and Phase II (1.3% Lys) periods. In Exp. 1, pigs were fed one of three Phase I diets: 1) basal (B) diet containing corn, SBM, whey, fish meal, and blood cells (AP-301 G), 2) B + 4% spray dried porcine plasma (SDPP), or 3) B + 2% SDPP+2% PP. In Phase II, the dietary groups from Phase I were divided into two subsequent groups. One group received a diet containing corn, SBM, whey, fish meal, and 2% blood cells, and the second group received the same diet with 2% PP, resulting in six treatments for the Phase II and overall periods. In Exp. 1, ADG and ADFI were increased (P<.10) during Phase I in pigs fed 4% SDPP or 2% SDPP+2% PP. Gain-feed (GF) was not affected (P>.10) during Phase I. In Phase II, the 2% PP addition did not affect ADG, ADFI, or GF. Also, Phase I diets did not affect (P>.10) growth performance during Phase II. Overall, ADG and ADFI were increased in pigs fed 2% SDPP+2% PP during Phase I. In Exp. 2, ADG and GF were increased in pigs fed 2% SDPP+2% PP during Phase I. During Phase II, ADG was increased in pigs fed 2% SDPP+2% PP relative to those fed the basal diet (P<.005) or the diet containing 4% SDPP (P<.01) in Phase I. Also in Phase II, GF was increased in pigs fed 2% SDPP+2% PP (P<.03) relative to those fed 4% SDPP. Overall, ADG and GF were not affected (P>.10) during Phase II. Overall, ADG, ADFI, and GF were not affected (P>.10) by the addition of 2% PP relative to 2% blood cells. Overall, pigs fed 2% SDPP+2% PP had equal performance to those fed 4% SDPP.

Key Words: Pigs, Protein Sources, Growth


Three-hundred weanling pigs (5.0 kg initial weight, 14-21 d of age) were used in a 28 d experiment to evaluate the effects of a water soluble globulin protein (WSGP). Pigs were blocked by sex and initial weight and randomly allotted to two experimental treatments with 25 pigs/pen and 6 pens/treatment. Experimental design was a completely randomized, replicated 3-phase nursery program with and without WSGP. Total lysine content of diets offered was 1.65, 1.30 and 1.20% for phases one, two and three, respectively. Sprayed-dried animal plasma was included at a level of 4% in the phase one diet. Pigs were fed the various diets for 7, 14 and 7 days for phase one, two and three, respectively. WSGP was replaced through the water source for 14 d using a commercially available proportional dispenser. Compared to d 0-7, the concentration delivered was reduced by 50% during d 7-14. During the initial 7 d, pigs receiving WSGP had improved (P<.001) average daily gain (ADG), average daily feed intake (ADFI) and gain/feed (G/F) compared to the controls. Relative improvements in each measure were 65, 33 and 27% for ADG (0.130 vs 0.215 kg), ADFI (0.137 vs 0.182 kg) and G/F (0.94 vs 1.19). From d 7-14, ADFI (0.227 vs 0.318 kg), ADFI (0.304 vs 0.273) and G/F (0.74 vs 0.86) was improved (P<.02) for pigs receiving WSGP compared to controls. Overall (d 0-28) WSGP improved performance (P<.01), ADFI, ADFI and G/F was 0.300 kg, 0.398 kg, 0.76; and 0.350 kg, 0.438 kg, 0.80 for control and WSGP pigs, respectively. These results suggest the WSGP improves performance from d 0-14 and the enhancement in performance is maintained through 28 d postweaning.

Key Words: Globulin protein, weaning pigs, liquid-feeding

316 Use of spray dried plasma in combination with different types of milk proteins in diets for piglets. P. Medel1, F. Baucells1, J. C. de Blas1, and G. G. Mateos*, 1Universidad Politécnica de Madrid, Spain, 2Pinós Baucells, Barcelona, Spain.

A trial was conducted to evaluate the influence of milk protein source (casein vs serum proteins) and spray dried animal plasma (SDP) supplementation (0% inclusion vs 4% of either APC-920 or Proglobulin) on performance of piglets weaned at 21-d. A total of 180 male piglets (21-d and 5.4 kg of average body weight) were used in a 2 x 3 factorial experiment with 6 replicates of five piglets per treatment. The experimental diets were formulated to be isonitritive (2500 kcal/kg NE, 21.6% crude protein, 1.54% total lysine, and 10.3% lactose) and were offered ad libitum for 20-d. Afterwards, all the replicates were fed a common starter diet containing 2435 kcal/kg NE, 21% crude protein and 1.28% total lysine. Spray dried animal plasma supplementation improved growth at 10 (154 g/d; P = .01) and at 20-d of trial (346 vs 312 g/d; P < .01). The effect was mostly due to an increase in feed consumption (191 vs 162 g/d, P = .02, and 379 vs 346 g/d, P = .09, from 0 to 10, and from 0 to 20-d, respectively). Feed conversion was not modified by SDP addition. Diets that included casein as the main milk protein source showed better feed conversion than diets based on serum protein at 10 (1.01 vs 1.11 g/g; P = .10) and at 20-d (1.08 vs 1.13 g/g; P = .14) of trial. A significant interaction between milk protein source and SDP supplementation was observed for average daily gain, but not for feed conversion; the addition of SDP improved growth more in piglets fed milk serum proteins than in piglets fed casein (P = .03). No differences were detected between SDP sources for any of the parameters studied. It is concluded that SDP addition improves growth of piglets mostly due to an increase of feed consumption and that casein diets tended to decrease feed conversion with respect to serum milk protein diets during the first 20-d after weaning. The addition of SDP resulted in better performance when serum vs casein protein was used.

Key Words: Milk protein, Spray dried plasma, Piglets

317 Effects of increasing pellet conditioning temperature of diets containing spray-dried animal plasma on weaning pig performance. M. U. Steidinger*, R. D. Goodband1, M. D. Tokach1, J. L. Nelssen1, L. J. McKinney1, J. C. Woodworth1, B. S. Borg2, and J. M. Campbell2, 1Kansas State University, 2American Protein Corp. Ames, IA.

Two hundred fifty-two weanling pigs (6.0 ± 1.3 kg and 21 ± 3 d of age; PIC) were used in a 14 d growth assay to determine the effects of
increasing pellet conditioning temperature on pig growth performance. Experimental treatments consisted of a corn-soybean meal control diet (1.4% lysine and 15% dried whey) with no spray-dried animal plasma (SDAP) and fed in a meal form, or the control diet with 5% SDAP replacing soybean meal on a equal lysine basis also fed in a meal form. Additional treatments were the 5% SDAP diet pelleted (3.97 mm diameter) at conditioning temperatures of 60, 66, 71, or 77°C. Corresponding pellet exit temperatures were 68, 74, 77, and 80°C. The pelleted diets were conditioned with a ten second retention time and then pelleted using a Master Model HD 1000 series California Pellet Mill equipped with a 31.8 mm effective thickness die. Pigs were blocked by initial weight and allotted randomly to each of six dietary treatments with six pigs/pen and seven replications/treatment. From d 0 to 14 after weaning, pigs fed diets containing SDAP had greater (P < .001) ADG, G/F, and (P < .08) ADFI than pigs fed the control diet. No differences in performance were observed among pigs fed the meal diet containing SDAP and the mean of pigs fed the pelleted diets. Increasing pellet conditioning temperature up to 77°C did not adversely affect growth performance of pigs fed diets containing 5% SDAP from d 0 to 14 after weaning.

Key Words: Weaning Pigs, Spray-dried Animal Plasma, Pellet Conditioning Temperature


We evaluated the effect of feeding liquid versus dry diets after weaning on pig performance and intestinal morphology. At 14 d of age, 32 pigs (4.67 ± 0.06 kg) were assigned to 1 of 4 treatments in a RCBD: 1) cross-fostered to another sow (SOW); 2) weaned to a dry diet with 7% spray-dried plasma (SDP); 3) weaned to a dry diet with no SDP; 4) weaned to a liquid milk replacer (MR) diet. The 0 and 7% SDP diets contained 30% lactose and exceeded NRC (1998) recommendations for other nutrients. All pigs were killed after 4 d, and intestinal samples collected at 3 equidistant sites from the proximal jejunum to the distal ileum to measure villus heights, crypt depths and villus:crypt ratio (VCR). The stomach, heart, kidney, and liver were weighed. The final weight of pigs fed milk replacer were similar to the pigs cross-fostered to another sow (6.03 vs 5.83 kg). There was no difference between the pigs fed either 0 or 7% SDP (4.61 vs 4.59 kg), with both groups weighing less than either group on a liquid diet (P ≤ .001). The villi for pigs fed either liquid diet were taller (P ≤ .001) than pigs fed either dry diet. The crypt depth of the most distal section for the pigs that remained on the sow was reduced compared to all other crypt depth measurements (P ≤ .001). The pigs fed either dry diet had a lower VCR than the pigs on a liquid diet (P ≤ .001), and the most distal section for the pigs that remained on the sow had a higher VCR than all other VCR measurements (P ≤ .01). Organ weights are shown below. This study shows that pigs weaned to a liquid milk replacer perform similar to pigs kept on a sow, while pigs weaned to a dry diet have reduced performance. There were also differences in intestinal morphology which may be related to pig performance.

Organ | SOW | 0% SDP | 7% SDP | MR | SEM
---|---|---|---|---|---
Heart | 9.87a | 9.40ab | 8.82b | 10.06a | .035
Kidney | 10.85ab | 9.68a | 9.90a | 13.47ab | .655
Stomach | 8.15ab | 8.64b | 7.98ab | 7.77b | .238
Liver | 44.98a | 41.94a | 42.48b | 57.29b | 1.48

1/1g/kg BW, a,bP < .05
Key Words: Weaned pigs, Liquid diet, Intestinal morphology


Three hundred-twenty PIC (C22 x 355 barrow and gilt) nursery pigs (10.89 kg) were used to compare the effects of increasing dietary lysine from L-Lysine HCl (L-LYS) or Peptide PlusTM (PP). Peptide Plus is a hydrolyzed bovine muscle protein source. L-LYS was added at 1.595, .3185 and .4775% or PP at 2.39, 4.78, and 7.16% to a basal corn-soybean meal diet (0.90% lysine; negative control, NEG) to achieve diets with 1.025, 1.15 and 1.275% total LYS, respectively. A positive control (POS) diet was formulated to 1.275% LYS with corn and soybean meal. Ideal ratios of other amino acids were maintained in all diets with synthetic amino acid additions. All diets were formulated to maintain similar dietary Ca, P, Na, Cl and ME. There were eight replications of the eight treatments with five pigs/pen. Data were analyzed as a randomized complete block design with seven single df contrast comparisons; POS vs NEG, POS vs other 1.275% LYS, L-LYS linear, L-LYS quadratic, PP linear, PP quadratic and L-LYS vs PP. For the 19-d study period, ADG increased linearly (P < .01) with increasing dietary LYS. Feed intake tended to decrease linearly (P = .12) and G/F increased (P < .01) with increasing PP. Increasing dietary LYS with L-LYS resulted in linear (P < .001) and quadratic (P = .011) improvements in G/F. Pigs fed diets containing L-LYS vs PP had increased ADG (P < .05) and G/F (P < .001). Pigs fed the POS diet had decreased (P < .05) ADFI and increased (P < .001) G/F compared to pigs fed the other 1.275% LYS diets. These data suggest that PP is less bio-available than L-LYS and that high levels of synthetic amino acids or PP do not promote the same degree of feed utilization as soybean meal.

Key Words: Weaning Pigs, Liquid diet, Intestinal morphology

320 Effects of free fatty acids in choice white grease on growth performance of nursery pigs. J. M. DeRouchey*, J. D. Hancock, C. A. Maloney, H. Cao, D. J. Lee, J. S. Park, D. W. Dean, and R. H. Hines, Kansas State University, Manhattan, KS.

A total of 120 crossbred barrows and gilts (average initial BW of 6.2 kg) were used to determine the effects of free fatty acids (FFA) in choice white grease (CWG) on growth performances of nursery pigs. The pigs were blocked by weight and allotted to pens based on sex and ancestry for the 33-d growth assay. The pigs (five per pen) were housed in an environmentally controlled room and fed diets formulated to 1.7% lysine for d 0 to 5, 1.55% lysine for d 5 to 19, and 1.40% lysine for d 19 to 33. Treatments were a corn-soybean meal-based control with no added fat, 6% CWG, and 6% CWG that had been heated at 35°C and treated with 1872, 1.1752 and 2.248 lipase units/g of fat. The FFA concentrations in the CWG were increased from 1.8% to 18.3, 35.4 and 53.3% with increasing lipase concentrations. As for pig growth, those fed the control diet (no added fat) had the same ADG (P < .30) but lower gain/feed (P < .04) than pigs fed diets with added fat. There were no effects of FFA concentration on ADG or gain/feed (P < .36) and ADFI increased as FFA concentration was increased (linear effect, P < .04). In conclusion, our data suggest that concentrations of FFAs up to 53.3% in CWG do not adversely affect growth performance of nursery pigs.

Free Fatty Acids, %

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<th>Item</th>
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<tr>
<td>ADFI, g/kg</td>
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Key Words: Pigs, Free fatty acids, Fat quality


The influence of intraduodenal (id) application of vegetable oils on the spontaneous reaction of the exocrine pancreas of piglets has not yet been studied. Six growing pigs (BW 13.3 kg) were prepared with a pancreatic duct catheter and a duodenal re-entrant T-cannula. The animals were fed twice daily (10.00 and 16.00 h), a commercial weaner diet at a level of 2% of BW. Beginning with the morning feeding, olive oil, coconut oil
or saline as a control were loaded id via the duodenal cannula over a period of 1 h according to a 3 × 2 Latin square design. The amount of each oil loaded corresponded to 0.1% of BW. Pancreatic juice was collected over a period of 4 h, beginning 1 h preprandially (09:00) till 3 h postprandially (13:00). The volume of secretion was determined in 30 min intervals, an aliquot for analyses was obtained and the remainder was re-infused into the duodenum. In addition to volume of secretion, total lipase activities were estimated. Data were analyzed using repeated measures ANOVA. No time effect (P ≥ 0.2) with respect to the volume of secretion was observed for the saline and the coconut oil treatment, whereas a time effect (P ≤ 0.03) was recorded for the olive oil treatment. The volume of pancreatic juice secreted for the olive oil decreased (P ≤ 0.04) over the time compared to the coconut oil treatment. Lipase activities were affected over the time by id loading of olive oil (P ≤ 0.01), coconut oil (P ≤ 0.01) and saline (P ≤ 0.02), respectively. No differences (P ≥ 0.2) between the slopes of the curves for the saline and coconut oil treatments were observed, but an increase for the olive oil compared to saline (P ≤ 0.05) and coconut oil (P ≤ 0.04) treatments was determined. It is suggested that under prandial conditions, the exocrine pancreas responds differently in its spontaneous secretion to different vegetable oils.

Key Words: Pancreatic secretion, Fat, Pig


A total of 150 crossbred barrows, boars, and gilts (average initial BW of 6.8 kg) were used to determine the effect of rancidity in choice white grease (CWG) on growth performance in nursery pigs. The pigs were blocked by weight and allotted to pens based on sex and ancestry for the 35-d growth assay. The pigs (five per pen) were housed in an environmentally controlled room and fed diets formulated to 1.7% lysine for d 0 to 7, 1.55% lysine for d 7 to 21, and 1.40% lysine for d 21 to 35. Treatment groups were: a corn-soybean meal-based control diet with no added fat, 6% CWG, and 6% CWG heated at 80°C with O2 gas bubbled through it for 5, 7, 9, and 11 d. Peroxide values for the CWG increased with 0, 5, and 7 d oxidation (i.e. peroxide values of .8, 40, and 105 mmEq/kg, respectively), but decreased to 1 mmEq/kg as the peroxide values decreased from 0 to 11 d of oxidation. As for growth performance of the pigs, ADG was not affected (P > .91) but gain/feedback was less for pigs fed the control diet with no added fat (P < .04). Average daily gain (linear effect, P < .01) and ADFI (linear effect, P < .001) decreased as fat became more rancid, but gain/feedback was not affected (P > .16). In conclusion, our data suggest that as fat is oxidized (especially to peroxide effect, P < .05) the ADG was not affected (P = .07) and tended to increase feed intake (228 vs 210 g/d; P = .21) but did not modify feed conversion during the first 14-d. Heat processing did not influence performance of piglets from 14 to 28-d (average daily gain of 492 vs 496 g/d; P = .42 for treated and raw oil, respectively) or fecal digestibility of energy at 28-d (79.3 vs 76.6%; P = .22) but tended to increase the fecal digestibility of organic matter (81.7 vs 78.9%; P = .14). No differences were found in T1 or T2 between M and E barley diets for any of the parameters studied. It is concluded that HP of barley improved performance in both chickens and piglets in the first stages of feed (0 to 14-d after hatch or weaning, respectively) and tended to increase nutrient digestibility at 28-d. However, HP did not influence performance of piglets beyond 14-d of weaning and, in fact, reduced that of broilers from 14 to 28-d of age.

**Key Words:** Barley processing, Piglets, Broilers

**324 Effects of Hemicell® addition to nursery diets on growth performance of weanling pigs.** L. A. Pettry*, S. D. Carter, B. W. Senne, and J. A. Shriver, Oklahoma State University, Stillwater.

Two experiments were conducted to evaluate the effects of Hemicell® (Bmannanasse; Chem-Gen Corp., Gaithersburg, MD) addition to nursery diets on growth performance of weanling pigs. In Exp. 1, 156 pigs (20 d, 6.27 kg BW) were allotted by BW, sex, and litter to 4 dietary treatments (6 reps/trt of 3-4 pigs/pen). Treatments were a factorial arrangement of diet complexity (simple vs complex) and Hemicell® addition (0 vs .05%). Complex diets used in Phase (P) 1 (1.50% Lys) and 2 (1.30% Lys) were fortified corn-soybean meal-dried whey based with plasma while simple diets were corn-soybean meal based. During P3, pigs were fed simple corn-soybean meal diets (1.10% Lys). Pigs were fed in 3 dietary phases (P1, d 1-14; P2, d 14-28; and P3, d 28-42). Pigs fed complex diets gained faster and were more efficient (P <.05) during P1 than pigs fed simple diets. Hemicell® had no effect on growth performance during P1. Hemicell® addition to P2 and P3 complexes increased (P <.01) G:F. For the 42-d period, G:F was improved (P<.10) for pigs fed complex diets (.632 vs .615) and for those fed Hemicell® (.636 vs .611). There were no diet complexity x Hemicell® interactions. In Exp. 2, 117 pigs (44 d, 13.62 kg BW) were allotted by BW, sex, and litter to 3 dietary treatments (10 reps/trt of 3-4 pigs/pen) in P3 (21 d) of the nursery period. Diets (1.20% Lys) were: (1) simple corn-soybean meal-based control (2) as 1 + soybean oil to increase ME by 100 kcal/kg, and (3) as 1 + Hemicell® (.05%). Calculated ME of the 3 diets were: 3,296, 3,396, and 3,296 kcal/kg. Pigs were fed a common diet in P1 & P2 prior to the experiment. Over the entire 21-d period, ADG and G:F for the 3 diets were: 543, 553, and 559 g; and .568, .587, and .594, respectively. Pigs fed diets with added soybean oil or Hemicell® had greater G:F (P <.01) than pigs fed the control diet; however, ADG and G:F were similar for pigs fed soybean oil or Hemicell®. These results suggest that HP of barley improves growth performance of weanling pigs during the latter phase of the nursery period.

**Key Words:** Enzyme, Weanling pigs, Growth performance

**325 Supplemental NaCl or KCl added to weaning pig diets containing naturally high Na and Cl contents.** D. C. Mahan*, S. D. Carter, G. M. Hill, and J. L. Nelsen, NCR-42 Committee on Swine Nutrition.

Previous results had demonstrated a growth and feed efficiency response when supplemental chloride (Cl) was added to diets containing dried whey or spray dried plasma protein. These feed ingredients contain naturally high levels of Na and Cl. The reported studies had not used these ingredients in combination, suggesting that a composite use of several components with naturally high contents of these nutrients may give different results. A regional study involving 4 stations (KS, MI, OH, OK) evaluated the effects of adding Cl to NaCl or KCl to diets containing feed ingredients naturally high in Na or Cl. The basal diet during Phase 1 (0 to 14 d postweaning) used a mixture of corn-soybean meal-fermented barley with added soybean meal and a barley meal-fishmeal but with added spray dried blood cells (3.5%), and was formulated to a 1.50% lysine level. During Phase 2 the basal diet was formulated using a mixture of corn-soybean meal-fermented barley with added soybean meal and dried whey (25%) and was formulated to a 1.50% lysine level.
were not affected by treatment (P > .19). Thus, our results suggest that these varieties of grain sorghum were similar in feeding value.

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Key Words: Sorghum, Food-grade, Pig


To investigate why lean growth rates of pigs fed low-protein diets supplemented with crystalline amino acids (AA: lysine, threonine, tryptophan, methionine) are lower than those of pigs fed standard corn-soybean meal diets, a N balance experiment was conducted. Twelve gilts (initial weight 41 kg) were fitted with urinary catheters and fed six different diets in a modified Latin Square design (two squares and three, 7-d periods). Diets were as follows: 1) 18% CP, 2) 14% CP + AA, 3) 10% CP, 4) 12% CP + AA, 5) 14% CP + AA, 6) 10% CP + AA. The AA were added to provide the same amounts, on a total basis, as those in the intact protein diets that were 4% CP higher (i.e., Diet 2 was equivalent to Diet 1, etc.). Gilts were allowed ad libitum access to feed and water. There were no differences among treatments (P > .30) for ADG (74 kg), ADFI (1.54 kg), or ADG/ADFI (.47). Nitrogen retention (g/d) decreased (P < .01) in both the standard diets (27.1, 24.5, 21.0) and the AA-supplemented diets (21.5, 19.2, 15.8) as CP decreased and was consistently lower (P < .01) in the equivalent AA-supplemented diets. Nitrogen retention (% of N intake) tended to be greater for AA-supplemented diets, but differences were not significant. Apparent N digestibility was greater (P < .01) in standard diets than in AA-supplemented diets (87.7 vs 85.1%). There were no differences among treatments (P > .30) in ADG, ADFI and nitrogen retention. Thus, at AA concentrations that did not affect N retention and growth rates, AA-supplemented diets failed to achieve the same N retention as equivalent corn-soybean meal diets. These data suggest that dietary factors other than amino acid concentrations account for the reduction in lean growth observed in pigs fed low-protein, AA-supplemented diets.

Key Words: Pigs, Nitrogen Balance, Amino Acids

329 Effect of low protein diets on energy utilization in growing pigs. L. Le Bellego1, J. van Milgen1, M. Rademaker2, S. Van Cauwenbergh3, and J. Noblet1, 1INRA, Saint-Gilles, France, 2Degussa, Hanau, Germany, 3Eurolysine, Paris, France.

Twenty two (Large White x Landrace) x Pietrain castrated males of 65 kg body weight, were used to study the effect of reducing the crude protein (CP) content of the diet on the utilization of energy in growing pigs kept under thermoneutral conditions (24°C). Four protein levels ranging from 18.9% (CP1) to 16.7, 14.6 and 12.3% (CP4) were tested by replacing soybean protein by corn starch; industrial amino acids were added to maintain an optimal and balanced amino acid supply. All diets provided .578 g/MJ ME of digestible lysine and pigs were fed at about 2.63 MJ/day/kg BW60 of ME. After adaptation to diets and experimental conditions, excreta were collected for 8-d with heat production (HP; indirect calorimetry), feeding behavior and physical activity measured over the last 4-d; the fasting heat production (FHP) was also measured over a subsequent 2-d period. The thermic effect of feed (TEF), FHP and HP due to physical activity (AHP) were calculated. Pigs performance and nitrogen balance were not affected by reduction of the dietary CP level and nitrogen excretion was linearly reduced (minus 58% between CP1 and CP4). The average FHP (0.797 MJ/day/kg BW60 at zero physical activity) and AHP (0.214 MJ/day/kg BW60) were not affected by the treatment. When adjusted for zero activity and the same average ME intake (2.4 MJ/day/kg BW60), HP was lower (P < .01) when CP level was reduced and represented 53.3% and 49.2% of ME intake,
for CP1 and CP4 respectively. This lower HP was mainly due to a reduction of TEF (P < .03) which corresponded to 19.9 and 15.8% of ME intake for CP1 and CP4, respectively. The reduced HP for identical ME intake resulted in a greater quantity of retained energy with lower CP diets. It is concluded that the reduction of the CP content in pig diets with essential amino acids levels kept optimal allows to reduce the quantity of nitrogen excreted, but is also accompanied by a more efficient utilization of energy. In situations where performance is limited by ME intake, a greater efficiency of resources can be obtained.

**Key Words:** Growing Pigs, Dietary Protein, Heat Production

#### 330 Effects of increasing lysine:calorie ratio and dietary fat addition on growth performance and carcass characteristics of gilts from 27 to 120 kg. M. De La Llata*, S. S. Dritz, M. D. Tokach, R. D. Goodband, and J. L. Nelssen, Kansas State University, Manhattan, KS.

A total of 1,200 gilts (PIC C22 x 337) with an initial weight of 27 kg were used in a 120 d growth trial to determine the effect of lysine:calorie ratio and dietary fat (choice white grease) addition on growth performance and carcass characteristics. Pigs were allotted to one of 8 dietary treatments in a completely randomized design with 25 pigs/pen and 6 pens/treatment. The corn soybean meal-based diets were arranged in a 2 x 4 factorial with two levels of added dietary fat (0 and 6%) and four lysine:calorie ratios in each phase. The four phases were 27 to 45, 45 to 75, 75 to 100, and 100 to 120 kg. Lysine:calorie ratios (g lysine/Mcal ME) were 2.96, 3.26, 3.56, and 3.86 in phase 1, 2.25, 2.50, 2.75 and 3.0 in phase 2, 1.64, 1.84, 2.04 and 2.24 in phase 3, and 1.12, 1.32, 1.52 and 1.72 in phase 4. No interactions occurred between lysine:calorie ratio and dietary fat except for ADFI in phase 1 (P < .06) and 3 (P < .08). During every phase, ADG, and feed efficiency (G/F) linearly increased (P < .01) with increasing lysine:calorie ratio. However, for the overall experiment, the greatest response was observed in gilts fed the third lysine:calorie ratio (quadratic, P < .05). Increasing added dietary fat increased (P < .03) ADG during phase 1 and 2. Increasing added dietary fat from 0 to 6% decreased (P < .01) ADFI in all phases and increased (P < .01) G/F in phases 1, 2, 3, and overall. Fat depth decreased linearly (P < .01), and loin depth, percent lean and fat free lean index (FFLI) increased linearly (P < .01) with increasing lysine:calorie ratio. Fat addition to the diet numerically increased (P < .17) feed intake and increased G/F, and that the third lysine:calorie ratio regimen used was appropriate to maximize growth performance of gilts in a commercial finishing environment. 

**Key Words:** Fat, Lysine:calorie ratio, Gilts

#### 331 Effects of increasing lysine:calorie ratio and dietary fat addition on growth performance and carcass characteristics of barrows from 34 to 120 kg. M. De La Llata*, S. S. Dritz, M. D. Tokach, R. D. Goodband, and J. L. Nelssen, Kansas State University, Manhattan, KS.

A total of 1,200 barrows (PIC C22 x 337) with an initial weight of 34 kg were used in a 120 d growth trial to determine the effect of lysine:calorie ratio and dietary fat (choice white grease) addition on growth performance and carcass characteristics. Pigs were allotted to one of 8 dietary treatments in a completely randomized design with 25 pigs/pen and 6 pens/treatment. The corn soybean meal-based diets were arranged in a 2 x 4 factorial with two levels of added dietary fat (0 and 6%) and four lysine:calorie ratios in each phase. The four phases were 27 to 45, 45 to 75, 75 to 100, and 100 to 120 kg. Lysine:calorie ratios (g lysine/Mcal ME) were 2.96, 3.26, 3.56, and 3.86 in phase 1, 2.25, 2.50, 2.75 and 3.0 in phase 2, 1.64, 1.84, 2.04 and 2.24 in phase 3, and 1.12, 1.32, 1.52 and 1.72 in phase 4. No interactions occurred between lysine:calorie ratio and dietary fat except for ADFI in phase 1 (P < .06) and 3 (P < .08). During every phase, ADG, and feed efficiency (G/F) linearly increased (P < .01) with increasing lysine:calorie ratio. However, for the overall experiment, the greatest response was observed in gilts fed the third lysine:calorie ratio (quadratic, P < .05). Increasing added dietary fat increased (P < .03) ADG during phase 1 and 2. Increasing added dietary fat from 0 to 6% decreased (P < .01) ADFI in all phases and increased (P < .01) G/F in phases 1, 2, 3, and overall. Fat depth decreased linearly (P < .01), and loin depth, percent lean and fat free lean index (FFLI) increased linearly (P < .01) with increasing lysine:calorie ratio. Fat addition to the diet numerically increased (P < .17) feed intake and decreased (P < .05) ADG. The results from this experiment indicate that the addition of 6% dietary fat decreases feed intake and increases G/F, and that the third lysine:calorie ratio regimen used was appropriate to maximize growth performance of gilts in a commercial finishing environment.

**Key Words:** Fat, Lysine:calorie ratio, Barrows

#### 332 Effects of increasing neutral detergent fiber (NDF) on the performance and carcass characteristics of growing-finishing swine. J. D. F. Gomes1, P. J. A. Sobral1, R. S. Fukushima1, C. G. Lima1, A. C. A. Fagundes2, L. W. O. Souza2, S. C. Murino2, C. F. Uyebiama1, C. Grossklaus3, and L. L. Oetting1.

1Faculdade de Zootecnia e Engenharia de Alimentos da Universidade de Sao Paulo, Brazil, 2Faculdade de Medicina Veterinária e Zootecnia da Universidade de Sao Paulo, Brazil.

Despite high utilization of the dietary fiber fraction in ruminant animals, swine can show positive responses when fed diets containing this alternative source of energy. The utilization of fibers for swine may control possible problems with stress caused by housing and excessive feed. Furthermore, adding fiber to the diet may allow better control of carcass standards, resulting in adequate weight gain to lean meat yield. Thus, it is possible to ensure reduction in the backfat, a positive aspect very important to the actual market. This study was conducted to evaluate the effects caused by inclusion of neutral detergent fiber (NDF), through the utilization of Tifton hay as the source of dietary fiber, on performance and carcass characteristics of growing-finishing swine (73-150 d). The experimental design employed was a completely randomized design with 20 male and 20 female crossbred (Large White x Landrace) pigs. Daily feed consumption (DC), daily weight gain (DG), and feed/gain (FG), hot carcase yield (HC), cool carcase yield (CC), lean carcase yield (LC), loin area (LA), and backfat(BF) were measured. Data were analyzed using GLM procedure (SAS®). The results showed no differences (P > 0.17) between experimental treatments relative to DC, DG, and FG. In relation to carcass characteristics, no differences were observed (P > 0.20) between treatments, although was occurred reduction in HC, CC and BF of animals fed with 10% of hay grass (8% NDF). The utilization of the low NDF (8%) diet, did not promote alterations in performance and carcass characteristics of growing-finishing swine. These results indicate that inclusion of fiber in the diet does not alter the development and, thus, performance and carcass characteristics.

**Key Words:** Neutral detergent fiber, Performance, Carcass characteristics

#### 333 The effects of Hemiceil® on digestibilities of minerals, energy, and amino acids in pigs fitted with steered ileo-cecal valve cannula and fed a low and high protein corn-soybean meal diet. J. S. Radcliffe, B. C. Robbins*, J. P. Rice, R. S. Pleasant, and E. T. Korney, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Twelve crossbred barrows (BW = 44 kg), fitted with steered ileo-cecal valve cannula (SIVC) cannulas, were used to investigate the effects of Hemiceil® (β-mannanase) on the apparent total tract digestibilities (ATTD) of energy, Ca, P, DM, and the apparent ileal digestibilities (AID) of Ca, P, DM and amino acids. All diets were corn-soybean meal-based. Diets 1 and 3 contained 12% and 16% CP, respectively. Diets 2 and 4 contained 12% and 16% CP, respectively, and were supplemented with Hemicell® at a level of .50% of the diet. Calcium and P levels were .54% and .45% for the low CP diets and .53% and .45% for the high CP diets, respectively. Pigs were randomly allotted to one of the four dietary treatments in 3 blocks of a 4 x 4 Latin square. Pigs were individually housed in metabolic pens (1.2m x 1.2m). Water was supplied ad libitum, and feed was given at a level of 9% of the pigs metabolic BW (BW75/2). Each 2-wk period consisted of a 7-d adjustment, a 3-d total collection, a 12-h ileal digesta collection, a 3-d readjustment, and a second 12-h ileal digesta collection. There were no interactive effects of Hemiceil® and CP level; therefore, only main effects are reported. Increasing the level of CP in the diet from 12 to 16% improved (P < .001) ADG, G/F, and the AID of DM, Ca, P, N and all amino acids measured. In addition, the ATTD of CP (P < .01) was increased while the ATTD of CP (P < .05) and the AID of DM (P < .001) were increased. The addition of Hemiceil® to the diet increased AID of DM (P < .001) and ATTD of energy (P < .05).
Although, numerical means favored Hemiecii, differences were not significant (P > .10) for AID of Ca, P, and amino acids or ATTD of Ca, P, and DM. Based on the results of this study, Hemiecii may be a useful feed additive for increasing the energy availability in a corn-soybean meal-based diet fed to pigs.

Key Words: Pigs, Energy digestibility, β-mannanase


This study assessed effects of fermentation and bulkiness of dietary carbohydrates on fluctuation in heat production and physical activity. Eight clusters of 14 group-housed pigs were fed one of four diets, in a 2 × 2 factorial design. Factors included 1) level of gastro-intestinal fermentation and 2) dietary volume. Contrasts in fermentation were created by exchanging gelatinized maize starch with raw potato starch on a volume basis. Dietary volume was altered by adding 15% milled wheat straw to the diets. Amounts of other dietary ingredients fed to the pigs were similar. Heat production (H) was measured every 9 min during a 14-d experimental period. Mean daily H was related to activity (Hact) by an 17.6% lower for the potato starch diet compared to the maize starch diet (P < .01). Gastro-intestinal fermentation did not affect average daily total H (Htot) and H corrected for activity (Hcor). Daily pattern in Htot differed between potato and maize starch diets. Hourly and digesta was frozen at -20°C. The within day variation in Hcor was reduced when the gastro-intestinal fermentation was stimulated. Dietary volume (addition of milled straw) did not affect mean daily values or daily patterns in Htot, Hact and Hcor. In conclusion, the effect of non-starch polysaccharides on activity of group-housed pigs is related to stimulated proto-intestinal fermentation, and not the dietary volume of fiber-rich diets. Furthermore, fermented carbohydrates compared to digested carbohydrates reduce within day variation in metabolism, which is likely related to a more gradual absorption of nutrients.

Key Words: Pigs, Behaviour, Heat production


An experiment was conducted to test the effect of dietary cation-anion differences (CAD, Na+ + K+ − Cl−: mg/kg) on postprandial blood pH changes and acid base balance in pigs. Four pigs with a mean body weight of about 40 kg were surgically fitted with catheters in the carotid artery. Two dietary CAD levels (-200 and 200 mg/kg) were tested by using a cross over experimental design, that consisted of two periods, each of one wk duration. Two pigs were assigned to one of two experimental diets in each period. Feed was provided in pelleted form at a rate equivalent to 2.6 times the maintenance requirement for energy in two meals per d. Water was freely available. In each period, blood samples were taken on two days (d 5 and 7), at 0, 0.5, 1, 1.5, 2, 2.5, 3, 4, 6 and 9 h after feeding through catheters. Blood pH, HCO3−, base excess (BE), Na+, and K+ were measured immediately after sampling using an acid-base meter (HP iSTAT WR052) with EGG+ cartridges. Plasma Cl− content was measured using a chloride meter (PCLM digital chloride meter). Blood pH was corrected (P < .001) at -200 CAD (7.46) compared to 200 CAD (7.46). Base excess (3.15 mmol/L)and HCO3− (27.5 mmol/L) were also at a lower concentration in the blood in the -200 CAD group compared to the 200 CAD group (8.61 and 32.3 mmol/L, respectively). Plasma Cl− and blood K+ concentrations were higher (P < .01) for the CAD -200 group compared to CAD 200. However, Na+ concentration in the blood was not influenced by dietary CAD. Arterial blood pH remained constant after feeding in both CAD groups. Dietary CAD significantly influenced postprandial plasma Cl−, and blood Na+ and K+ concentrations. However, pigs maintained a constant CAD level (electrolyte balance) in the blood after feeding. In conclusion, dietary CAD changed blood pH and acid-base buffer system in pigs while maintaining a constant postprandial blood pH and electrolyte balance.

Key Words: Pigs, Blood pH, Acid-base balance


The effect of added dietary quebracho extract (QE, Schinopsis spp.) on endogenous nitrogen (N) and amino acid (AA) losses in pigs was measured using the peptide alimentation ultrafiltration technique. Quebracho contains relative high levels of condensed tannins and serves as a model for tannins in pig feeds. The control diet based on maize starch (521 g/kg) contained enzyme hydrolyzed casein (180 g/kg; MW < 5 kDa) as the sole N source and Cr2O3 (1 g/kg) as digestibility marker. Addition of QE (12% catechin equivalents, 65% total phens) to the control diet at 4% of feed intake resulted in the quebracho diet. Control diet and quebracho diet were tested in a cross-over design with 12 cross-bred castrated male pigs (15-25 kg BW). Pigs were housed individually and fed a mash feed (water/feed = 2.5 vol/wt) at 2.4 times their energy requirement for maintenance. Feeding times were 8.00 h and 20.00 h. Animals were fitted with a post valve T-caecum cannula for collection of ileal digesta. After a 7-day adaptation period, digesta was collected between feedings on days 8, 9 and 10. Collection bags were changed hourly and digesta was frozen at -20°C. Thawed digesta was pooled per animal, analyzed for DM, freeze-dried and analyzed for N and Cr. After resuspending in water, it was subjected to centrifugation (7,000, g 5°C) followed by ultrafiltration (MW cut off 10 kDa, 20°C). The precipitate + retentate (> 10 kDa), considered to be the endogenous fraction, was analyzed for DM, N, and AA. Adding QE to the diet increased the endogenous N flow (> 10 kDa) from 1.65 ± 0.07 to 5.8 ± 0.09 g/kg dry matter intake (DMI; P < .001). Endogenous AA flows (g/kg DMI) were increased by QE (P < .001), but AA pattern (g AA per 160 g N) of the endogenous fraction was changed. The most obvious changes caused by QE, were an increase in proline (75 ± 3.0 vs 128 ± 6.1, P < .001), glycine (41 ± 0.5 vs 60 ± 0.6, P < .001) and arginine content (30 ± 0.8 vs 46 ± 1.0, P < .001) and a decrease in glutamate (205 ± 6.0 vs 140 ± 7.3; P < .001) and serine content (119 ± 2.2 vs 87 ± 2.7, P < .001). It is concluded that dietary quebracho extract increases the ileal endogenous N flow and that the amino acid pattern of ileal endogenous N losses is not constant, but depends on composition of the diet.

Key Words: Pigs, Endogenous amino acids, Tannins

337 Effects of sorghum ergot in diets for nursery pigs. D. W. Dean*, R. H. Hines1, J. D. Hancock, G. A. Kennedy1, J. K. Porter2, C. A. Maloney1, J. M. DeRouchey3, D. J. Lee1, S. Park1, and H. Cao1, 1Kansas State University, Manhattan, KS, 2R.B. Russell Agricultural Research Center, Athens GA.

Two experiments were conducted to determine the effects of ergot contaminated sorghum grain in diets for nursery pigs. All pigs, in both experiments, were fed the same complex starter diet (1.7% lysine) for 7 d and then changed to the experimental sorghum-based diets. In Exp. 1, 48 crossbred barrows and gilts (4.8 kg average initial BW) were blocked by weight and allotted to pens based on sex and ancestry. The pigs were fed diets with normal sorghum or ergot infected sorghum in the 32-day growth assay. The sorghums were analyzed for ergot alkaloids and found to have none and 1.2 ppm dihydroergosine for the normal and contaminated sorghums, respectively. When fed to pigs, overall ADG (P < .003) and ADFI (P < .001) were reduced by the diet with ergot infected sorghum. However, gain/feed was improved (P < .02) for pigs fed the diet with ergot. In Exp. 2, 48 crossbred barrows and gilts (average initial BW=4.9 kg) were used in a 28-day growth assay. Treatment were: 1) normal sorghum; 2) 50% normal:50% ergot infected sorghum (1 g/kg dihydroergosine); and 3) ergot infected sorghum (1.2 ppm dihydroergosine). Average daily gain and ADFI decreased (linear effects, P < .02) as contaminated grain in the diets was increased from none to 100%. Gain/feed was not affected (P > .6) by ergot contamination of the diets. Results suggest that ergot infected grain sorghum (with levels as low as .6 ppm dihydroergosine) will markedly decrease feed intake and growth in nursery pigs.

Key Words: Pigs, Diets, Ergot, Sorghum
338 The effects of antibiotic regimens on fecal shedding patterns and bacterial resistance in pigs infected with Salmonella typhimurium, P. D. Ebner* and A. G. Mathew, University of Tennessee, Knoxville, TN.

An experiment was conducted to determine effects of antibiotic regimens on fecal shedding and antibiotic resistance in pigs infected with Salmonella typhimurium. Fifty 50-d-old pigs were inoculated with Salmonella typhimurium, blocked by litter, and assigned to one of four treatments including: 1) IM injection of cefotiofur sodium for three days followed by inclusion of oxytetracycline (OTC) (110 ppm of feed), 2) apramycin (165 ppm of feed) for 14 d followed by OTC (110 ppm), 3) carbadox (55 ppm) followed by OTC (110 ppm), and 4) no antibiotics (control). Pigs were housed in a common room; however, direct contact between pigs of different treatment groups was not possible. Fecal samples were collected by rectal swab, pre-inoculation, 48 and 72 h post-inoculation, and at weekly intervals, until pigs reached approximately 110 kg BW. Salmonella isolates were analyzed for resistance to cefotiofur sodium, apramycin, carbadox, and OTC on days 2, 5, 7, 21, 42, and 70 post-inoculation. Reduced shedding (P < .05) was observed in pigs receiving the apramycin/OTC treatment when compared to the control; however, no differences were observed between antibacterial treatments and no antibiotic treatment increased shedding. The percentage of resistant isolates increased with time within every treatment (Treatment x Time interaction, P < .05). Resistance to individual antibiotics also increased with time in every treatment (Antibiotic x Time interaction, P < .05). The percentage of isolates resistant to carbadox was significantly greater (P < .05) in pigs receiving the carbadox/OTC treatment compared to other antibiotic treatments; however, this was the only Antibiotic x Treatment interaction observed. These data indicate the antibiotics tested do not increase shedding of Salmonella typhimurium; however, resistance to those antibiotics increases over time following treatment dose.

Key Words: Pigs, Salmonella typhimurium, Antibiotics

339 Inhibitory/stimulatory effect of organic acids on intestinal microflora. A. Piva1, G. Biagi1, E. Meola1, J. B. Luchansky2, and P. P. Gatta1,1 University of Bologna, Italy, 2 University of Wisconsin, Madison, WI.

The use of organic acids in monogastric diets has become a common practice despite the variable outcomes. Very little is known about the effect of organic acids on the host microflora. We investigated the effect of several organic acids in swine in vitro fermentation. Cecal inoculum was collected from pigs within 20 minutes from slaughter and the fermentation was carried out in a batch culture system that allowed quadruplicate observations per treatment at time 0, 4, 8, and 24 h after the incubation commenced. Gas production was recorded hourly and the data were fitted by the Gompertz bacterial growth model (r2 > 0.98). Organic acids were used at 60, 120, and 240 mmol/L, in fermentation vessels with pH adjusted to 6.5-6.7. Compared to control diet, formic acid (FA) decreased cumulative gas production (VF) by 29% and 55% at 120 and 240 mmol/L, respectively (P < .05). Acetic acid (AA) showed no effect on VF. Propionic acid (PA) decreased VF by 24% and 48% at 120 and 240 mmol/L, respectively (P < .05). Lactic acid (LA) increased VF by 19%, 59%, and 24% at 60, 120, and 240 mmol/L, respectively (P < .05). Maximum rate of gas production was modified by PA by +27%, and +44% at 60, and 240 mmol/L, and by LA by +127%, +210% and +56% at 60, 120, and 240 mmol/L, respectively (P < .05). Ammonia concentration (mmol/L) after 8 h fermentation, was restrained by 29% by LA at 60 mmol/L. The other acids, beside FA at 60 and LA at 120 mmol/L, resulted in an increase at 8 h. Samples collected from fermentation vessels at 8 h were plated on Violet Red Bile Agar and Rogosa Agar showing no difference in colony forming units. Organic acids seemed to have different degrees of inhibition of swine cecal microflora delaying and reducing the gas production curve. PA and FA gave the most promising indications for an effective control of cecal microflora. Interestingly, LA resulted in a stimulatory effect on microflora as suggested by gas and ammonia data.

Key Words: Additive, Acidifier, Pig


The objective was to measure the pH of the proximal region of the porcine stomach to determine whether buffers added to the water supply could decrease acidity in order to reduce the incidence of pars esophageal ulceration. Four barrows (25 ± 2 kg) had gastric cannulas surgically implanted into the proximal region of the stomach. Pigs were placed on a finely ground and pelleted corn-soybean meal diet (398 ± 2.35 microm) prior to surgery and fed ad libitum. The experimental design was a Latin Square. Water treatments included: water (control), 200 mOsM sodium bicarbonate, 250 mOsM sodium bicarbonate, and 250 mono/disodium phosphate. Pigs were given a 4-d adjustment period and pH sampling began on the morning of the 4 and continued for 24 h under normal feeding conditions. Feed was removed and measurements were continued for 16 h. Buffered water raised the pH of the proximal region of the stomach when compared to the control during the entire sampling period (P < .0001). Average pH while consuming the 250 mOsM NaHCO3 buffer was 4.63 ± .11 (n = 4), 4.86 ± .11 (n = 4) for the 200 mOsM NaHCO3, 4.59 ± .14 (n = 3) for the 250 mOsM mono/diphosphate buffer, and 3.65 ± .11 (n = 4) for the water control. Buffers also raised the pH of the proximal region of the stomach for both the fed phase (P < .0001) and the fasting phase (P < .01) of the trial when they were analyzed separately. Drinking water disappearance was measured during the buffer adjustment period. The water disappearance rates when pigs were given the NaHCO3 were higher than the water control (P < .1). Average daily drinking water disappearance for the 250 mOsM NaHCO3 was 13.77 ± .74 liters, 13.56 ± .74 liters for the 200 mOsM NaHCO3, 10.33 ± .96 liters for the phosphate buffer and 9.13 ± .74 liters for the water control. Therefore, the pH of the proximal region of the stomach was increased by adding buffers to the water supply although addition of the bicarbonate buffers resulted in increased drinking water disappearance by the pig.

Key Words: Buffer, pH, Water

341 Potential role of pancreatic enzymes in the formation of pars esophageal ulcers in growing pigs. T. Parr*, V. M. Gabert1, D. B. Anderson2, and M. Ellis1, 1 University of Illinois, Urbana, IL, 2 Eli Lilly, Greenfield, IN.

The present study was carried out to determine the impact of fasting on the incidence of pars esophageal ulcers and the composition of stomach contents in growing swine. Control animals (fed) were left in the nursery facility with ad libitum access to feed and water, while treated animals (fasted) were mixed with unfamiliar pigs, moved to a growing facility and not allowed access to feed. Ad libitum water was available. After 24 hours, pigs from both groups were euthanized. Stomachs were weighed and pH was measured from the cardiac and pyloric regions of the stomach, as well as the small intestine. Stomach contents were collected from the same location, and enzyme activities were determined. Ulcer scores were assigned to all pig stomachs. Fasting pigs decreased (P < .0001) full stomach weights and increased ulcer scores (P < .0001) compared to fed pigs, 1.37 and 0.2, respectively. No pH difference was found (P > .05) between fed (3.9) and fasted (3.5) pigs. Trypsin activity was higher in the cardiac region of fed pigs (0.41 U/g of gastric digesta) vs. fasted pigs (0.18 U/g) and in the pyloric region of fasted pigs (0.29 U/g) as compared to fed pigs (0.06 U/g). Chymotrypsin activity was low in the cardiac and pyloric regions (0.01 U/g) of the stomach in fed pigs, however, it tended to be higher (P < .10) in the cardiac and pyloric regions of the stomachs in fasted pigs, 0.16 U/g and 0.19 U/g, respectively. The level of pepsin was lower in the cardiac (102.9 ± μg/g) and pyloric (94.2 ± g/g) regions of the stomachs in fed pigs, but was higher (P < .01) in the
cardiac region (357.9 µg/g) of fasted pigs and tended to be higher in the pyloric region (465.8 µg/g) of the fasted pigs. There were no significant differences in trypsin, chymotrypsin or pepsin levels in the duodenum between treatments. The results indicate that pancreatic enzymes reflux into the stomach and are active despite the low gastric pH. Therefore, the autodigestive properties of pancreatic enzymes could contribute to ulceration of the pars esophagea.

**Key Words:** Pigs, Ulcers, Chymotrypsin

342 Effect of Aureomycin® chlortetracycline (CTC) in grower and finisher diets vs. Tylan® or BMD® on performance, health, carcass parameters, meat quality characteristics and probability of having lightweight pigs, in lean genotype, high health swine. G. Gourley1, J. Deen2, and T. Wolff3. 1Swine Graphics Enterprises, Webster City, IA, 2North Carolina State University, Raleigh, NC, 3Roche Vitamins Inc., St. Charles, MO.

The objective of this study was to compare the effects of two CTC programs (CTC 110 mg/kg in grower diets followed by 55 mg/kg in finisher diets, fed to market (≥ 122 kg BW), or followed by zinc bacitracin (Bacitracin) 27.5 mg/kg starting 2 wk before market), vs. Tylan 44 mg/kg in grower, followed by 22 mg/kg in finisher, vs. BMD 33 mg/kg in grower and finisher. Single-sourced pigs (n = 1000), averaging 24 kg BW, were randomized by weight and sex to 40 pens (25 pigs/pen). Pigs were fed corn-soy meal diets in a five-phase feeding program, with gits fed diets ranging from 1% to .64% lysine, and lysine levels of barrows ranges from 1% to .55%. Pigs fed 110 mg/kg CTC in grower diets were heavier (P < .01) than all the other treatment groups. Pigs fed 110 mg/kg CTC in grower diets had higher ADG (P < .01) and ADFI (P < .05) vs. all other treatment groups. Overall, comparison of within-pen CV showed a trend (P < .1) toward reduced variability for the CTC-only group vs. non-medicated pigs. The CTC treatments reduced (P < .1) the odds of having lightweight pigs (< .77 kg ADG) by 48% and 42% vs. non-medicated controls, while the Tylan and BMD reductions (25% and 4%, respectively) were not significant. Mortality and mortality were minimal and were not different between treatment groups. None of the treatments impacted (P > .05) carcass characteristics nor meat quality. In summary, CTC fed at low levels in grower-finisher diets positively impacted performance and reduced (P < .01) the probability of having slow-growing pigs vs. non-medicated controls, while Tylan or BMD did not.

**Treatment Nonmed CTC CTC/Bac Tylan BMD CV**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>ADG (kg)</th>
<th>ADFI (kg)</th>
<th>F/G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grow-Fin</td>
<td>.85b</td>
<td>2.2b</td>
<td>5.28</td>
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</tr>
<tr>
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<td>3.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

abMeans with uncommon superscripts differ, (P<.05)

**Key Words:** CTC, Tylan, BMD

343 The effect of various factors on the analytical procedures for L-gulonolactone oxidase activity in swine liver. S. Ching*, D. C. Mahan, R. Moreau, and K. Dabrowski, The Ohio State University, Columbus, OH.

The vitamin C requirement in swine has been evaluated using various biological methods (immune response, performance, and tissue ascorbic acid concentration), but none have used live L-gulonolactone oxidase (GLO) activity. L-Gulonolactone oxidase is the key enzyme in vitamin C biosynthesis present in the liver of the pig. This study was conducted to establish analytical procedures for evaluating the activity of GLO in the liver. The effect of substrate (L-gulonolactone) levels, storage time, antioxidant (glutathione, GSH) levels, tissue sample to buffer ratio, and sampling locations in the liver on GLO activity were analyzed. Five pigs for each variable were killed and the liver collected and frozen (-80°C). The substrate levels evaluated were 0, 33, 66, 100, and 132 mM. Enzyme activity increased quadratically (P < .01) as substrate levels increased and plateaued at 100 mM of gulonolactone. The GSH was added at 0, 16, 33, 50, and 66 mM, but GLO activity was not affected (P > .15). Enzyme activity was analyzed after 0, 7, 15, and 30 d of storage. No difference (P > .15) was found for the different storage durations. There was no difference (P > .15) in enzyme activity when analyzed from five different locations of the liver. The ratio of liver sample (g) to buffer (ml), including deoxycholate as a detergent for GLO extraction, was 1:1, 1:2, 1:4, 1:8, and 1:16. Enzyme activity increased quadratically (P < .01) as the ratio decreased. The absorbance scan of ascorbic acid from multi-wavelength spectrophotometry was not stable when the ratio of 1.5:1 was used. These results suggest that for measuring GLO activity in pig liver, the optimal level of gulonolactone and GSH should be 100 and 50 mM, respectively. The suitable liver sample to buffer ratio was 1 g of liver to 4 ml of buffer. GLO activity can be analyzed within 30 d of storage without loss of activity and with similar results at the various liver locations.

**Key Words:** Pig, Gulonolactone oxidase, Ascorbic acid

344 Comparison of the performance of, hematology and serum chemistry of rabbits fed supplementary antibiotics or copper or yeast or Leuescaena leucocephala. Å. A. Oni-fade, D. O. Adejumo, E. O. Onipede, R. I. Obiyan, A. O. Abu, O. T. F. Abanikannda, G. M. Babatunde, and A. Abubakar, University of Ibadan, Ibadan, Nigeria.

A comparison of four nutrition-based strategies to improve rabbit performance and health was the objective of this study. Two antibiotics: Tylosin or Neoterramycin at 100 mg/kg; Copper sulfate at 125 or 250 mg/kg; Yeast as Saccharomyces cerevisiae (YeaSac®) at 1.5 or 4.0 g/kg, and a forage named Leuescaena leucocephala served fresh at 50 g/day were added to experimental diets for rabbits. The control diet contained neither antibiotic nor forage supplement, and each diet was fed ad libitum to ten individually caged rabbits for 56 days. Performance of rabbits was determined weekly, while hematology and blood chemistry were determined terminally using conventional clinical procedures. The results showed that all the rabbits fed the supplements had superior (P < .05) growth rate, feed intake and feed conversion to the control group. The erythrocytes and hematocrit were highest (P < .05) in rabbits fed 3.0 g/kg yeast and 250 mg/kg Cu, while Leucocytosis were highest (P < .05) on Neoterramycin and Cu-based diets and lowest (P < .05) on Leuescaena-supplemented diet. Activities of alkaline phosphatase, aspartate and alanine aminotransferases were highest (P < .05) in the control rabbits whereas feeding antibiotic- and Cu-based diets resulted in lower (P < .05) values for these enzymes that were fed ad libitum to ten individually caged rabbits for 56 days. Performance of rabbits was determined weekly, while hematology and blood chemistry were determined terminally using conventional clinical procedures. The results showed that all the rabbits fed the supplements had superior (P < .05) growth rate, feed intake and feed conversion to the control group. The results showed that all the rabbits fed the supplements had superior (P < .05) growth rate, feed intake and feed conversion to the control group. The results showed that all the rabbits fed the supplements had superior (P < .05) growth rate, feed intake and feed conversion to the control group. The results showed that all the rabbits fed the supplements had superior (P < .05) growth rate, feed intake and feed conversion to the control group.

**Key Words:** Pig, Glutathione, Ascorbic acid


Beef cattle production in the Western US faces numerous regional challenges. Arid rangelands with limited forage production, as well as, seasonal and yearly extremes in forage quality create the need for supple-

**PASTURES & FORAGES**

mentation programs that are dynamic and regionally specific. Likewise, some regions consist of cool season forage bases and/or high elevation rangelands characterized by significant winter precipitation (snow accumulation) which, as a result, necessitates heavy reliance on harvested forage during the winter. The economic future of western beef producers may relate to the ability to reduce winter feed costs with the use of low-quality roughages such as bi-product straws, and dormant,
stockpiled forages. Winter management strategies, in turn, often blend optimal production with low-input, economically sustainable strategies that may differ from other regions of North America. Our Western Coordinating Committee (WCC 104) endeavored to create a publication that defined supplementation of low-quality roughages in the context of western beef production systems. This publication offered many authors, focusing on protein, energy, and protein form issues. Additionally, this publication includes discussions of general supplementation concepts (matching production expectations with the resources available), strategies for supplement delivery, supplementation of vitamins and minerals, comparisons of hand-fed versus self-fed supplements, and supplementation concepts within economically sustainable framework. While most authors conducted general reviews within their topic areas, emphasis was placed on regional research and, more specifically, research specific to western beef production systems.

**Key Words:** Beef cattle, Low-quality roughages, Supplementation

**346** Forage quality and animal performance in beef heifers grazing stockpiled fescue as influenced by supplemented whole cottonseed (WCS). M. H. Poore*, M. E. Scott, S. P. Morgan, and J. T. Green, North Carolina State University, Raleigh, NC.

An 83-d trial was conducted to determine changes in quality of stockpiled fescue and to evaluate performance of beef heifers. Thirty-six heifers (initial wt 265 kg, initial body condition score 5.0) were assigned to six groups. Each group was randomly assigned to a 2.4 ha infected pasture. Thirty ruminally-fistulated yearling heifers were used in a completely randomized design with a 4 × 2 factorial treatment arrangement. Performance data included weight gain, average daily gain (ADG) .46 kg/d; P < .01) decrease in hay OM intake (HOMI; 5.25, 5.31, 5.04, 4.05 kg/d) with a quadratic (P < .01) response (6.75, 6.55, 6.27, 3.71 kg/d) in NOCRN treatments. Feeding CORN+0.4 increased (P < .01) HOMI (4.05 vs 3.71 kg/d) over NOCRN+0.4. A cubic (P < .01) response to decreasing DIP was observed in HOMD (49.3, 41.9, 45.8, 29.5%) in CORN treatments no trend (P > .49) was found in NOCRN treatments (55.1, 56.2, 54.5, 58.0%). Supplementation with CORN+0.4 depressed (P < .01) HOMD (29.5 vs 58.0%) compared to NOCRN+0.4. Decreasing DIP resulted in a linear (P < .01) decrease in total digestible OM (TDOMI; 5.51, 4.92, 4.89, 3.70 kg/d) in CORN treatments with a quadratic (P < .01) effect (4.75, 4.55, 4.14, 2.66 kg/d) in NOCRN treatments. Supplementation with CORN+0.4 increased (P < .01) TDOMI (3.70 vs 2.66 kg/d) compared to NOCRN+0.4. Balancing total diet DIP to TDN appeared to overcome negative associative effects typically found when low-quality forages are supplemented with large quantities of low-protein, high-starch feeds.

**Key Words:** Protein, Starch, Fiber digestion

**348** Undegraded intake protein supplementation of steers on native Sandhills range. C. B. Wilson*, T. J. Klopfenstein1, and D. C. Adams2, 1University of Nebraska, Lincoln, NE, 2University of Nebraska WCRC, North Platte, NE.

A trial was conducted to evaluate the effects of undegraded intake protein (UIP) supplementation on pasture gains of compensating yearling steers and summer born calves. Upland sandhills range consisting of a mixture of warm and cool season species was utilized in 1998 (June to September). Forty-eight yearling steers (339 kg) were used in a completely randomized design with a 4 × 2 factorial treatment arrangement. Yearlings were wintered at a rate of gain, .68 (Fast) and, .45 kg/d (Slow/Fast and Fast/Slow). Thirty-two summer born calves (June–July 1997) calves (235 kg) were also utilized. All steers and summer born calves were assigned to one of two summer treatments: supplemented or unsupplemented control. The supplement supplied .2 kg of UIP per d attained by feeding 1.3 kg of supplement 3 d/wk. Supplement consisted of 78.5% treated soybean meal, 18.5% feather meal, and 3% molasses (DM basis). Biweekly forage samples contained on average (DM basis) 10.5% crude protein and 1.95% UIP (%DM). UIP supplementation significantly improved pasture gains in supplemented steers over unsupplemented controls (.15 kg/d; P < .05). Fast had a response of .22 kg/d to supplementation while Slow had a response of .15 kg/d. However, the interaction was not significant (P = .60). Summer born calves showed a positive response to the supplement (.15 kg/d; P = .0001) compared to unsupplemented summer born calves. Feedlot data showed no significant effect of summer treatment on DMI however feedlot average daily gain was significantly higher (P = .06) for unsupplemented cattles. There was also a trend (P = .17) for increased gain/feed for unsupplemented cattle. Carcass data showed no significant effects on fat, marbling or yield grade. There was a trend (P = .17) for increased gain/feed for unsupplemented cattle. Carcass data showed no significant effects on fat, marbling or yield grade. There was also a trend (P = .17) for increased gain/feed for unsupplemented cattle. Carcass data showed no significant effects on fat, marbling or yield grade.

**Key Words:** Undegraded intake protein, Compensatory gain, Calves

**349** First limiting nutrient for nursing calves grazing native range in southeastern North Dakota. T. W. Loy*, G. P. Lardy, J. S. Caton, and M. L. Bauer, North Dakota State University, Fargo.

Thirty-two spring-born, crossbred calves (average initial wt=169 ± 9.42 kg) were used in a randomized complete block design to evaluate the first limiting nutrient of nursing calves during the summer grazing season. Calves were blocked by sex, stratified by weight and parity, and assigned to one of four treatments: Control (no supplement); Energy (100% soy hulls; 385g/d); DIP (68% soy hulls, 32% SMB; 375g/d); or DIP+UIP (80% sulfitetreated soybean meal, 16% feather meal, 4% blood meal; 375g/d). Supplements were formulated to be similar in ME and the DIP and DIP+UIP supplied equal amounts of degradable protein. Supplemented calves were fed individually and refusals were collected following each feeding. Weight gain, fecal output and milk intake (MI) were measured in July, August and September. Forage intake was estimated during each period by 6-d total fecal collection with 4 steers per treatment. Six ruminally- fistulated yearling heifers were used to collect extra samples, which were analyzed for CP, NDF, ADP and IVOMD. MI was measured using the 12-hour weigh-suckle-weigh technique. Two-day weights were taken to determine weight gain. GLM

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procedure of SAS was used to determine treatment effects. Orthogonal contrasts were used to compare Control vs. supplemented calves; Energy vs. protein-supplemented; and DIP vs. DIP+UIP. MI tended to differ between treatments ($P = .11$) and supplemented calves had higher MI than Control calves ($P = .02$). Total forage intake (OM kg/d) differed between Energy calves and those on protein treatments ($P = .03$). Forage intake as a percentage of body weight was affected by treatment ($P = .06$). Control calves had higher intakes compared to those receiving supplement ($P = .07$) as did Energy calves vs. protein-supplemented calves ($P = .05$). Supplemented calves gained faster than Control calves over the entire trial ($P = .05$). Based on this data, energy appeared to be the first limiting nutrient for weight gain by nursing calves grazing native range in eastern North Dakota.

Key Words: Nursing calves, Supplementation


This research investigated whether performance responses to protein supplements could be explained by total sulfur amino acids in bypass (UIP) and supplements. Cows were fed for 49 days. Supplements were provided to 3 or 5 g/d of total sulfur amino acids (TSAA, methionine plus cystine) in the UIP from either blood-feather meal (BFM, 50:50), corn gluten meal (CGM) or a ruminant protected methionine (MET, Smartamine M®). These were compared to a control supplement. Supplements contained 84% fortified (urea, minerals, vitamins) sugarcane molasses and 16% corn. Cows were supplemented with varying levels of TSAA to determine the respective effects on nitrogen retention and weight gain in light horse breeding, average body weight, 600 kg and 8 of draft horse breeding, average body weight, 1350 kg. All sources of methionine gave similar ($P = .53$) results suggesting that TSAA concentration of BFM and CGM was the limiting nutrient that was improving performance. Cattle gains increased linearly ($P < .01$) for each gram of bypass TSAA up to the 5 g/d and all ($P < .01$) responses improved by adding supplementation. The main plot of species and stages of pregnancy were assigned to the 16 treatments in 1997-98. Twenty-four Holstein, and Jersey heifers were assigned to 16 treatments in 1996-97. Fifteen heifers were assigned to 16 treatments in 1995-96. Feces and urine were collected for five days. The early cut hay, late cut hay and oats contained 11.7%, 7.1%, and 13.6% crude protein respectively (DM basis). The re-
results also suggest that the dehydration process failed to increase the rumen escape protein value of dehy alfalfa pellets.

**Key Words:** Alfalfa, Processing, Rumen degradability

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### 354 Social behavior of grazing beef cattle: implications for management

B. F. Sowell*, J. C. Mosley, and J. G. P. Bowman, Montana State University, Bozeman, MT.

The purpose of this paper is to explore the social structure and behavior of grazing beef cattle and apply that knowledge to management problems. Cattle herds are composed of stable, social subgroups. These subgroups form strong, long-term social bonds which influence home range use. Selective culling is one management strategy which may be used to alter subgroup composition and home range fidelity. This technique could improve cattle distribution and reduce damage to riparian areas. Herding is another technique which can improve habitat use by altering home range fidelity. Grazing distribution is often a learned response. Management strategies which alter the social composition and structure of cattle subgroups can affect habitat use. If a particular subgroup has desirable range use patterns, replacement heifers should not be introduced from outside subgroups. Cattle form social hierarchies which can present a number of feeding problems. Older, heavier, more dominant animals may consume a greater proportion of supplement than smaller, less dominant animals. Sorting cattle into similar age groups with similar physiological demands can improve intake variation between individuals. Variation in individual supplement consumption may be reduced by changing delivery methods. Management of grazing cattle is an exercise in behavior modification. The more we understand about these behaviors and how they are acquired, the more readily they can be manipulated to enhance management.

**Key Words:** Selective culling, Subgroups, Social hierarchies

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### 355 Grazing time and assessment for beef cows on pasture using GPS

M. C. Udal, L. W. Turner, B. T. Larson, L. J. Driedger*, and S. A. Shearer, University of Kentucky, Lexington, KY.

Global Positioning Systems (GPS) can be used to assess animal behavior and grazing patterns. Collars with GPS receivers tracked beef cows in summer on continuously grazed fescue. Animal activity (grazing, standing, lying) was determined by two dual-axis motion sensors in GPS collars that record "up-down" and "side to side" movements of head and neck. Minimum time between two logged events (pulses) is 0.5 s. Events counted per sensor per time period indicate relative activity. Seven GPS-collared cows were placed in a 6 ha pasture. GPS fixes were taken every 5 minutes for 7 days, and the activity sampling window was set for the 4 minutes between fixes. Cows were observed on 4 occasions of up to 8 consecutive hours to validate motion sensor counts to specific activity (standing, grazing, lying). Counts from activity sensors were summed for the 4 minutes between the 5 minute GPS fix intervals. Data were analyzed for differences between collars and activity periods. A counter sum cutoff was determined that classified activity of cows, and validated observed data. Visual observations documented 135 active (grazing) periods and 1196 inactive (standing or lying) periods of 5 minutes each. Sensor values were different between collars (P < .003). Observed grazing and non-active sensor count means for all cows indicated the activity classification means were different (P < .0001). The system correctly classified grazing (94.8%, and inactive (91.2%) data records (91.7% of total records). The GIS database visualized inactive points and grazing locations. Grazing locations were well spaced and distributed. Inactive points were clustered near water, or in favored resting places. Predicted grazing time mean values were 32.9% per day. Four of five collars estimated grazing time within 1.3% of the mean. One collar produced an estimate of 1/3 less grazing time, which could result from sensor variability, animal differences, or collar attachment differences. This technique shows promise for assessing grazing behavior of cows on pasture.

**Key Words:** Grazing, Beef cattle, GPS

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### 356 Beef cow-calf production from pastures containing hay-type or grazing tolerant alfalfa hybrids grazed by season-long or complementary stocking

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To evaluate forage production, legume persistence, and cow-calf production from pastures containing hay-type and grazing tolerant alfalfa hybrids and grazed by different stocking systems, six 2.02-ha pastures were seeded in 1997 with ‘Barton’ smooth bromegrass, a mixture of ‘Afton’ alfalfa (a hay-type hybrid) and ‘Barton’ smooth bromegrass. This may be a success, or a mixture of ‘Amerigrazie’ alfalfa (a grazing tolerant hybrid) and ‘Barton’ smooth bromegrass to be grazed season long. Four 2.02-ha pastures were used for complementary grazing were divided into 1.21 ha seeded with ‘Barton’ smooth bromegrass and .81 ha seeded with ‘Affinity’ or ‘Amerigrazie’ alfalfa and ‘Barton’ smooth bromegrass. In 1998, each pasture was divided into ten paddocks and rotationally strip-stocked with crossbred cows at 1.98 cows/calf units/ha for 120 d beginning on May 18. On June 1, hay was harvested from 40% of each pasture. Cows grazed paddocks in the remaining 60% of each pasture for the first 44 d and 100% of each pasture on d 45 to 120. Daily forage allowance was calculated from the live mass estimated with a falling plane meter (1.2 kg/m²) and assuming that DM of each cow-calf pair was 3.5% of cow weight. Total and live forage masses were greater (P < .05) in May and September from all alfalfa pastures than the season-long smooth bromegrass pastures and from season-long alfalfa pastures than pastures using alfalfa for complementary grazing. Proportions of ‘Affinity’ and ‘Amerigrazie’ alfalfa in pasture live DM decreased 55 and 70% in pastures grazed season long and 42 and 60% in pastures using alfalfa for complementary grazing (Hybrid, P < .05; Grazing system, P < .05). Calf daily gain (kg/d) and seasonal BW production (kg/ha) were not affected (P > .10) by the presence of alfalfa, alfalfa hybrid, or grazing system. Total animal (cow and calf) production was greater (P < .05) in pastures containing alfalfa than smooth bromegrass and greater (P < .10) in alfalfa pastures grazed season long than those grazed by the complementary system.

**Key Words:** Beef cattle, Alfalfa, Grazing

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### 357 Performance and nutrient utilization of steers consuming kenaf, pearl millet, or Bermuda grass

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Kenaf is gaining in popularity as a fiber crop in the southeastern U. S. During the vegetative phase subproducts from kenaf may be utilized for cattle growth. To determine animal performance, 72 steers (214 ± 65 kg) were allotted to one of three forages: kenaf (K); pearl millet (M); or Bermuda grass (B) and allowed to graze for 56 days. During the first 28 days, steers grazing M gained faster (P < .01; .90 kg/d) than those grazing K (.71 kg/d) but slower than steers grazing B (1.05 kg/d). During the 2nd 28 d, steers grazing B gained slower (P < .05; .24 kg/d) than those grazing K or M (.62 and .70 kg/d, respectively). Total gain for steers grazing M was faster (P < .05; .80 kg/d) than those grazing B or K (.65 and .67 kg/d, respectively). To determine nutrient utilization, 12 steers were divided into the same three forage groups and fed green chop while housed in metabolism crates. Dry matter intake differed (P < .05) between K, B, and M (1.07, 2.05, and 2.63 % of BW, respectively). Apparent digestibility of DM (60, 68, and 76 %) and OM (62, 73, and 80 %) were different (P < .05) for B, K, and M; respectively. Apparent digestibility of NDF, ADF and hemicellulose was less (P < .05) between K, B, and M (1.07, 2.05, and 2.63 % of BW, respectively). Apparent digestibility of protein was less (P < .05) in steers consuming B (58 %) than for those consuming K or M (78 and 77 %; respectively). Apparent digestibility of energy was least (P < .05) for B (66 %) and greatest for M (79 %) when K being intermediate (71 %). More (P < .05) protein was retained in steers consuming M (320 g/d) compared to those consuming B or K (78 and 107 g/d, respectively). Energy retained by steers was different (P < .05) for B, K, and M (9.6, 5.2, and 16.3 kcal/d, respectively). Steers grazing K did not perform as well as those grazing M. This may be due to steers utilizing protein and energy more efficiently when grazing M compared to K.

**Key Words:** Kenaf Grazing, Nutrient Utilization, Beef Cattle
358 Management influences on gaseous energy losses from grazing beef cattle. K. C. Olson1,1, A. J. Walker2, B. R. Bowman1, C. E. Foley1, C. A. Stonecipher1 and D. G. Eddington1, 1Utah State University, Logan, UT, 2South Dakota State University, Pierre, SD.

Management practices that reduce methane emissions contribute to improved energetic efficiency by ruminants. Methane reductions also contribute to reduced greenhouse gas loading. The objective was to evaluate management methods to decrease methane emissions from grazing beef cattle by improving production efficiency. Animal performance, nutrient utilization, and methane emissions were measured in 3 experiments to evaluate relative sensitivity of methane responses to different types of management practices including cattle, grazing, or forage management. To evaluate cattle management, cows and calves from an accelerated slaughter program were compared to contemporaries in a normal feeding program. Calves were compared from weaning to slaughter. Methane emissions per day were similar, but total methane emitted from weaning to slaughter was reduced (P = 0.009) by 57% because accelerated steers were slaughtered about 90 d sooner. Genetically superior cows used to produce accelerated calves were compared to control cows throughout the annual production cycle. Methane emitted per cow was similar (P > 0.05) but methane emitted per unit of calf gain was less for superior cows because of faster gain by the calves. To evaluate grazing management, a stocking rate trial was conducted using 4 rates to evaluate the effect on cows and calves on irrigated pastures during the growing season. Increased stocking rate decreased animal performance and nutrient intake, and tended to increase methane emitted per unit of cow or calf gain. To evaluate forage management, a grazing trial was conducted using pregnant, non-lactating beef cows during the fall and lactating beef cows in the spring to compare 4 improved grasses seeded on range and native range. Methane emissions varied among grass species and grazing season. For example, native range provided the lowest methane in fall, but was among the highest in spring. Methane emission reduction was more sensitive to manipulation of animal than forage or grazing management.

Key Words: Beef Cattle, Grazing, Methane


The objective was to determine the relationship between in vitro gas production (G) and in vivo digestibility and intake of tropical feeds by cattle. Eight feeds from semi-arid India including rice straw (2), millet straw (2), sorghum straw (2), groundnut hay (1) and natural pasture grass (1); and five feeds from Niger including rice straw (2), millet straw (2), sorghum straw (2), groundnut hay (1) and natural pasture straw (2) were evaluated on balanced subsets where each entry had both NDF and CP, and 16 native) and 133 mixed diets fed to non-lactating cattle. Equations for estimating voluntary intake (VI) have been proposed by the National Research Council (NRC) and the National Forage Testing Association (NFTA). The NRC equations are based on NEm, or CP+ADF (1984 and 1996 beef bulletins). The NFTA equation assumes NDF intake is a constant 1.2% of BW. Objectives were to (1) evaluate acceptability of these equations, and (2) develop and evaluate a new equation. The database was derived from 30 publications and Regional Project S-45. There were 93 grass hays fed alone (36 temperate, 41 tropical, and 16 native) and 133 mixed diets fed to non-lactating cattle. Esti- mates of NEm and TDN were based on in vivo digestibility. Observed VI (DM) as % of BW was regressed on VI estimated by the equations. Differences between estimated and observed values were calculated. A difference was considered unacceptable if its absolute value was > 0.46% of BW (that is 20% of the overall mean VI, 2.3% of BW). Equations were evaluated on balanced subsets where each entry had both NDF and ADF. In the following, numbers in parentheses after equation iden- tifications are the percentage of estimates that were unacceptable for 68 forages fed alone: NFTA (71), NEm-1996 (62), NEm-1984 (15), and CP+ADF (24); and for 140 forages and diets: NEm-1996 (51), NEm-1984 (28), and CP+ADF (26). New equations were developed on a subset that included 48 forages and 68 diets from 19 publications and S-45, and were evaluated on an independent subset. Equations fit the data better when ADF rather than NDF was included. The best new equa- tion is as follows for forages fed alone: VI (DM, as % of BW) = 2.318 + 0.442*CP + .0100*CT2 - 0.0638*TDN + +0.0092*TDN2 + .180*ADF + .00196*ADF2 + .00529 *(CI*ADF). For mixed diets, add + .186. For the evaluation set of 46 forages and diets, the percentages of unacceptable estimates were NEm-1996 (60), NEm-1984 (20), CP+ADF (21), and the new equation (7). Based on this study, the NFTA and NRC NEm-1984 VI equations are unacceptable for grasses or grass-based diets. Acceptability of the new equation is supported by a mean difference = 0 and r2 = .76.

Key Words: Forage, Intake, Prediction

360 Effect of water soluble carbohydrates on selection by sheep. S. W. Coleman1 and H. Dove2, 1USDA-ARS, El Reno, OK, 2CSIRO Plant Industry, Canberra, ACT, Australia.

A series of experiments was conducted to examine whether sheep select herbages of higher water soluble carbohydrates (WSC) content. In late November 1998, a field of Phalaris aquatica at the research facility near Canberra, Australia, was partitioned and cut at either 0530 (M) or at 1130 (N) based on previous observations of the times of minimum and maximum herbage WSC content. In addition, phalaris swaths that were in shaded or exposed material was conditioned that afternoon and compressor into rectangular baffles the next morning. Cut hay dried rapidly, since maximum temperatures on the days of cutting and baling were 36° and 33°C, respectively. Each hay was assayed for WSC (M 53.6 g/kg; N 78.7 g/kg DM) in duplicate and about 100 kg of each was coarsely chopped. A separate hay of moderate quality was used as a control (C). Each of the three chopped hays was fed to four sheep to determine rate of intake over five 2 minute intervals. Intake rates were 3.1, 5.0, and 2.7 g/min (P = 0.06) for C, M, and N hay respectively. A replicated 3x3 latin square design was used for the selectivity trials with the treatment being one of three two-hay comparisons (C-M, C-N, M-N). Sheep ate more M than C (difference = 2.9g/min; P < .05), more M than N (3.2g/min; P < .05) and equal proportions of C and N. Regressions of intake and the observed (O) vs predicted (P) rates of intake evolved a harsh feel after grinding for N hay suggested that physical characteris- tics of the hays influenced selection more than the chemical differences between them. Samples of the M and N hays were ground through a Christy-Norris mill to pass a 1 mm screen and the ground material was applied to the C hay with sufficient water to cause it to adhere. The three hays were then fed as above one treatment being the control hay without ground material. Statistically, the sheep made no preference for any hay, but there was a numerical preference for N over both M (4.2 g/min) and C (.6 g/min). These data suggest that any preference for increased WSC in these hays was masked by physical characteristics.

Key Words: Selectivity, Water-soluble carbohydrates

Standards of predominantly alfalfa forage were harvested as round bale silage by three methods: unprocessed, C (conventional round baling); Sliced, S (New Holland) 644 silage special baler) and prototype, P (experimental baler with a flail type pickup head designed to chop the forage as it entered the bale chamber). All forages were baled approximately 24 h after mowing using alternate bale and window techniques and were immediately wrapped in plastic. Bales were stored outside undisturbed for approximately 3 months until the feeding trial was initiated. At similar dimensions, the wet weight of S and P bales was 14% and 22% greater than conventional C bales indicating marked increases in bale density. Post-storage forage quality (% of DM) was excellent for C, S, and P bales, respectively: P, 22.2, 22.5, 21.8; ADL, 29.3, 30.9; and DM, 29.6, 32.1, 29.2 (ab, P < .05). Dry matter losses (%) during storage were 5.2th, 3.5b and 7.9a, respectively. Forty-eight crossbred pregnant yearling beef heifers (438 kg) were assigned to six pens of eight heifers per pen. Two pens of heifers were randomly assigned to the C, S, and P forages. A 6 d intake study was divided into three phases: 1, ad-libitum forage access, elevated cone feeders, 31 d; II, 2 h/d forage access, elevated cone feeders, 14 d; and III, 2 h/d forage access, ring feeders, 14 d. Dry matter intake (kg hd−1d−1) for heifers fed C, S, and P bales were: I, 10.87, 11.44, 11.29; II, 6.11, 6.79, 6.00; and III, 6.14, 7.69, 6.51. Body weight gain for the entire trial was (kg, P < .05). It is concluded that sliced processing of round bale silage during baling is conducive to improved forage intake and body weight gain by cattle that is not available to the prototype processing was noted.

Key Words: Forage, Intake, Beef cattle

Effects of feeding spear mint silage on nutrient utilization and rumen fermentation of steers. A. F. Mustafa*, C. J. McKinnon, and D. A. Christensen, University of Saskatchewan, Saskatoon.

The objectives of this study were to determine the effects of feeding spear mint (Mentha spicata) silage on ruminal fermentation and nutrient utilization by beef steers. Six steers fitted with rumen cannulae were fed mint silage or barley silage (three animals per treatment) in a 30-day metabolism trial. Relative to barley silage, mint silage contained 17, 180, 20, and 330% more (P<.05) neutral detergent fiber, acid detergent lignin (ADL), crude protein (CP), and acid detergent insoluble CP, respectively. Steers fed mint silage consumed less (P<.05) dry matter than steers fed barley silage. Rumenal pH was higher (P<.05) while volatile fatty acid (VFA) concentrations were lower (P<.05) for steers fed CSM and PM. Rumenal degradability of dry matter, CP, and ADF were 46, 62, and 11%, respectively higher (P<.05) for barley silage than for mint silage. Total tract nutrient digestibility coefficients were higher (P<.05) for barley silage than for mint silage fed steers. Digestible energy content (Mcal/kg) was higher (P<.05) for barley silage (2.63 Mcal/kg) than for mint silage (1.86). The results suggest that due to its high ADL and acid detergent insoluble CP, mint silage was poorly utilized by steers.

Key Words: Mint silage, Rumen fermentation, Nutrient degradability

Pearl millet grain hybrid silage: Forage quality and growing steer performance. G. M. Hilti*, P. R. Utley1, R. N. Gates2, W. W. Hanna2, and J. C. Johnson, Jr., University of Georgia Coastal Plain Station, Tifton, GA, USA, USDA-ARS, Coastal Plain Station, Tifton, GA, USA.

Spring-planted “HGM-100” pearl millet grain hybrid [Pennisetum glau- cum (L.) R. Br.] and corn (Zea mays L.) were compared as silages for growing steers. Pearl millet (PM) was planted May 20, 1996 (4.85 ha; 5.60 kg/ha; .91 m rows). On July 31, 1996, PM was direct-cut with grain at soft dough stage, weighed, and a microbial inoculant (Pioneer 1177) was added as PM was packed in large silo bags (diameter: 4 m; length: 18 m). Spring-planted corn was harvested at 38% DM, and stored in an oxygen limiting upright silo. In a 56-d trial, 75 beef steers (BW = 372 ± 36 kg; age = 9 mo) were randomly assigned to dietary treatments: millet silage (MS); millet silage with ground shelled corn (5.0% of forage wt) added at ensiling (MSC); and corn silage (CS). Steers were implanted with Synovex-S® on d 1, and initial and final BW were means of two daily full weights. Silages were fed free-choice, and soybean meal was fed with MS and MSC at .45 kg/steer daily, and CS at .68 kg/steer daily. The DM (% CP, ADF, NDF, and TDN (% DM), respectively, of silages were: MS= 31.2, 11.1, 38.3, 36.5; MSC= 36.4, 11.5, 36.9, 55.8; CS= 41.2, 8.0, 25.8, 42.3, 69.8. The pH and NH3, lactic acid, acetic acid, total VFA (% of DM), and lactic:acetic, respectively, for silages were: MS=6.04, 06, 4.23, 1.25, 1.52, 3.38; MSC= 5.35, .06, 5.65, .75, 8.5; CS= 4.00, .02, 6.61, .99, 1.06, 6.68; treatments were not different (P > .10) for these variables. Steer 56-d ADG, final BW, silage DM, total DM [silage + soybean meal]; kg and DM/gain, respectively, were: MS= .78b, 315.6b, 5.31b, 5.71b, 7.35a; MSC= .77b, 315.2b, 5.80a, 6.21a, 7.92a; CS= 1.22a, 340.6a, 5.58a, 6.21a, 5.05b; variables without common letters differ (P < .05) across treatments. Corn added at ensiling improved PM silage fermentation, but supplemental energy for PM silage would be required to equal performance of steers fed high-energy corn silage.

Key Words: silage, steer, millet

Comparison of sorghum silages, corn silage, and a typical feedlot receiving ration for average daily gain, feed intake and feed efficiency. B. Gravett1, K. R. Pond1, V. G. Allen2, R. Rice2, and C. Johnson2, 1Texas Tech University, 2Seed Resource, Inc.

Three sorghum silages and one corn silage, grown on the Texas South Plains, and a typical feedlot receiving ration were fed to 350 kg steers to determine daily gain (ADG), feed intake (FI) and feed-to-gain ratio (F:G). The study was a completely randomized block design using 80 steers, predominately Angus, with four steers per pen. The three sorghum silages were Fame (FM), Cow Vittals (CV) and Brown Mid-Rib (BMR) and were balanced to 12% crude protein using cottonseed meal. All steers were fed a vitamin and mineral pre-mix (PM). The corn silage (CS) was also balanced to contain 12% crude protein using AMS and PM. The feedlot receiving ration consisted of steam-flaked corn, ground alfalfa hay, CSM, urea, PM, fat and molasses. Steers were placed on a typical feedlot receiving ration during the adaptation period. On d 15, steers were weighed and treatments were introduced during a 4-d adjustment period. After 14 d, the CNTL diet was increased to an 80% concentrate corn diet, whereas the silage diets remained at 100%. On d 32, steers were weighed and daily gains, feed intake, and F:G were calculated. During the 32-d, FI kg/differed (p <.05) and was 7.97a,5.93b, 5.98b, 6.35b, and 5.6b for the CNTL, FM, BMR, CV, and CS, respectively. The ADG, kg/d was 1.70a, 0.93b, 1.22b, 1.23b, 0.83b and the F:G was 4.73a, 6.56ac, 5.06ac, 5.98ac and 7.19bd for the respective diets. The CNTL diet was the most efficient diet overall and of the silage-based diets FM sorghum was more efficient.

Key Words: Silage, Sorghum, Beef Cattle

Role of supplemental vitamin E in neonatal lamb survival. P. G. Hatfield*, J. T. Daniels, R. W. Kott, and D. E. Burgess, Montana State University, Bozeman, MT.

Neonatal lamb mortality costs US sheep producers approximately $114 million annually. Mortality rates have been reported in excess of 20% with little improvement over the past 40 yr. Our objectives were to investigate: 1) the potential of supplemental vitamin E (SE), given to either newborn lambs or gestating ewes, to decrease neonatal lamb mortality and 2) the effect of SE on immune function. In a 2-yr study, 480 twin-born lambs/yr were used to determine the influence of SE (single dose of 390 IU/lambda) given to lambs shortly after birth on lamb survival. Although SE lambs had greater (P = .01) serum vitamin E concentrations than non-supplemented lambs (NE), lamb mortality and kg of lamb weaned/eve did not differ (P > .56). In a 3-yr study, 430 ewes/yr were assigned to either NE or SE (330 IU daily, for 21d prior to lambing). During the first half of lambing, lamb mortality was lower (P = .03) in lambs born to SE than NE ewes (12 and 17% mortality, respectively), resulting in 2.6 kg more (P = .01) lamb weaned per SE than NE ewe. No differences (P > .20) were detected in mortality or kg of lamb weaned/eve in late born lambs. To investigate SE and immune function, 52 twin-bearing ewes were assigned to NE or SE (400 IU daily, for 28 d prior to lambing). Half the ewes were vaccinated with Parainfluenza type 3 (PI3) to evoke an immune response that was measured as PI3 titers. Although serum vitamin E concentrations were greater (P < .01) in SE than NE ewes and lambs, no differences (P > .20) were measured.
detected in colostral or serum IgG concentrations or serum PI3 titers of ewes and lambs. These results indicate that SE had no effect on these indicators of humoral immunity in the ewe or passive immunity to the lamb. Although SE when given to the ewe positively influenced lamb survival, the mechanisms of this effect remain unknown. Research directed towards cell-mediated immune function and fetal energy status may better address the role of vitamin E in neonatal lamb survival.

Key Words: Survival, Immunity, Vitamin E


The objective was to evaluate the effect of two intensive grazing systems, on different productive parameters of Saint-Croix ewe-lambs. Forty Saint-Croix ewe-lambs, three months old with 12.5 Kg initial body weight, were randomly allotted into two either short duration grazing (T1, n=20) or continuous grazing (T2, n=20) systems for a 168 days period. Grazing period for T1 was 3 days for about six hours per day in a lot of 1190 m² of grassland. There were 21 grassland lots allowing one complete round in 60 days time enough for grass to growth. T2 was summed to continuous grazing, in a lot of 2500 m² of grassland also six hours per day. The seasonal rainfall meadow was composite from two type of grasses, Buffel grass (Cenchrus ciliaris) and Pretoria 90 grass ( Dichanthium annulatum). Precipitation during the period of study was 267 mm. Ewe-lambs were weighed (BW), measured heart girth circumference (HGC) and height at withers (HW), every 28 days either, to estimate growing. Results showed body weight were no different between treatments (T1=15.9kg, T2=15.4kg). HGC (T1=135.9cm, T2=58.3cm) and HW (T1=49.9cm, T2=51.4cm) were not significantly different also. However, at the end of 168 days period the grassland condition in T1 was good and in T2 is bad, whit a positive and negative tendency condition respectively. In conclusion, short duration grazing system showed a higher condition response at grazing, than continuous grazing system.

Key Words: Grazing systems, productive parameters, Saint-Croix

368 Selenium content of beef produced in North Dakota varies by geographic region. K. J. Hintze2, J. W. Finley3, G. P. Lardy4, M. J. Marchello5, and K. K. Sedivec1, 1North Dakota State University, Department of Animal and Range Science, 2USDA-ARS Grand Forks Human Nutrition Research Center.

Recent evidence suggests that selenium (Se) has human health benefits including enhanced immune function, cancer prevention, and enhanced neuro-psychological function. Beef provides 17% of human dietary Se intake. Skeletal muscle from the semimembranosus, and liver samples were taken from cull cows obtained from twenty-one different ranches in five distinct geographic regions throughout North Dakota. Regions overlying geologic formations known to produce forages either high or low in Se were picked as target areas. Se concentrations were determined by hydride generator atomic absorption spectroscopy after acid digestion. Differences in skeletal muscle and liver Se (mg/kg wet weight basis)

<table>
<thead>
<tr>
<th>Region</th>
<th>Central (C)</th>
<th>Northwest (NW)</th>
<th>Southeast (SE)</th>
<th>South-central (SC)</th>
<th>Southwest (SW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>8</td>
<td>21</td>
<td>14</td>
<td>20</td>
<td>29</td>
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<tr>
<td>Muscle1</td>
<td>.40 ± 0.14</td>
<td>.67 ± 0.22</td>
<td>.28 ± 0.06</td>
<td>.48 ± 0.10</td>
<td>.43 ± 0.08</td>
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<tr>
<td>Liver</td>
<td>.61 ± 0.11</td>
<td>.72 ± 0.21</td>
<td>.47 ± 0.07</td>
<td>.78 ± 0.14</td>
<td>.60 ± 0.19</td>
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1Values are means ± SD; means with different superscripts are significantly different (P < .05).

Geographic region significantly affected muscle and liver Se content (P < .0001). All sampled areas in North Dakota produce beef higher in Se than the United States average (.22 mg/kg wet weight basis). Beef produced on land overlying seleniferous geologic formations have higher concentrations of Se in muscle and liver than the national and state averages. Further work is needed to show if beef high in Se can consistently be produced from these areas and whether this increase can enhance product marketability and producer profitability.

Key Words: Selenium, Beef, Liver

369 Quality characteristics and secondary chemistry of sericea lespedeza exposed to tropospheric ozone. M. C. Powell4, D. D. Crosby, R. B. Muntifering, and A. H. Chappelka, Auburn University, AL, USA.

Tropospheric (i.e., ground-level) ozone (O\textsubscript{3}) is the most significant phototoxic air pollutant in the USA, and it is expected to increase globally by .3 to 1.0%/yr over the next 50 yr. Because little is known about O\textsubscript{3} effects on warm-season forages, we conducted an experiment in which sericea lespedeza (L.) exposed to tropospheric ozone (O\textsubscript{3}) in open-top chambers (OTC) to which added air had been carbon-filtered (CF), representative of that found at the cleanest air quality sites in the USA; non-filtered (NF), characteristic of ambient air in Auburn, AL; or enriched with O\textsubscript{3} to twice the ambient concentration of O\textsubscript{3} (2X).

Primary-growth (early-vegetative, early-bloom and mid-bloom stages of maturity) and vegetative regrowth forage were harvested from each of six OTC (two OTC/air treatment) between 12 and 24 wk postseeding. Mean daytime O\textsubscript{3} concentrations over the entire experiment (May 7 - October 23, 1997) were 22, 45 and 91 ppb, respectively, for CF, NF and 2X treatments. Mean ambient O\textsubscript{3} values peaked in mid-May and again in late August-early September at 50-60 ppb, and highest ambient O\textsubscript{3} values were recorded in late July, late August and mid-September at >90 ppb. Germination and seedling growth were unacceptably poor under 2X conditions, and this treatment was terminated following the initial primary-growth harvest. Concentrations of crude protein (CP) and cell wall constituents in primary-growth forage did not differ between CF and NF treatments, but CP regrowth forage had greater (P<.1) concentration of CP (15.9 vs 14.3%) and lower (P<.1) concentration of NDF (44.3 vs 47.1%) than did NF regrowth forage. Concentration of protein-precipitating tannins was greater (P<.1) for CF than NF primary-growth forage (115 vs 105 mg/g), although concentrations of total phenolics, condensed tannins and hydrolyzable tannins in primary-growth forage did not differ between treatments. In contrast, concentrations of total phenolics tended to be greater and condensed tannins lower in CF than NF regrowth forage. Seasonal changes in quality characteristics and secondary chemistry of sericea lespedeza exposed to ambient tropospheric O\textsubscript{3} may have nutritional implications to its utilization by herbivores.

Key Words: Tropospheric ozone, Forage quality, Sericea lespedeza

370 Effects of Seaweed extract and Endophyte infected-tall fescue grazing prior to the finishing period on beef color and shelf life. J. L. Montgomery1, R. Evans2, C. P. Bagley2, R. L. Ivy3, J. P. Fontenot1, K. E. Saker4, C. P. Brown4, K. R. Pond6, M. F. Miller4, and V. G. Allen7, 1Texas Tech University, 2Mississippi State University, 3Virginia Polytechnic Institute and State University, 4Virginia-Maryland Regional College of Veterinary Medicine.

A total of 96 steers, 48 from Mississippi and 48 from Virginia were grazed on tall fescue that was either endophyte infected (E+) or endophyte free (E−) and had been treated or untreated with seaweed (Ascophyllum nodosum) extract. At the end of the grazing season steers from both locations were transported to the Texas Tech Feedlot and finished on the same finishing diet. After slaughter 48 strip loins were captured and delivered to the Texas Tech Meat Laboratory for color and shelf life determination. Steaks were removed from the strip loin at d 7, 14, 21, and 28 postmortem and placed in a display case for color determination. Color determinations were made by a beef sensory visual panel and a Minolta Colorimeter for 3 to 5 consecutive d for each of the four aging treatments. Additionally, cooked sensory determinations made. Seaweed extract treatment increased (P < .05) Hunter a* values and color scores and decreased percentage discoloration and browning. Effects of seaweed were greater in steers that grazed the E+ fescue (seaweed by endophyte interaction (P < .05). Cattle that grazed fescue not treated with seaweed extract had slightly increased initial and sustained tenderness and sustained juiciness panel scores over aging treatments (P < .05). Seaweed treatment on E+ fescue improved visual color, objective color, percentage browning and percentage discoloration measurements during d 2,3,4 and 5 of retail display by a to one full score (P < .05). The quality of shelf life of beef by treatment could not be better the experiment could yield in fewer economic losses for the beef retailer. The mechanism through which seaweed increases the shelf life of beef is unknown and

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requires further investigation but may be related to observed changes in antioxidant activities in the plant and animal.

Key Words: Endophytes, Seaweed Extract, Beef Color

371 Comparison of chromic oxide to chromium mordanted fiber for the estimation of ruminant fecal output. E. E. D. Felton1 and M. S. Kerley, University of Missouri-Columbia.

Four dual-cannulated (rumen & duodenum) beef steers (average BW = 277 kg) were used in a replicated 2 x 2 Latin square design experiment to compare the use of chronic oxide (Cr₂O₃) to chromium mordanted fiber (Cr-f) for the estimation of fecal output. Steers were individually tied in metabolism stalls, fed a common diet of chopped alfalfa hay and had ad-libitum access to water and trace mineralized salt blocks. Steers were fed at 110% of the previous day’s intake. All steers were dosed twice daily at 12 h intervals with their respective treatment intra-ruminally, throughout each period. Each period consisted of 7 d of adaptation to diet and treatment followed by 3 d of total fecal collection. When predicted fecal output was expressed as a percent of actual fecal output, no difference was detected (P = .29) between the use of Cr₂O₃ (102.35%) and Cr-f (93.27%). Likewise, treatment (Cr₂O₃ vs Cr-f) had no effect (P > .10) on either dry matter intake (5.07 vs 4.90 kg/d) or diet digestibility (53.90 vs 49.76%). From these data it appears that both Cr₂O₃ and Cr-f do a similar job as a tool for the estimation of fecal output.

Key Words: Fecal Output, Cattle, Chromium

372 Validation of a visual obstruction technique for estimating forage mass of Plains Old World bluestem. C. J. Ackerman1, H. T. Purvis II1, G. W. Horn1, M. E. Payton1, L. T. Vermeire2, S. I. Paisley1, and T. N. Bodine3, 1Oklahoma State University, 2Texas Tech University, 3Kansas State University.

A visual obstruction technique was used to develop prediction equations for estimating forage mass of Plains Old World bluestem (Bothriochloa ischaemum L. Keng) during August of 1997 and 1998. Visual obstruction measurements (VOM) and clipped forage samples (CFS) were collected from 12 pastures (4.2 to 10.1 ha) assigned to a two-year stocking rate study. Pastures were grazed from May through August. Five VOM and CFS samples were collected at similar intervals throughout each pasture for a total of 120 observations. Forage samples were collected by clipping a quadrant (.1 m²) to approximately 2 cm from the soil surface at the same site at which the VOM was recorded. Clipped forage samples were dried at 55°C for approximately 72 h and weighed to estimate forage mass on a DM basis (FM). Experimental units for the stocking rate trial were individual pastures, therefore, the means of the five measurements from each pasture were used for the development of prediction equations. Regression analysis was conducted using FM and VOM as the dependent and independent variables, respectively. The relationship between FM and VOM was linear (P < .01) for both years. Dummy regression analysis indicated that the slopes of the regression lines for 1997 and 1998 did not differ (P = .23). However, the intercept of the regression line was greater (P = .02) in 1998 than in 1997, therefore, the prediction equations for each year are different and were not pooled across years. Prediction equations for FM (kg DM/ha) were: Y = 1845.0 + 166.9x, r² = .60; Y = 2728.7 + 317.3x, r² = .57; for 1997 and 1998, respectively. Mean forage mass was 7338 (S_y = 1833.8) and 6403 (S_y = 1561) kg DM/ha for 1997 and 1998, respectively. Interpretation of these results may indicate that VOM has good potential for predicting forage mass of Plains Old World bluestem.

Key Words: Old World Bluestem, Forage Mass, Prediction Equations

373 Effects of terpenes on intake of alfalfa pellets by sheep. R. E. Estell4, E. L. Fredrickson1, D. M. Anderson1, K. M. Havvstadi, and M. D. Remenga2,1 USDA/ARS/Jornada Experimental Range, Las Cruces, NM, 2New Mexico State University, Las Cruces, NM.

Five experiments were conducted to examine influences of terpenes on intake of alfalfa pellets by sheep. Five mono- and sesquiterpenes that were related to tarbush (Flourensia cernua) consumption by livestock in previous studies using multivariate analysis were examined individually. Average concentrations of selected compounds (C) were 5, 25, 50, 100, and 10 g/g of tarbush DM for p-cymene, α-humulene, 1,8-cineole, 3-carene, and sabine, respectively. During each experiment, 45 individually penned lambs received one of five treatments (multiples of C: 0X, 5X, 1X, 2X, or 10X) for five consecutive days. Treatments were applied to alfalfa pellets (.64 kg, DM basis) and intake was monitored during a 20 min interval each morning. Lambs were adapted to handling and individual pen feeding for 10 d before experiments began and were maintained and fed alfalfa pellets (4.7% of BW, DM basis) as one group except during 20 min tests. No linear or quadratic responses of intake to treatment level were detected (P > .05) for any of the five compounds. These five terpenes had little influence on consumption of alfalfa pellets, suggesting these compounds are not responsible for differential herbivory of individual tarbush plants by livestock.

Key Words: Intake, Sheep, Terpenes


To evaluate chemical composition effects on intake by heifers, forages were mowed and baled as large round bales from second harvest alfalfa at and 4 wk after the one-tenth bloom maturity stage and from smooth bromegrass and big bluestem at and 4 wk after the boot maturity stage. Experimental diets were tubed and fed as 5% of BW twice daily on a FM basis. Dry matter hay ratios of 1:0, 2:1, 1:2, and 0:1 with .9 kg of a soybean meal-based supplement twice daily to 12 crossed yearling heifers (mean BW, 338 kg) in an experiment with three 4 x 4 Latin square designs with 7 d adjustment and intake recording periods. To estimate fecal output and digestibility, 1 gm chromic oxide was fed twice daily on d 12 to 14 and mature fecal samples were collected twice daily on d 12 to 14 of each period. Forage samples were analyzed for IVDM, CP, NDF, ADF and indigestible NDF (iNDF) determined by manual or automated methods with 96 and 48 h in vitro incubations, respectively. In vitro digestible DM and CP concentrations were higher (P < .01) and NDF, ADF and automated iNDF concentrations were lower (P < .01) in alfalfa diets than grass diets and in smooth bromegrass diets than big bluestem diets. Dietary IVDM concentrations increased (P < .01) to chromium both Cr and Cr-f do a similiar job as a tool for the estimation of ruminant fecal output.

Key Words: Intake, Sheep, Terpenes

375 Effects of change in dietary forage level on dairy goat performance. A. L. Goetsch1, M. I. Lachica1, R. Puchala1, T. Sahlu2, L. J. Dawson2, and A. L. Adams3, E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK, College of Veterinary Medicine, Oklahoma State University, Stillwater, OK.

Thirty-one Alpine does and 31 doelings (52 ± 1.62 and 34 ± 8.6 kg, respectively) were used to determine effects of dietary levels of forage and ruminally undegraded protein (RUP), and change in forage level, on early lactation performance. Goats began a 2-wk covariate period at 3 to 9 d after parturition, then assigned to treatments: 80 = 80% forage diet; 80R = 80 with RUP; 40 = 40% forage diet; 40R = 40 with RUP; A = 80 in wk 1 to 3, transition to 40 in wk 4 to 5, and 40 in wk 6 to 16; AR = 80R in wk 1 to 3, transition to 40R in wk 4 to 5, and 40R in wk 6 to 16. Diets were formulated at 17.5% CP, for 80 and 40R, equal CP was supplied by blood, fish, and feather meals, substituting for 67% of soybean meal CP. Overall, parity did not interact with dietary treatment (P > .10). Milk production was greater (P < .05) for 40 and 40R than for 80 and 80R and influenced (P < .05) by RUP in wk 1 to 3 and 4 to 5 (wk 1 to 3: 2.51, 2.74, 2.72, 3.33, 2.44, and 2.54 kg/d; wk 4 to 5: 2.52, 2.73, 3.13, 3.59, 2.56, and 2.62 kg/d; wk 6 to 16: 2.18, 2.33, 2.85, 3.11, 2.54, and 3.01 kg/d for 80, 80R, 40, 40R, A, and AR, respectively). Dietary treatments had little or no effects on
milk fat and lactose levels; however, forage level influenced *(P < .05)* milk protein concentration (*wk 1* and 2: 2.99, 2.99, 3.25, 3.11, 2.98, and 3.13%; *wk 5*: 2.81, 2.72, 2.91, 2.86, 2.76, and 2.94%; *wk 7*: 2.11, and 15: 2.48, 2.51, 2.86, 2.69, 2.74, and 2.68% for 80, 80R, 40, 40R, A, and AR, respectively). In conclusion, milk production and protein concentration were greatest with 40% of straw throughout the 16-wk lactation period, although RUP impacted milk production only in the first segment. Changing dietary forage level in early lactation of dairy goats did not influence subsequent production.

**Key Words:** Goat, Lactation, Forage

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**Evaluation of supplemental carbohydrate source on utilization of stockpiled tall fescue by beef steers.**

L. J. Dridger*, E. S. Vanzant, S. J. Lewis, B. T. Larson, and R. F. Bapst, University of Kentucky, Lexington, KY.

Twelve ruminally-fistulated, crossbred, beef steers (388 kg) grazing stockpiled tall fescue in December were blocked by weight and randomly assigned to control (C), fiber (F), or starch (S) treatments. Steers on C received no supplement, and S and F received corn starch (Cargill), or hydrogen peroxide-treated oat fiber (Snowite®, Canadian Harvest) at 0.75% BW via rumen fistula daily (0800). Adaptation (d 1 to d 11) was followed by ruminal Co:EDTA dosing and subsequent ruminal fluid sampling (d 12 at 0800, 1100, 1400, 1700, and 2000; d 13 at 0800), ruminal evacuation and masticate sampling (d 13 to d 16; AM and PM) total fecal collection (d 17 to d 22) and ruminal fluid sampling (d 23; 0800, 1100, 1400, 1700, and 2000h) for pH, ammonia, and VFA analyses.

Treatments did not affect diet selection (*P > .10*). Masticate samples for C, F, and S averaged 87.4, 86.1, and 87.4% OM; 15.9, 15.4, and 16.1% CP; 47.2, 48.9, and 46.2% NDF; and 22.7, 24.1, and 22.3% ADF. Weight change (kg/d) was greater (*P < .01*) for F (1.3) than for C or S (-0.3 and 0.4). Fecal DM output (% BW) was greatest (*P < .10*) for F and lowest for S (0.53, 0.88, and 0.42 for C, F, and S). Ruminal DM fill (%BW) was lower (*P < .10*) for S (1.1) than for C or F (1.3 and 1.4) at the PM sampling, but was unaffected (*P > .10*) by treatment at the AM sampling (avg = .85). Ruminal liquid dilution rate (%/hr) was slower (*P > .10*) among treatments. Acetate (%) and acetate:propionate ratio were lower (*P < .10*) for S (51.7; 2.9) than for C or F (66.7; 3.6 and 67; 3.5). Ruminal ammonia concentrations (mM) were greatest for C and lowest for S (31.2, 12.3, and 2.6% BW) was greatest (P < .01) for C and F (1.3 and 1.4) at the PM sampling, but was unaffected (P > .10) by treatment at the AM sampling (avg = .85). Ruminal liquid dilution rate (%/hr) was slower (P > .10) among treatments. Acetate (%) and acetate:propionate ratio were lower (P < .10) for S (51.7; 2.9) than for C or F (66.7; 3.6 and 67; 3.5). Ruminal ammonia concentrations (mM) were greatest for C and lowest for S (31.2, 12.3, and 2.6, for C, F, and S). Supplemented steers with fiber- instead of starch-based supplements may enhance utilization of stockpiled tall fescue.

**Key Words:** Grazing, Fescue, Carbohydrate source

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**Effect of birdsfoot trefoil and tall fescue pastures on steer performance.**


In a completely randomized design two varieties of birdsfoot trefoil interseeded with tall fescue were evaluated for its effects on steer performance in a continuous grazing system. The treatments consisted of birdsfoot trefoil with rhizomes (RBFT), birdsfoot trefoil without rhizomes (BFT), tall fescue (TF), BFT+TF and RBFT+TF with 4 paddocks (0.53 hectare, ha) per treatment. The number of steers assigned to each paddock was based on forage availability using the put-and-take switchback-designed feeding trial. The objective was to evaluate the ruminal performance and the voluntary feed intake, four Hereford steers 230 kg and permanent cannulated were fed to a basal oat straw diet and supplemented with alfalfa hay to levels (0, 10, 20 and 30 %) of dry matter intake and .5 kg rolled milo per animal d-1, all diets were isonitrogenous. Rumen fluid samples were collected at 0, 15, 3, 6, 9, 12, and 16 hours after first meal and analyzed for pH, ammonia-nitrogen and volatile fatty acid (VFA) concentration. The data were analyzed using a 4x4 latin square. The results showed not significant differences (P > .05) on liquid rumen pH and ammonia-nitrogen production at different alfalfa hay levels. The VFA concentration had a linear trend to increment (P < .01) as the level of alfalfa increases. The ration with and 20 % of alfalfa had the highest levels of acetic (79.6 and 78.7 mM) and propionic acid (15.07 and 15.96 mM). The voluntary intake of straw (57.3, 59.9, 62.3 and 72.6 g kg-1W0.75) and total diet (64.6, 69.8, 80.7 and 81.1 g kg-1W0.75) was improved (P < .01) proportional an increase in the supplements levels. Alfalfa hay clearly improve the efficiency of an oat straw basal ration.

**Key Words:** Steers, Ruminal parameters, Straw

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**Kinetics and particle size characterization of the solid fraction of ruminal contents and residues in steers fed a basal oat straw diet.**


Four Hereford steers with permanent ruminal cannula were used in a switchback-designed feeding trial. The objective was to evaluate the effect of two sizes of chopped forage, 2.5 cm (T1) and 10 cm (T2), on the ruminal kinetics of the solid fraction, and to characterize the particle size of ruminal contents and feces. The animals were fed a diet of 80% oat straw and 20% alfalfa hay ad libitum. A wet sieving technique was used to determine the percentage of ruminal and fecal dry matter retained on 2.36 mm, 1.18 mm, .5 mm, .3 mm, and .15 mm sieves. A two-compartment model was used to determine K1, K2, and mean retention time of the solid fraction. Steers fed T1 had a greater (P < .05) dry matter intake than steers fed T2 (79.7 vs 70.8 g/kg BW 0.75). Steers fed T1 had a greater (P < .05) K1 (2.96 vs 2.49 h-1), and a lower (P < .05) mean retention time (59.8 vs 57.5 h) than did steers fed T2. However, K2 did not differ (P > .05) between treatments (5.9 vs 5.9 h-1). The percentage of ruminal particles retained on a 2.36 mm sieve was higher (P < .01) for T2 than T1, 7.06 vs 5.36%, respectively. No treatment differences (P > .05) were found between T1 and T2 in the percentage of ruminal or fecal particles, respectively, retained on the following sieves: 1.18 mm (10.4 vs 10.8%; 3.65 vs 3.37%), .5 mm (12.8 vs 14.6%; 7.9 vs 8.1%), .3 mm (24.2 vs 22.4%; 23.2 vs 23.1%), .15 mm
(21.5 vs 19.1%); 29.3 vs 28.1%). No differences (P > .05) were found between T1 and T2 in the percentage soluble fraction of ruminal contents or feces (25.6 vs 26.1%; 35.8 vs 37.3%).

Key Words: Steers, Kinetics, Particle size

380 Determinant of forage quality in Clitoria ternatea. T Clavero1, 1La Universidad del Zulia.

A field experiment under tropical dry forest conditions was carried out in dryland farming area in Venezuela in order to evaluate the nutritive value of Clitoria ternatea under three levels of N (0, 100, 200 kg/ha) and three levels of P (0, 150-300 kg/ha). A split-plot in a random block design with four replications was used. Result obtained show that the N*P interaction affected (P<0.05) in vitro dry matter digestibility increased while the structural components decreased with increasing the fertilizer levels. The highest values for crude protein (25.2 %) and in vitro dry matter digestibility (68.3%) were obtained when C. ternatea was fertilized with 200 kg N/ha and 150 kg P/ha. The average decreased was 5 digestible units and 3 crude protein units between unfertilized and fertilized treatments. The contents of Ca and K were no affected for fertilization which showed a mean of 1.9 and 2.7 for Ca and K, respectively. These data indicate that N and P fertilization of Clitoria ternatea are critical for nutritive value of this legume.

Key Words: Clitoria ternatea, nutritive value, fertilization


The effects of single applications of exceptional quality biosolids to bahiagrass (Paspalum notatum) pasture as related to satisfying beef cattle nutrient requirements was studied. Twenty-five 0.8 ha pastures were divided into five blocks. Biosolids were applied as an “agronomic rate” (X) and 2X. Each pasture within a block received one of five treatments: 1) control, 0.922 t/ha NH4NO3 added twice at 496 kg/ha per application, 2) Baltimore-1X biosolids applied at 22.4 t/ha, 3) Baltimore-2X biosolids applied at 44.8 t/ha, 4) Tampa-1X biosolids applied at 16.8 t/ha, and 5) Tampa-2X applied at 33.6 t/ha. Applications of biosolids to pastures elevated crude protein (CP) but had little effect on Ca, P, Na, and K. Some increases (P<0.05) in forage Ca, Cu, Fe, Zn, and Se were observed at various sampling times, but the increases were generally small. Although forage Mo samples from pastures with the Tampa biosolids applied were consistently higher than the control (P<0.05), at no time did they approach levels considered toxic. In general, all treatments were associated with soils low in K but adequate in Ca, P, and Mg. Biosolids improved soil Cu, Mn, and Zn. In relation to grazing beef cattle requirements, all treatments resulted in generally adequate forage levels of Ca, P, Mg, K, and CP, however, Na, Co, Cu, Se and Zn concentrations were deficient.

Key Words: Biosolids, Forage, Minerals

382 Digestibility of Water Oak and Shining Sumac leaves fed to Alpine goat wethers. R. Merkel1*, C. Toerien1, T. Sahlu1, and C. Blanche2, 1E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK, 2Dale Bumpers Small Farms Research Center, USDA, ARS, Booneville, AR.

Eight Alpine wethers (60.6 ± 2.43 kg BW) were randomly assigned to consume, free-choice, either Shining Sumac or Water Oak leaves as a sole diet. Leaves were collected and dried prior to feeding. A 14-d adaptation period was followed by a 4-d total fecal and urine collection. Chemical composition (%) of the fed tree leaves revealed similar levels of OM and N with higher concentrations of cell wall fractions, NDF and ADF, in Water Oak (OM 94 vs 96, NDF 55 vs 51, ADF 26 vs 35, and N 1.42 vs 1.54 for Shining Sumac and Water Oak, respectively). Body weight of wethers differed between treatments although, this difference did not affect DM intake (BW 64.3 vs 55.8, P < .10; DMI 60 vs 66 g/kg BW 75, P > .10, for Shining Sumac and Water Oak, respectively). Daily intakes of DM (1.35 vs 1.35 kg), OM (1.29 vs 1.3 kg), ADF (.38 vs .43 g), and N (18.3 vs 22.6 g) were similar between treatments (P < .10). However, NDF intake was lower (P = .002) in goats fed Shining Sumac than in those consuming Water Oak (.42 vs .75 kg). Daily fecal output of all components with the exception of N was higher (P < .05) in Shining Sumac- than Water Oak-fed goats. Differing fecal outputs, coupled with similar intakes of DM, OM, and ADF led to lower apparent digestibilities (%) of these components in Water Oak-fed animals (DM 82 vs 71, OM 83 vs 72, ADF 75 vs 44, for Shining Sumac and Water Oak, respectively). The higher NDF intake and fecal output for the Water Oak treatment led to NDF digestibility similar to that for Shining Sumac (70 vs 63% for Shining Sumac and Water Oak, respectively). Nitrogen digestibility was similar between treatments (64 vs 56% for Shining Sumac and Water Oak, respectively). In conclusion, the higher OM digestibility by goats of Shining Sumac than Water Oak implies that goats consuming Shining Sumac would have a better ability to maintain and/or increase BW gain or body condition.

Key Words: Goat, Water oak, Shining sumac


Five annually comminuted, cross-bred steers (mean BW = 387 kg) were used to determine the effects of calendar date and previous summer management scheme on the in situ kinetics of in situ DM digestibility of stockpiled Greenfield bermudagrass. At one site, forage was stockpiled after a summer hay management system with high inputs of N fertilizer from poultry litter and commercial sources. At the second site, forage was stockpiled after a summer pasture management scheme with moderate N inputs. Forage samples were taken from each site under caged enclosures at four-week intervals, beginning 17 October 1997 and ending 9 January 1998. At the hay site, NDF concentrations increased (P < 0.05) from 69.9% to 75.8% over the sampling period. Concentrations of CP declined (P < 0.05) from 13.4% in October to 11.9% in December, but CP concentrations on the initial and final sampling dates were not different (P > 0.05). Neither NDF nor CP concentrations changed (P > 0.05) over sampling dates at the pasture site (overall means = 71.8% and 12.1%, respectively). A in block received the basis of in situ DM partitioning was 5 digestible units and fecal output was the NDF digestibility similar to that for Shining Sumac (70 vs 63% for Shining Sumac and Water Oak, respectively). In conclusion, the higher OM digestibility by goats of Shining Sumac than Water Oak implies that goats consuming Shining Sumac would have a better ability to maintain and/or increase BW gain or body condition.

Key Words: Stockpiled Bermuda, In SITU, DM Disappearance

384 Effect of stocking rate on cow-calf productivity while grazing improved kikuyu pasture during fall versus spring calving seasons. J. R. Carpenter1, B. W. Mathews2, B. R. LeaMaster1, B. A. Buckley1, and R. Y. Niino-DuPonte1, 1CTAHR, University of Hawai‘i at Manoa, 2CAFNRM, University of Hawai‘i at Hilo.

Pasture is the primary feed for cow-calf systems in tropical beef production. Forage growth varies during the year, but stocking rates (SR) are usually fixed for the entire calving cycle. The objective was to determine the effect on production of increasing stocking rates of cow-calf pairs on improved kikuyu grass (Pennisetum clandestinum) pasture over two fall and three spring calving seasons [average (avg) 154 d/trial]. After calving, composite breed beef cow-calf pairs were randomly assigned by age and body weight to one of five treatments (trts) designated as low (1) to high (5) stocking rates (avg 3.2, 3.6, 3.9, 4.4, and 4.7 AUE/ha for trts 1 to 5, respectively). All trts had three 1.2 ha paddocks, each with a 4-wk rest and 2-wk grazing cycle. Grass samples from each cycle were taken to determine forage yield and nutrient composition. Animals were weighed and body condition scores given at the beginning and end of each trial; animals were weighed again at weaning to determine AUE and feed efficiency. Average initial body weights (kg) for cows and calves were 511.6 and 108.4 in the fall and 487.6 and 117.3 in the spring (P > 0.05),
Forage composition was similar in the fall and spring. [avg 20.1, 12.1, 59.8, 31.3, 67.5, 1.5, and .9 in DM, CP, NDF, ADF, TDN (%), and NEI, and NEg (Mcal/kg DM), respectively]. Total DM yield was similar for the spring and fall (avg 83.0 kg/(ha d)). ADG for the calves were .96, 1.01, .93, .89, .90 kg/d, for trt 1 to 5 respectively (P < .05). Total beef production of the calves increased linearly (P < .05) with SR [1.11, 1.31, 1.34, 1.42, 1.56 tonne/(ha yr)] for trt 1 to 5, respectively. As SR increased, loss in cow body weight increased (P < .05), and was more pronounced in the fall than spring. Results indicate the benefits of determining and maintaining the proper SR over fall and spring calving seasons to maximize pasture yield and quality, and cow-calf productivity.

Key Words: Kikuyu grass, Tropical beef production, Stocking rate

385 Evaluation of forage management systems for spring-calving beef herds: winter. M. J. Hersom and J. R. Russell*, Iowa State University, Ames, IA

A 3-yr experiment was conducted to compare BW, body condition score, and stored hay use by beef cows that sequentially grazed corn crop residues (CCR) and stockpiled endophyte-free tall fescue-red clover (TF-RC) or smooth bromegrass-red clover (SB-RC) forages to cows maintained in a drylot as the winter portion of a year-round management project. In the fall, grazed areas (BW, 520 kg, condition score, 4.7) in each treatment were allotted to four 3.04-ha fields containing CCR to strip-graze, followed by four 6.08-ha pastures containing stockpiled TF-RC (Year-round/TF-RC system) or SB-RC (Year-round/SB-RC system) forage to strip-graze for 120 d. Simultaneous to initiation of CCR grazing, sixteen similar cows were allotted to replicate drylot areas (BW, 510 kg, condition score, 4.7). In mid-June, CCR was harvested from two 1.52 to 2.025-ha areas in summer cool season grass-legume pastures (Minimal land system). All cows were offered hay as necessary to maintain a body condition score of 5. Forage samples were taken monthly from grazed and ungrazed areas in each pasture. During CCR and winter stockpiled forage grazing, BW and condition scores of cows in the Year-round systems decreased more (P < .05) than cows in the Minimal land system. During spring stockpiled forage grazing, cows in the Year-round systems lost less (P < .05) BW and gained more (P < .05) body condition than Minimal land system cows. Seasonal BW and condition score changes did not differ between management systems. Amounts of hay fed (P < .05) and amounts of hay harvested in excess of that fed (P < .05) were 155, 3116, 199, 3347, and 2869, -1611 kg/cow for the Year-round/TF-RC, Year-round/SB-RC, and Minimal land systems. Organic matter yields of CCR fields, TF-RC pastures, and SB-RC pastures were 4016, 2836, and 2275 kg/ha at the initiation of CCR grazing and decreased at 29.9, 7.5, 10.1, 3.8, and 7.3, 1.9 kg/ha/d from grazed and ungrazed areas over 139 d. Concentrations of IVOMD (P < .05) from grazed and ungrazed CCR, TF-RC, and SB-RC decreased at .15, .07, .11, .11; and .03, .05 %/d over 139 d.

Key Words: Beef cattle, Corn crop residues, Stockpiled forages

386 Evaluation of three forage management systems for spring-calving beef herds: summer. M. J. Hersom and J. R. Russell*, Iowa State University, Ames, IA

A 3-yr experiment was conducted to compare production of calves, stockers, hay and stockpiled forage from cool season grass-legume pastures as the summer portion of a year-round management project. In May, 16 crossbred cows (BW, 520 kg; condition score, 4.7) with calves in each treatment were allotted to four 4.05-ha smooth bromegrass-orchardgrass-birdsfoot trefoil (SB-OG-BT) pastures to graze 2.05 to 2.53 ha by rotational stocking (Minimal land system). First growth forage was harvested as hay from the remaining 1.52 to 2.025 ha in mid-June. After regrowth, cow-calf pairs were allowed to graze each entire pasture until November. Calves were weaned in November and finished on a high grain diet. In the Year-round systems, 20 crossbred cows (BW, 520 kg) with calves in each treatment were allotted to four 4.05-ha SB-OG-BT pastures to grazed by rotational stocking for 40 d beginning in May. Cow-calf pairs from this system and one strip-grazed four 6.05-ha pastures containing second-growth endophyte-free tall fescue-red clover (TF-RC) or smooth bromegrass-red clover (SB-RC) for 60 d following a hay harvest. In August, yearlings were placed in a feedlot for finishing on a high grain diet and cow-calf pairs returned to the SB-OG-BT pastures to graze until November. Herbage masses of SB-OG-BT pastures where yearlings grazed in June and July were greater (P < .05) than SB-OG-BT pastures in the Minimal land system or TF-RC and SB-RC pastures of the Year-round systems that cow-calf pairs grazed. In August, IVOMD concentrations of forage from SB-OG-BT pastures that yearlings had grazed were greater (P < .05) than pastures that cow-calf pairs grazed. Seasonal calf weight gains (P < .05), growing animal weight gains (P < .05), and total winter forage production (P < .05) from the Minimal land, Year-round/TF-RC, and Year-round/SB-RC systems were 193, 193, 1736; 95, 142, 4054; and 88, 133, 4422 kg/ha. It required 198 and 114 d in feedlot (P < .10) to finish calves from the Minimal land system and yearlings from the Year-round systems

Key Words: Beef cattle, Grazing, Rotational stocking

387 Vitamin E concentration in lamb muscle as influenced by concentrate or pasture finishing. K. E. McClure1*, K. E. Turner2, and W. P. Weiss1, 1 The Ohio State University, Wooster, OH, 2 USDA-ARS, Beaver, WV.

Sixty Hampshire x Targhee wether lambs (26.1 kg initial BW) were used to compare the efficacy of vitamin E (RRR-a-tocopherol) in grazed forage with supplemental vitamin E (all rac a-tocopherol acetate) in all-concentrate diets in drylot (DL) on a-tocopherol accumulation in carcass lean. Alalfa (ALF) or ryegrass (RG) were rotationally grazed and DL diets (whole shelled corn + supplement pellet), offered ad libitum, were formulated to provide 16% CP and either 15 (NRC), 150 (10 NRC), or 300 (20 NRC) IU of supplemental vitamin E per kg of diet DM. Target slaughter BW for DL were 51, and 53 kg for ALF and grazed lamb. Fresh forages collected from test paddocks at the onset of each of 3 grazing rotations were stored on ice, frozen, and freeze dried. Aliquots of DL diet composites were obtained. On d 3 post-slaughter a boneless loin chop was frozen and stored at 60°C. Alphatocopherol concentrations (µg g -1) in lamb diets were: ALF, 137; RG, 169; NRC, 17; 10 NRC, 184; and 20 NRC, 335. Alpha-tocopherol levels in loin steaks were: ALF, 2.5; RG, 2.89; NRC, 57; 10 NRC, 3.22; 20 NRC, 4.19 µg/g. For DL lambs the alpha-tocopherol concentration of muscle was linearly related to the natural logarithm (Ln) of the dietary vitamin E concentration (muscle alphatocopherol, µg/g = -2.81 + 1.189 x Ln dietary vitamin E, mg/kg; P < .01, r 2 = 0.97; RMSE = 0.29). Loan alphatocopherol concentrations were similar when lambs grazed ALF or RG or were fed the 10 NRC diet in drylot. The daily DM (kg) of DL lambs were 1.46, 1.49 and 1.49 which were not different (P = .75). This resulted in daily supplemental Vitamin E intakes of 24.8, 274.2, and 499.1 IU in DL diets.

Key Words: Vitamin E, Pasture, Muscle


This research was conducted with two goals: first, to investigate the biological characteristic of shiitake culture waste (SCW); and second, to evaluate the feed value of rice straw treated with SCW. Two types of experimental diet were formulated: 1) Rice straw was mixed with SCW, corn and molasses at the ratio of 1:0.67:0.18:0.02. This formula was used for control. 2) The mixture of rice straw, corn and molasses was anaerobically pre-fermented at 30°C for 6 days, and then SCW was added and two weeks of aerobic treatment period was provided. Chemical composition, in situ nutrient disappearance and degradability of diets were analyzed and compared each other, to evaluate the feed value of treated diet with WSSC. In situ experiments were done with cannulated Korean cattle (Hanwoo). Biological study revealed that any microorganisms were not survived in rot-sapwood and heartwood layers, but lentudos endodes hyphals were observed in non-rot-sapwood layer and they had enough activity to grow during the aerobic treatment. Finishing aerobic treatment with SCW, lentudos endodes hyphals that were observed in non-rot-sapwood layer of SCW were also detected inside cell wall of rice straw. The contents of neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose and crude protein increased with the aerobic treatment with SCW, while hemicellulose content clearly decreased (P < 0.01). In situ DM, NDF and ADF disappearance rates of the treated diet with SCW at 6 and 12 hours after feeding were lower than those of control diet. However, they were significantly increased with further progress, showed the higher rates from 24 hours after feeding (P < 0.01). Based on the results, it was concluded that reuse of SCW as an inoculum for the biological treatment of rice straw could be a useful
means to improve the feed value, as well as to alleviate disposal problems of agricultural wastes. Also, the employed pre-anerobic treatment strategy can be an effective way for the prevention of microbial decomposition of rice straw occurring during the followed aerobic treatment with WSSC.

**Key Words:** Shitake culture waste (SCW), Rice straw, Disappearance rate

### 389 Effect of hybrid, maturity and processing on ruminal degradability of corn plants, J. G. Andreasse1, C. W. Hunt1, C. G. Doggett1, G. T. Pritchard1, W. Kezar2, and W. Mahanna2, 1University of Idaho, Moscow, 2Pioneer Hi-Bred, Johnston IA.

Two trials were conducted to measure the effects of corn hybrid, maturity and processing on ruminal degradability of corn plants. In trial one, eight hybrids were harvested when kernels were at either 2/3 milky or blacklayer maturity. At each maturity, three hybrid replicates of twenty plants were obtained. Ten plants from each replicate were partitioned into ear and stover portions and weighed. The stover (S) and whole plant (WP) portions of each replicate were chopped and frozen for subsequent chemical analyses and 24 h in situ DM (ISDMD) and NDF (ISNDFD) disappearance. Samples were not further processed prior to incubation in 30 x 35 cm nylon bags. In trial two, each of the eight hybrids was harvested at blacklayer either with or without mechanical processing. Samples were ruminally incubated for 24 h in four cows. In trial 1, proportion of ear and S were affected by hybrid (P < .05) and maturity (P < .01). Both hybrid and maturity affected DM content of S (P < .01) and WP (P < .01) fractions. There was a hybrid x maturity interaction (P < .01) for NDF content of both S and WP fractions. Stover NDF increased in four of the hybrids as maturity increased, but was unchanged for other hybrids. Similarly, WP NDF concentration decreased for some hybrids as maturity increased, but did not change for other hybrids. Stover and WP ISDMD were not affected from these studies indicate that corn hybrids mature and develop differently. In addition, magnitude of improvement in corn silage degradability due to processing is variable across hybrids.

**Key Words:** Corn, Hybrid, Maturity

### 390 The effect of various levels of ammonia or a buffered propionic acid-based preservative on the fermentation and aerobic stability of corn silage, J. M. Robinson, L. Kung, Jr.*, N. K. Ranjit, and J. Y. Tavares, University of Delaware, Newark.

The objective of this study was to compare the effect of aqua-ammonia to a buffered propionic acid-based preservative (87% active ingredients) on the fermentation and aerobic stability of corn silage. Whole-plant corn was harvested at the 1/2 milky stage of maturity. Forage was packed in 20-L silos in triplicate with the following treatments (kg/ton of fresh forage weight): 1) control (untreated), 2) 0.9 kg of ammonia-N equivalent (an aqua-ammonia mix), 3) 1.8 kg of ammonia-N, 4) 2.7 kg of ammonia-N, 5) 0.9 kg of a buffered propionic acid-based preservative (BPAP), 6) 1.8 kg of BPAP, and 7) 2.7 kg of BPAP. After 10 days of ensiling, the silages treated with ammonia had higher pH (P < 0.05) than other treatments. The propionic acid content was 0.06, 0.21, 0.38, and 0.64% (DM basis) for untreated silage and silage treated with the low, moderate and high level of BPAP, respectively (P < 0.05). As expected, treatment with ammonia increased (P < 0.05) the ammonia-N and CP content of silage in a dose-dependent manner. The acetic acid contents of silage treated with the moderate (230%) and high (282%) amount of ammonia was greater (P < 0.05) than in untreated silage (218%). Increasing the amounts of ammonia, tended to increase the content of residual water soluble carbohydrates but decreased (P < 0.05) the production of ethanol when compared to untreated silage. The low and moderate doses of ammonia and BPAP numerically improved the aerobic stability (2°C rise in temperature) of silage compared to untreated silage. The highest dose of ammonia (treatment 4, 82 hr of aerobic stability) and BPAP (treatment 7, 69 hr of aerobic stability) increased (P < 0.05) the hours of aerobic stability when compared to untreated silage (35.3 hr of aerobic stability). These results indicate that ammonia and a buffered propionic acid preservative can improve the aerobic stability of corn silage to a similar extent.

**Key Words:** ammonia, propionic acid, aerobic stability

### 391 Evaluating silage hybrids for forage quality, D. J. R. Cherry* and W. J. Cox, Cornell University, Ithaca, NY.

The objective of this study was to evaluate the influence of corn silage sample preparation (either fresh or ensiled in mini-silos) on forage quality parameters of twelve commercial hybrids. The NDF, in vitro true digestibility (IVTD), and digestible NDF (dNDF) were determined for ensiled and fresh samples of three field replicates of each hybrid. Samples taken from mini-silos were much more variable than fresh samples for all parameters. The NDF in fresh samples ranged among hybrids from 38.2 to 46.2% with a MS error of 2.7 resulting in detectable differences (P < 0.05) among the 12 hybrids. Samples taken from mini-silos had a similar range in NDF among hybrids (40.1 to 46.1 %), but they had a much higher MS error (19.4), resulting in no-detectable differences (P > 0.05) among hybrids. Ranges for IVTD (approximately 13.5 percent units difference among hybrids) and dNDF (approximately 27.5 percentage units difference among hybrids) for ensiled and fresh material were similar. As with NDF, however, ensiled samples had much higher MS errors (14.4 for IVTD and 49.1 for dNDF) than fresh samples (1.5 for IVTD and 8.0 for dNDF). As with NDF, this resulted in detectable differences among hybrids for fresh samples but not for ensiled samples. Ranking of hybrids varied with sample preparation such that there were no significant correlations between sample preparation types for NDF (r = 0.10, P > 0.10) or IVTD (r = 0.40, P > 0.10). The dNDF between sample preparation types was correlated at r = 0.52 (P < 0.09). Results of this study indicate that variability in forage quality parameters among samples preserved in mini-silos is much higher than among samples harvested directly. This increased variability of samples from mini-silos versus fresh samples prevented detection of differences in NDF, IVTD, and dNDF among hybrids.

**Key Words:** Corn silage, Forage quality, Mini-silo

### 392 The performance of pregnant ewes offered basal diets of hay or grass silage supplemented with molassed sugar beet pulp or a commercially available concentrate, T. F. Crosby*, J. V. O’Doherty3, P. Nowakowski2, P. J. Quinn1, J. J. Callan1, B. Flynn1, and C. McGrane1, 1University College Dublin, Dublin, Ireland, 2Agricultural University of Wroclaw, Wroclaw, Poland.

The objective was to examine the effects of supplementing a roughage based diet of hay or grass silage with molassed sugar beet pulp or with a balanced concentrate having a higher protein content on the performance of pregnant ewes and their lambs, and on colostrum yield and quality. From day 91 of pregnancy, twin bearing ewes (n=88) were offered hay or grass silage ad libitum, supplemented with 400 g DM/eweed of either molassed sugar beet pulp (MSBP) or a commercially available concentrate having crude protein percentages of 10.2 and 17.6 respectively. Average daily intakes per ewe of forage DM (0.78 and 1.09 kg), total metabolizable energy (2605 and 3417 calories) and total crude protein (127.3 and 147.3 g) were recorded for silage and hay fed ewes respectively. From day 98 to 24 hours post lambing, ewes on the MSBP treatments lost significantly more weight (5.3 vs. 2.9 kg; S.E.M. 0.55; P < 0.05) and body condition (0.82 vs. 0.33; S.E.M. 0.13; S.E.M. 0.064; P < 0.001). Ewes offered the commercial concentrate produced higher (P < 0.05) yields (ml) of colostrum at 1h (421 vs 261; S.E.M. 40), 10h (515 vs 349; S.E.M. 41) and 18h (530 vs 346; S.E.M. 28) post lambing, having higher yields of total solids, protein (P < 0.001) and immunoglobulin (IgG)/(P < 0.05). Lambs born to ewes offered the commercial concentrate consumed more colostrum (P < 0.05) and IgG (P < 0.001) than lambs born to ewes offered the MSBP. Lambs born to ewes on the commercial concentrate had higher growth rates (274 vs 251 g/d; S.E.M. 8.7; P < 0.05) to 7 weeks of age and also had higher weaning weights (30.2 vs 28.3 kg; S.E.M. 0.7; P<0.05) than those on the MSBP treatment. These data support the theory of higher dietary intakes by pregnant ewes of hay relative to grass silage and the superiority of a balanced high protein concentrate as a supplement to those forages in terms of colostrum yield and quality and lamb growth to weaning.

**Key Words:** Ewe, Colostrum, Concentrate
393 Intravenous L-carnitine administration reduces hyperammonemia in Suffolk ewes experiencing urea toxicosis, M. M. Kaye1, J. M. Fernandez1, L. D. Bunting1, D. L. Thompson, Jr.1, T. W. White1, R. L. Walker1, G. D. Harding1, J. A. Barrett1, and K. Q. Owen2. 1LSU Agricultural Center, Baton Rouge, LA, 2Lonza, Inc., Fair Lawn, NJ.

An experiment was conducted to determine the effects of L-carnitine administration on plasma constituents in experimentally-induced hyperammonemic ewes. Non-bred Suffolk ewes (BW = 76 kg) were penned, and fed Bermuda grass hay ad libitum supplemented with .45 kg of corn twice daily for 2 wk. On the morning of the experiment, feed and water were withheld, and the ewes were weighed and equipped with jugular vein catheters. Ewes were randomly assigned to one of two treatment groups: saline control (SAL; n = 8) and carnitine treatment (CAR; n = 8). Blood samples were collected at 15 min intervals throughout the 330 min collection period. Following 30 min of collection, hyperammonemia was induced using an oral urea load test (OULT, 400 mg urea/kg BW). Following the 60 min sampling, either 0 (SAL) or 6.4 (CAR) mmol L-carnitine/kg metabolic BW was administered i.v. Rumen fluid samples were obtained preceding (at 30 min) and 30 min after (at 60 min) the OULT. An 11-fold increase in ruminal ammonia N levels (5.6 vs 61.3 mmol/L) indicated that acute hyperammonemia had been achieved using the OULT. One of the SAL ewes succumbed to hyperammonemia within 60 min after the OULT and her data was not included in the statistical analyses. A treatment*time interaction (P < .05) was observed in plasma ammonia N, due to a reduction in peak plasma ammonia N levels in the CAR group, particularly within the first 60 min following CAR administration. In addition, CAR-treated ewes had elevated concentrations of plasma glucose between 75 and 225 min (treatment*time, P < .05). There were no treatment*time effects (P > .10) in plasma urea N and insulin. L-carnitine administration reduced plasma ammonia and increased glucose levels in hyperammonemic ewes. The data look promising, but further research is needed to investigate L-carnitine's effectiveness as a potential therapeutic agent in the treatment of hyperammonemia.

Key Words: Hyperammonemia, Carnitine, Sheep

394 Effects of locoweed on reproductive function in cattle. K. E. Panter* and L. F. James, USDA-ARS-Poisonous Plant Research Laboratory, Logan, Utah, USA.

Effects of Locoweed on Reproductive Function in Cattle K. E. Panter and L. F. James USDA-ARS Poisonous Plant Research Laboratory Logan, Utah, USDA Locoweed are defined as those species of the Astragalus and Oxytropis genera which contain the indolizidine alkaloid toxin, swainsonine. Locoweed poisoning is an induced lysosomal storage disease caused by swainsonine inhibition of lysosomal Golgi mannosidase II. This prevents the hydrolysis of mannose-rich oligosaccharides, subsequent lysosomal accumulation of these oligosaccharides and ultimately cellular dysfunction and death. Swainsonine-induced mannosidase II inhibition disrupts normal protein glycosylation resulting in widespread cellular dysfunction including abnormal cell to cell communication, cell movement and cellular adhesion. Clinically, these changes are seen as abnormal hormone and receptor function resulting in anestrus, reproductive failure and abortion. Locoweed in ranges and pastures inhibit optimum utilization and cause poisoning that results in significant losses to livestock producers. Clinical signs of poisoning usually occur after prolonged ingestion of these plants and include reproductive dysfunction, behavioral changes, loss of body condition, proprioceptive deficits, wasting and death. Reproductive dysfunction occurs soon after cows begin to graze locoweed and include extended estrous cycle length, abnormal behavioral estrus, ovarian dysfunction and repeat breeding. Ingestion of locoweed during pregnancy may result in embryonic/fetal loss during the first trimester and fetal death and abortion during the second and third trimesters. Recovery of reproductive function occurs once cows are removed from locoweed but the time to full recovery depends on the length of time cows have grazed the locoweed and their physical and behavioral condition at the time they are removed from locoweed.

Key Words: Locoweed, Swainsonine, Cattle


The effects of locoweed consumption on serum swainsonine (SW) concentration and selected serum constituents during the first 22 h after initial consumption of locoweed in sheep were investigated. In Trial 1, six sheep (BW = 48.0 ± 12.6 kg) were stratified by weight and randomly assigned to one of three treatments; 2, .6, or 1.8 mg SW/kg BW. Diets were restricted to 1.75% BW (DMB) and formulated to be isonitrogenous and isocaloric. In Trial 2, thirteen sheep (BW = 47.2 ± 9.6 kg) were stratified by weight and randomly assigned to one of three treatments; 2, .4, or .8 mg SW/kg BW. Diets were restricted to 1.84% BW (DMB) and formulated to be isonitrogenous and isocaloric. Animals were adapted to a basal diet of blue grama and alfalfa hay for a minimum of 14 d for each trial. Locoweed (Oxytropis sericea) replaced alfalfa to provide SW. Blood samples were collected immediately prior to feeding locoweed (Time 0; control). Blood was then collected every 30 min for the first 6 h, every 1 h for the following 6 h, and every 2 h for the remaining 12 h. Serum SW, alkaline phosphatase (AP), total iron (FE), and unsaturated iron binding capacity (UIBC) were measured. A treatment by time interaction (P < .05) for serum SW was detected in both trials. In both trials serum SW peaked between 10 and 20 h for all treatments. In Trial 1, no treatment or treatment by time interaction was detected for AP. In Trial 2, a treatment by time interaction (P < .001) was detected for AP, however no differences (P > .05) were detected within time. In both trials, no treatment or treatment by time interaction was detected for FE or UIBC. Interactions noted for serum AP levels in Trial 2 taken with data previously reported by our lab concerning elevated (P < .05) 24 h serum AP levels coupled with no changes in other tissue damage markers, may indicate early changes in serum AP are not related to cytotoxicity.

Key Words: Sheep, Locoweed, Alkaline Phosphatase

396 Effect of dietary supplements of dried red blood cell protein on growth and brain regional neurochemistry of starter pigs fed grains contaminated with deoxynivalenol and fusaric acid. T. K. Smith* and E. J. MacDonald, 1Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada, N1G 2W1., 2Department of Pharmacology and Toxicology, University of Kuopio, Kuopio, Finland.

The feeding of grains contaminated with deoxynivalenol (DON) and fusaric acid (FA) can result in growth depression and alterations in brain regional neurochemistry in starter pigs. This has been thought to be due to an increase in hypothalamic tryptophan and serotonin concentrations. An experiment was conducted, therefore, to determine the potential for the feeding of diets rich in large neutral amino acids to overcome the mycotoxin-induced brain uptake of tryptophan. A total of 105 starter pigs (initial weight about 10 kg) were fed either (1) control (2) contaminated grains (4.1 ppm DON + 33.4 ppm FA) for (3) contaminated grains + 6% dried red blood cell protein for 21 days. Fifteen pigs fed each diet were subsequently euthanized and brains were excised, sectioned and analyzed for indolamines and metabolites. The feeding of the contaminated grains reduced growth over the 21-day period (P<0.05) with the biggest difference being in the first week of feeding. Pigs fed contaminated grains + dried red blood cell protein grew at a rate not different from controls (P>0.05). Hypothalamic serotonin concentrations tended to decline with the feeding of dried red blood cell proteins. It was concluded that the growth depressing effects of diets containing DON and FA can be at least partially overcome by the feeding of dried red blood cell protein. This effect is likely mediated through alterations in brain neurotranschemistry. (Supported by OMAFRA and Ontario Pork.)

Key Words: swine, deoxynivalenol, fusaric acid
397  Effect of ergotamine on pancreatic hormones, metabolites, and leptin in follicular phase heifers. R. Browning, Jr.*, S. J. Gissendanner, and T. Wakefield, Jr., Tennessee State University, Nashville.

The influence of ergotamine, a tall fescue ergopeptide alkaloid, on metabolic regulators and intermediates was assessed in four cycling Holstein F₁ heifers (397 kg; SD = 21). On two occasions, luteolysis for paired heifers was induced synchronously with two PGF₂α injections given 11 d apart. Two days after the second PGF₂α injection, plasma was sampled every 15 min for 1 h before an i.v. bolus of ergotamine tartrate (19 µg/kg body weight; ET) or saline vehicle (SV) and for 4 h after treatment. Heifers were then administered 100 USP units of oxytocin i.v. and bled every 30 min for an additional 3 h. Mean ambient temperature was 31.4°C (SD = 1.3) and relative humidity averaged 42% (SD = 11) during data collection. Each heifer received one treatment per synchronized period and both treatments during the study. Treatment time affected (P < 0.01) plasma concentrations of insulin, glucagon, glucose, triglyceride, urea nitrogen and leptin. All means were separated by protected LSD procedure (α = .01). Insulin decreased dramatically from 13.65 ± 5.2 µU/mL before ET to 5.89 ± 5.2 µU/mL 1 h after ET, then increased to 10.25 ± 5.2 µU/mL by 4 h after ET, still lower than pretreatment. Insulin after SV declined gradually from 14.4 ± 5.2 µU/mL before treatment to 10.16 ± 5.2 µU/mL by 4 h after treatment. Glucagon increased from 57 ± 1.4 pg/mL before ET to 76.3 ± 1.4 pg/mL 1 h after ET. Glucagon after SV did not differ from before SV, however, glucagon increased for ET and SV heifers 1 h after oxytocin. Glucose increased from 80 ± 3 mg/dL before ET to 126 ± 4 mg/dL 1 h after ET, but was unchanged after SV. Urea nitrogen increased steadily from 9.6 ± .3 mg/dL before ET to 11 ± 3 mg/dL by 7 h after ET, but was unchanged after SV. Triglyceride increased from 11.4 ± 5.5 mg/dL before ET to 16.1 ± 5.5 mg/dL 1 h after ET, then declined to 6.9 ± 5.5 mg/dL by 4 h after ET, but was unchanged after SV. Leptin increased transiently from 2 ± 0.5 ng/mL before SV to 2.2 ± 0.5 ng/mL 1 h after SV. However, leptin for ET heifers increased continuously from 2.19 ± 0.05 ng/mL before treatment to 2.5 ± 0.06 ng/mL 7 h after treatment. Results indicate ergotamine can alter plasma concentrations of hormones and intermediates involved in metabolic processes of cattle.

Key Words: Tall fescue ergopeptide, Pancreas, Leptin


Fescue toxicosis in cattle is a result of consumption of ergot alkaloids found in endophyte-infected (E+, Neotyphodium coenophialum) tall fescue (Poa annua). The condition is characterized by pyrexia, decreased weight gains, rough hair coats, and decreased calving rates. The objective of this experiment was to investigate whether steers grazing E+ fescue have altered host response to lipopolysaccharide (endotoxin, LPS) challenge compared to steers grazing endophyte-free (E-) fescue. Angus steers (n=8) had continuously grazed either E+ (n=4) or E- (n=4) tall fescue grass for eight months prior to the experiment. The E+ steers had lower body weight, depressed average daily gain (ADG), and decreased basal serum prolactin (PRL) compared to the E- steers prior to LPS administration. Each steer received a single bolus i.v. injection of LPS (0.2 µg/kg BW–1; Escherichia coli; 026:B6) dissolved in sterile saline and blood was serially collected every 30 min for 4 h and at 24 h post LPS administration. Lipopolysaccharide increased serum tumor necrosis factor alpha (TNF-α), cortisol, and haptoglobin (Hp) but decreased plasma glucose and insulin-like growth factor-1 (IGF-1). Importantly, however, TNF-α, cortisol, and IGF-1 responses to LPS were greater in E+ compared to E-. These results indicate that animals grazing E+ fescue had altered integrated metabolic host response compared to animals grazing E- fescue. Potentially, combined exposure to E+ fescue and LPS, could have greater deleterious effects to the animal compared with exposure to only one of the two and would likely lead to increased catabolism.

Key Words: Fescue Toxicosis, Lipopolysaccaride (LPS), Steers

PHYSIOLOGY AND ENDOCRINOLOGY

399 Cytokine and NO modulation of cellular energetics, mitochondrial function and cytotoxicity. J. R. Lancaster*, Louisiana State University Medical Center, New Orleans, LA.

Nitric oxide (NO) is a ubiquitous messenger and cellular effector for an astonishing multitude of physiological and pathophysiological phenomena. In spite of this biological diversity, the immediate cellular actions of NO are dictated by only a few fundamental principles. While many actions of NO are beneficial and necessary in coordinating biological functions and aiding immune defense, other functions of NO can be deleterious in cytotoxic reactions within tissues. The three dominant interactions of NO in biological systems are (1) wide-ranging free diffusion of NO to multiple cells surrounding a single NO-producing cell, (2) reaction with oxygen species, and (3) reaction with transition metals. These principles will be reviewed in this presentation, followed by discussion of one important application of these principles, effects on cellular metabolism.

Key Words: Cytokine, Nitric oxide, Cytotoxicity

400 Role of proinflammatory cytokines and NO in pancreatic β-cell dysfunction and β-cell insulin resistance. M. L. McDaniel*, G. Kwon, G. Xu, and C. A. Marshall, Washington University School of Medicine, St. Louis, MO.

Our previous studies have addressed cellular mechanisms related to the development of type 1 diabetes that results in immunologically-mediated destruction of the β-cells of the islets of Langerhans. These approaches have focused on the ability of proinflammatory cytokines, in particular IL-1, to inhibit insulin secretion from the β-cell and facilitate β-cell destruction via the formation of the free radical, NO. The overproduction of NO by proinflammatory cytokines (IL-1, IFN-γ) could modulate iNOS expression of β-cells and possibly other insulin-sensitive cells in type 2 diabetes.

Key Words: Pancreas, Nitric oxide, Insulin resistance

401 Cytokine modulation of reproductive processes. J. L. Pate*, Ohio State University, Wooster, OH.

Perhaps the early recognition that there is communication between the immune and reproductive systems came when it was realized that ovarian steroid hormones could modulate immune response mechanisms, probably via effects on cytokine production and/or action. At about the same time, the field of neuroendocrinimmunology was born, with the understanding that inhibitors of iNOS enzyme activity such as aminoguanidine or the IL-1 receptor antagonist, IRAP, which prevents iNOS expression in primary β-cells by blocking the IL-1 receptor, have proven effective in attenuating these deleterious effects of NO both in vitro and in vivo. Recent studies have identified a β-cell insulin receptor that functions in the regulation of protein translation and mitogenic signaling similar to that described for insulin-sensitive cells. These findings have raised the possibility that β-cells may exhibit insulin resistance similar to skeletal muscle, liver and fat. To test this hypothesis, the effects of TNFα, a cytokine proposed to mediate insulin resistance associated with obesity by interfering with insulin signaling, was evaluated. Our findings suggest that TNFα either alone or in the presence of other endogenous cytokines activate intraislet macrophages resulting in the release of IL-1 that then induces iNOS expression and overproduction of NO in β-cells. NO mediated inhibition of cellular metabolism leads to interference of insulin and growth factor signaling associated with β-cell growth and proliferation. These defects in β-cell insulin signaling are normalized by antidiabetic PPARγ agonists that down regulate macrophage iNOS expression and also by IRAP and aminoguanidine. These results suggest that a global inhibition of metabolism by NO may be a major factor in the pathogenesis of insulin resistance in β-cells and possibly other insulin-sensitive cells in type 2 diabetes.

Key Words: Pancreatic, Nitric oxide, Insulin resistance
that substances produced by immune cells could influence pituitary hormone secretion, and that some immune cells may possess receptors for hypothalamic or pituitary proteins. More recently, several investigators have provided evidence that cytokines may serve as direct messengers to facilitate communication between immune cells and gonadal cells. Cytokines such as macrophage chemotactic protein-1 (MCP-1) and macrophage migration inhibitory factor (MIF) have been localized in ovarian follicles and corpora lutea, and are thought to recruit and retain macrophages during structural reorganization of these tissues. Pro-inflammatory cytokines, such as interferon-γ (IFN-γ) and tumor necrosis factor-α (TNF-α) are produced in the ovary, and may serve as local regulators of steroidogenesis, in addition to augmenting a localized immune/inflammatory response. Interleukin-1β is produced in the ovary, and appears to play an intermediary role in ovulation. Some of these cytokines have also been found in the testis, and have some functional effects on testicular cells in vitro. Finally, it has become clear that cytokines (IFN-τ, GM-CSF and others) are involved in the communication between the embryo and maternal tissues to facilitate maternal recognition of pregnancy and embryonic development. This review will focus on recent advances in our understanding of how cytokines are involved in regulating reproductive processes.

Key Words: Cytokines, Reproduction, Monokines

402 Role of prostaglandins in modulating uterine immune responses in postpartum ewes. R. C. Seals*, M. C. Walster-Radcliffe1, E. L. Hensley1, and G. S. Lewis1, 1Virginia Polytechnic Institute and State University, Blacksburg.

Exogenous progesterone (P4) and PGE2 can make the uterus susceptible to infection. Therefore, we studied the roles of P4 and PG in uterine immune function. Ewes were assigned to randomized treatments in a 2 × 2 factorial array (n = 4 to 5 ewes/group); ovariotomy and exogenous P4 (5 mg/2.5 ml of canola oil i.m., 2 ×/d) were main effects. Ewes were sham-ovariotomized (SHAM) or ovariotomized (OVEX) on d 9 postpartum (d 0 = parturition), and their uteri were inoculated with 56 × 10^6 cfu of Arcanobacterium pyogenes and 26 × 10^6 cfu of E. coli on d 15. Vena caval blood was collected on d 9, 14, and 19. Vena caval blood was collected on d 9, 14, and 15 to 19. Uteri were

Key Words: Cytokines, Reproduction, Monokines

404 Growth hormone (GH) administration augments and vitamin E (E) attenuates increases in plasma nitrate-nitrite (NOX) and decreases in IGF-1 after endotoxin (LPS) challenge. T. H. Ellassey1, S. Kahl1, T. S. Rumsey1, and R. Hoffman2, 1USDA, Agricultural Research Service, Beltsville, MD, 2Monanto Co., St. Louis, MO.

GH has been shown to increase the plasma NOX response to LPS, indicative of the increased metabolism of arginine to nitric oxide. The objective of this study was to determine whether daily injection of E would affect plasma concentrations of NOX and IGF-1 and decrease hepatic production of cytopotoxic peroxynitrite (ONOO−). Fifteen yearling heifers (334 ± 4 kg) were fed a forage concentrate diet (15% CP) to appetite, and synchronized to a similar stage of the estrus cycle with two injections of prostaglandin-F2α (P). Heifers were assigned to 2 × 2 factorial treatments (C vs E; daily corn oil and saline-bicarbonate injections, C), GH treatment (GH, 0.1 mg/kg, im., for 12 days), or GH + E (mixed tocopherol, im., 800 IU/d). All heifers were challenged with LPS (0.03 mg/kg) 8 d after the last injection of F and again 2 days later. Blood samples were obtained at 0, 1, 2, 3, 4, 6, 8, 12 and 24 h relative to LPS and liver tissue was obtained via biopsy 6-8 h after the last LPS. All heifers responded to LPS with increases in TNF; LPS1 responses were greater than those in LPS2 (P < 0.001); in LPS2 plasma TNF responses were greater (P < 0.006) in GH than C or E. Plasma IGF-I, increased with GH but decreased transiently in C (−22% maximum) and E (−11% maximum) after LPS. The decrease in IGF-I in GH (−39% maximum) was maintained to the end of the sampling period (P = 0.01). NOX responses were augmented over C with GH (P < 0.01) but diminished to C responses in GH + E (P < 0.01). Liver ONOO− responses, detected by immunocytochemistry for nitrotyrosine were increased in a gradient around central vein and perportal structures in GH but attenuated with the use of E. The data suggest that E may be effective in curbing some elements of cytotoxicity associated with increased production of NOX.

Key Words: Growth Hormone, Endotoxin, Vitamin E

405 Lutalyse changes the immune response in ewes after intrauterine bacterial inoculation. M. C. Walster-Radcliffe*, J. L. Bardugone, R. C. Seals, and G. S. Lewis, Virginia Polytechnic Institute and State University, Blacksburg.

The uterus is susceptible to infection during the luteal phase, and PGE2α allows the uterus to clear the infection. Thus, we determined whether Lutalyse (LUT; Pharmac & Upjohn), a PGE2α analogue, alters the uterine immune response to bacterial challenge (BC). Ewes (n = 8/6) were assigned to randomized treatments in a 2 × 2 factorial array; BC and LUT were main effects. Vena caval blood was collected on d 5 through 11 of the estrous cycle. On d 6, each uterus received either 35 × 10^6 cfu of Escherichia coli and 75 × 10^6 cfu of Arcanobacterium pyogenes in PBS or PBS. On d 9, ewes received two i.m. injections of either saline or Lutalyse (5 mg with a 5-h interval). The lymphocyte blastogenic response to mitogens was determined to evaluate the immune status of the ewes, progesterone (P4) was quantified, and white blood cells were counted. Uteri were collected at slaughter on d 11. The
packed cell volume (PCV) in uterine flushings and the ability to culture E. coli and A. pyogenes were used to diagnosis uterine infections. Bacterial challenge affected (BC vs PBS; P < .05) daily percentages of neutrophils (41 vs 50%), lymphocytes (41 vs 28%), and eosinophils (6 vs 10%). The LUT increased [P < .05] the percentage of neutrophils (LUT < PBS) and the number of circulating relative to linear growth (PCV = 1% and bacterial regrowth) in all ewes, but none of the PBS-treated ewes developed infections (PCV < 1% and no regrowth). Ewes given BC and treated with LUT seemed to clear uterine infections (PCV < 1% and no regrowth). The LUT decreased (P < .05) daily P4 concentrations and enhanced (P < .01) basal lymphocyte blastogenesis, but not blasticogenic response to mitogens. A reduction in uterine infections in ewes treated with LUT indicates that LUT enhanced the immune response to BC in sheep. However, the change in immune function after LUT did not seem to be in response to changes in lymphocyte populations.

Key Words: Sheep, Uterine infections, Lutalysine

406 Expression of two variants of growth hormone receptor messenger ribonucleic acid in porcine liver. J. Liu*, J. A. Carroll2, R. L. Matteri2, and M. C. Lucy1, 1University of Missouri, Columbia, 2Animal Physiology Unit, ARS-USDA, Columbia, MO.

Transcription of growth hormone receptor (GHR) mRNA is initiated from multiple promoters. Most GHR mRNA arise from Promoter 1 and 2 that transcribe GHR 1A and GHR 1B mRNA, respectively. The objective was to characterize the developmental expression of GHR 1A and GHR 1B mRNA in liver of castrated male pigs (Study 1) and intact male pigs treated with recombinant porcine somatotropin (rPST; Study 2). For Study 1, 24 castrated male pigs were slaughtered at one of four ages (1, 14, 28, and 42 d, n = 6/age group). For Study 2, 24 intact male pigs were treated with rPST (200 µg/kg BW/d) or control beginning at 7, 28, or 63 d of age and slaughtered 14 d later (21, 42, and 77 d; n = 4 pigs/treatment/age). Tissue samples were collected at slaughter for mRNA analyses. The porcine GHR 1A and GHR 1B cDNA were cloned and were 89.2% and 89.7% homologous to bovine, respectively. A ribonucleotide primer was used to develop GHR 1B mRNA in liver expressed GHR 1A and GHR 1B mRNA, whereas muscle, and ovary expressed GHR 1B mRNA. The liver of castrated male pigs (Study 1) expressed GHR 1B mRNA at all ages and the amount of GHR 1B tended to increase (P < .10) with increasing age (1.1, .12, .25, and .38 units for 1, 14, 28, and 42 d, respectively; SEM = .03). GHR 1A mRNA in the liver was not expressed until 42 d of age in castrated male pigs. The liver of intact male pigs (Study 2) expressed GHR 1A and GHR 1B mRNA by 21 d and there was an age-related increase in GHR 1A mRNA (0.4, .12, and .20; SEM = .03; P < .01) and GHR 1B mRNA (.56, .59, and .70; SEM = .06; P < .10; 21, 42, and 77 d, respectively). Administration of rPST had no effect (P > .20) on expression of GHR 1A or 1B mRNA. In conclusion, GHR mRNA in porcine liver was composed of at least two variants (GHR 1A and GHR 1B). The GHR 1B mRNA was found at all ages whereas GHR 1A mRNA was detected by 21 (intact male) or 42 (castrated male) d of age. Both GHR 1A and GHR 1B mRNA increased with age.

Key Words: Pig, Liver, GH receptor


Insulin inhibits both basal and growth hormone-releasing hormone (GHRH)-induced release of growth hormone (GH) from the anterior pituitary gland. Steers fed ad libitum for a 2-h period once each day have daily GH concentrations increased (P < .01) in alloxan-treated steers after feeding. Steers were injected i.v. with either sterile saline (control) or with freshly prepared alloxan monohydrate (110 mg/kg body weight) (n = 4 per group). Concentrations of insulin were increased (P < .05) in alloxan-treated steers (412.2 pmol/l) than in control steers (105.3 pmol/l) (poled SEM = 9.3). In addition, alloxan prevented concentrations of insulin from increasing (P = .02) after feeding (131.8 pmol/l) compared with control steers (442 pmol/l) (poled SEM = 66.5). Concentrations of GH were higher (P < .05) in alloxan-treated (6.9 ng/ml) than in control steers (4.0 ng/ml) (poled SEM = .61), but concentrations of GH decreased during feeding and remained low after feeding in both groups. Intravenous injection of GHRH stimulated release of GH 1 h before feeding, but net areas under the GH curve were not different between control and alloxan-treated steers (P = .96). Growth hormone-releasing hormone-induced release of GH was greatly suppressed (P < .001) in both groups 1 h after feeding, and the net areas under the GH curve were not different between groups (P = .98). We conclude that although reduced concentrations of insulin increase basal concentrations of GH in serum, insulin does not mediate feeding-induced decreases in secretion of GH in sheep.

Key Words: Insulin, Growth Hormone, Meal-Feeding

408 LH response to slow-release Deslorelin in estradiol benzoate (EV) primed ovariolectomized gilts. R. R. Kraeling1, C. R. Earb1, G. B. Rampacke2, D. Thompson2, J. Gibson2, S. Sullivan1, B. Simon1, and P. J Burns3, 1USDA, Agricultural Research Service, SAA; Athens, GA 30604, 2University of Georgia, Athens, Ga 30602, 3Louisiana State University, Baton Rouge, LA, 4Southern Biosystems Inc., Birmingham, AL, 5Thorn BioScience, Lexington, KY.

A dose response study was conducted to determine if Deslorelin, a potent GnRH analogue, delivered via the SABER Delivery System, a biodegradable controlled release system, would stimulate an ovulatory-like LH surge in the pig. Twenty ovarioectomized gilts, approximately 200 d old and 100 kg BW, received, i.m., 15 µg of EB/kg BW and 48 h later, 4 gilts each received, i.m., 12.5, 25, 50 or 100 µg of Deslorelin as Deslorelin acetate (DA) in sucrose acetate isobutyrate (SAIB)/propylene carbonate while 4 others received vehicle. Blood samples were taken at 0, 0.5, 1, 2, 4, 6, 12, 18, 24, 30, 36, 42 and 48 h after DA. Blood Deslorelin levels were elevated (P < .05) for 6 to 12 h; peak levels from 53 to 487 µg/ml in the 12.5 and 100 µg groups, respectively. Serum LH concentrations increased (P < .05) after DA compared to controls; mean peak concentrations from 8.7 in the 25 µg group to 17.8 ng/ml in the 12.5 µg dominant negative c-src, suggesting that the association of c-src and FAK. In contrast, association of the c-src-FAK complex with prolactin induced a rapid and transient increase in the tyrosine kinase activity of focal adhesion kinase (FAK), measured by immunoprecipitation of FAK followed by assessment of phosphorylation of substrate peptides. Maximum response was a 5.8 ± 0.8 fold increase, observed after 10 minutes in response to 10 nM prolactin. After 60 minutes, FAK activity had returned to baseline. The increased FAK activity was associated with increased tyrosine phosphorylation of the enzyme. The activation of FAK was largely paralleled to the activation of two other tyrosine kinases, JAK2 and c-sr. Propranol (10 nM for 10 minutes) gave a 5.6±0.7 fold increase in c-sr activity and a 7.4 ± 1.1 fold increase in JAK2 activity. Inhibition of JAK2 activity with a kinase inactive (dominant negative) JAK2 blocked not only JAK2 activation, but completely eliminated the activation of both c-sr and FAK. In contrast, JAK2 activation was not eliminated by a kinase inactive c-sr, suggesting that the association of c-sr and FAK with the prolactin receptor was not a consequence of c-sr or FAK activation. However, kinase inactive JAK2 blocked the association of

Key Words: GnRH, LH surge, pig

409 Prolactin induces activation of focal adhesion kinase (FAK) via JAK2-mediated activation of c-sr. L. G. Sheffield*, University of Wisconsin, Madison, WI.

Treatment of normal murine mammary epithelial cells (NMuMG line) with prolactin induced a rapid and transient increase in the tyrosine kinase activity of focal adhesion kinase (FAK), measured by immunoprecipitation of FAK followed by assessment of phosphorylation of substrate peptides. Maximum response was a 5.8 ± 0.8 fold increase, observed after 10 minutes in response to 10 nM prolactin. After 60 minutes, FAK activity had returned to baseline. The increased FAK activity was associated with increased tyrosine phosphorylation of the enzyme. The activation of FAK was largely paralleled to the activation of two other tyrosine kinases, JAK2 and c-sr. Propranol (10 nM for 10 minutes) gave a 5.6±0.7 fold increase in c-sr activity and a 7.4 ± 1.1 fold increase in JAK2 activity. Inhibition of JAK2 activity with a kinase inactive (dominant negative) JAK2 blocked not only JAK2 activation, but completely eliminated the activation of both c-sr and FAK. In contrast, JAK2 activation was not eliminated by a kinase inactive c-sr, suggesting that the association of c-sr and FAK with the prolactin receptor was not a consequence of c-sr or FAK activation. However, kinase inactive JAK2 blocked the association of
c-src and FAK with the prolactin receptor. These results indicate that prolactin, via activation of JAK2, induces a phosphorylation event that results in the translocation of a FAK-c-src complex to the prolactin receptor. This is followed by activation of c-src, which in turn activates FAK.

Key Words: Prolactin, Mammary Gland, Signaling


Our objective was to determine if vasoactive intestinal polypeptide (VIP) would affect the secretion of prolactin (PRL) in seasonally anestrous vs. cyclic pony mares. Ten pony mares weighing 258 ± 16.6 kg were separated into two groups during early winter and used in 3 replications (rep) at least one day apart. Five mares were housed under 16 h of artificial light to induce cyclicity and five were kept in ambient light conditions to maintain anestrous status. Mares in the first rep exhibited a naturally synchronized estrus but a single i.m. injection of prostaglandin F2α was used to synchronize estrus for the other reps. Doses were administered via jugular cannula and consisted of .3 mg VIP, 500 μg of thyrotropin releasing hormone (TRH) or 3 ml saline for the first rep while the second and third reps also included .6 mg VIP (n=5 to 7/trt). Blood samples were collected into tubes containing EDTA every 10 min from -30 to +60 min (treatment = 0 min) and every 30 min from +90 to +210 min via jugular cannulae. Plasma was collected and analyzed for PRL via radioimmunoassay. Prolactin secretion was affected by a treatment by season (status) interaction (P<.01). Treatment with VIP at .3 and .6 mg increased (P<.01) PRL in cyclic mares when compared to anestrous mares. In addition, TRH increased PRL in both anestrous and cyclic mares when compared to saline treatment (P<.01). Average PRL secretion was .80 ± .29, 1.33 ± .26, and 1.36 ± .30 ng/ml for control, .3 mg VIP, and .6 mg VIP in cyclic mares, respectively compared to .39 ± .31, .34 ± .26, and .22 ± .36 ng/ml for control, .3 mg VIP and .6 mg VIP in seasonally anestrous mares, respectively. Prolactin averaged 2.57 ± .32 and 4.80 ± .29 ng/ml for TRH treatment in anestrous and cyclic mares, respectively. In conclusion, vasoactive intestinal polypeptide increased prolactin plasma pro lactin in cyclic compared to anestrous pony mares when administered intravenously.

Key Words: Mares, Vasoactive intestinal polypeptide, Prolactin

411 Continuous, intracerebroventricular infusion of neuro peptide Y induces a prolonged suppression of LH. C. D. Morrison*, R. A. Daniel, P. R. Buff, and D. H. Keisler, University of Missouri, Columbia MO/USA.

Neuropeptide Y (NPY) is a neurotransmitter which provides an important hypothalamic link between nutrition and reproduction. A role for NPY in nutritional control of reproduction is supported by elevated expression of NPY in nutritionally anestrous animals, and by the suppression of LH/LHR/LH secretion in response to a single intracerebroventricular (i.c.v.) injection of NPY. It is currently not known, however, if NPY can continuously inhibit the secretion of LH over longer periods. The objective, therefore, was to determine if i.c.v. infused NPY can suppress LH secretion for a sustained duration. Eight ovarioectomized ewe lambs were fitted with lateral cerebroventricular cannula. NPY or saline (n = 4 per group) was continuously infused for 20 hours in a linearly increasing dose, ending at a maximum dose of 50 μg/hr. Blood samples were collected via jugular cannula every 10 minutes at hours -4 to 0 (Bleed 1, pretreatment), 6 to 10 (Bleed 2) and 16 to 20 (Bleed 3) relative to the initiation of NPY infusion. Serum concentrations of luteinizing hormone (LH) and growth hormone (GH) were determined by radioimmunoassay. Mean LH and LH pulse frequency were similar between NPY and saline infused lambs during Bleed 1 (Mean: 15.4 ± 12.6 ng/ml, P = .11; Frequency: 3.25 ± 3.75 peaks/bled, P = .23) but then decreased in NPY versus saline infused lambs during Bleed 2 (Mean: 5.9 ± 16.5 ng/ml, P = .001; Frequency: 1 vs. 2.75 peaks/bled, P = .001) and Bleed 3 (Mean: 4.2 vs. 10.2 ng/ml, P = .003; Frequency: .25 vs. 3.5 peaks/bled, P = .001). From these data we propose that increasing levels of i.c.v. infused NPY can suppress the secretion of LH for extended periods of time without compensatory desensitization, and that chronic, i.c.v. infusion of NPY may be used as a model system for the nutritionally anestrous ewe.

Key Words: Neuropeptide Y, LH

412 Orexin regulates appetite in sheep. J. L. Sartin*, D. L. Buxton, C. J. Dyer*, R. L. Matteri, M. A. Shores, and B. P. Steele, 1Auburn University, Auburn, AL, 2Animal Physiology Unit, ARS, USDA, Columbia, MO.

Orexin is a hypothalamic neuropeptide that regulates feeding behavior in rats. Orexin-B has recently been cloned in pigs and was shown to stimulate food intake after intramuscular injection. This study was designed to determine whether ivc and iv injections of orexin could regulate appetite in sheep. Suffolks whether were moved to indoor facilities and adapted to diets for 6 weeks and trained to stand in stanchions for 3 to 6 hours each day for 2 weeks before having lateral ventricle cannulas installed. These sheep were provided water and fed ad libitum. On the day before an experiment, sheep were provided jugular cannulas and on the day of an experiment were placed in stanchions and allowed to stand for 1 hour before use. Sheep were then monitored over a 2-hour control period prior to iv injection with saline or porcine orexin-B (3 μg/kg BW) or ivc injection with artificial CSF, orexin-B (0.3 μg/kg BW), neuropeptide Y (NPY; 0.3 μg/kg BW) or orexin and NPY. Food intake monitored for consecutive 2-hour periods. In both iv and icv sheep, food intake was increased in the first 2 hours by orexin (P<0.05). In the comparison with NPY, orexin had a similar effect to the NPY injection in the first two hours after injection (.09 kg food intake to .25 and .2 kg respectively). The combination of NPY and orexin had a slightly greater, though nonsignificant effect on food intake (to .34 kg). Differences were not apparent in the subsequent 2 h interval. These data indicate that orexin stimulates feed intake in sheep after ivc stimulation, and as described for the pig, orexin also enhances appetite when administered through a peripheral route.

Key Words: Orexin, Neuropeptide Y, Sheep

413 Effect of insulin administration on feed intake and conception rate in ewe lambs. E. L. McFadin-Buff*, N. C. Whiteley, and D. H. Keisler, University of Missouri, Columbia.

The objective was to determine the effect of once daily insulin injection on feed intake and post-treatment conception rate in ewe lambs. Eighty-four nulliparous ewe lambs (Romansov, Hampshire, Columbia, and crossbreds) weighing 45±9 kg were selected for study in the fall of the year. Estrus was synchronized using an intravaginal progesterone releasing device (Eazi-Breed CIDR; Inter Ag; Hamilton, NZ), and (or) a single injection of progastagentin F2α(10 mg; Lutalyse; Pharmacia & Upjohn; Kalamazoo, MI). Ewes were observed for estrus twice daily using sterile rams and penned individually beginning on d 7 following estrus. A mixed ration was fed twice daily at a total rate of 4% BW. On d 9 through 13 following estrus, ewes received once daily injections (s.c.) of either 1 IU/kg BW of insulin (Eli Lilly Lente Iletin I, beef/pork; n=44) or an equivalent volume of saline (n=40). Feed intake was not influenced by treatment and averaged 1.76±1.04 kg/d. On day 14, ewes were removed from their pens and managed on pasture in groups of no more than 15 ewes per fertile ram (wearing marking harnesses). Ewes in estrus during the 10 d following estrus were injected with saline, or saline treatment (i.e. until d 23 following the synchronized estrus) were recorded. Ewes cycle length and percentage of ewes in estrus did not differ between insulin and saline treatment (81±5.9% vs. 77±6.6%, respectively). Thirty days post-breeding, pregnancy was determined via trans-rectal ultrasonography using a 3.5 MHz probe. Conception rate did not differ with respect to insulin vs. saline treatment (89±5.3% vs. 81±7.2%, respectively). Of interest, however, feed intake among insulin-treated ewes was negatively related to conception rate (r= -.38; P < .03), while no such relationship existed among saline-treated ewes (r= -.21; P < .25). Treatment of ewes with insulin did not influence conception rate or feed intake in nulliparous ewe lambs under these conditions.

Key Words: Ewe, Insulin, Intake
**414** Leptin receptor mRNA expression in the brain, pituitary, and other tissues in the pig. J. Lin*, C. R. Barb, R. L. Matteneri, R. R. Kraeling, X. Chen, G. B. Rampacek, and R. J. Meek. C. R. Barb is with the University of Georgia, Athens, GA, USA; C. R. Barb is with USDA, Agricultural Research Service, SAA; Athens, GA USA, USDA, Agricultural Research Service, Columbia, MO. Recently, much effort has focused on understanding the role of leptin, the obese gene product secreted by adipocytes, in regulating growth and reproduction in rodents, human and domestic animals. We previously demonstrated that leptin inhibited feed intake and stimulated GH and LH secretion in the pig. Therefore, this study was conducted to determine location of leptin receptors in various tissues of the pig. The leptin receptor has several splice variants in the human and mouse, but the long form receptor (LR) is the major form capable of signal transduction. The LR is expressed primarily in hypothalamus of the human and rodent but has been located in other tissues as well. In the present study, a partial porcine long form leptin receptor cDNA, cloned in our laboratory and specific to the intracellular domain, was used to evaluate the LR mRNA expression by RT-PCR in the brain and other tissues in three 105 day old gilts and 50 day fetus. The LR was expressed in brain, intestine, muscle, fat, liver and umbilical cord in 50 day fetus. In 105 day old gilts, leptin LR was expressed in the hypothalamus, cerebral cortex, amygdala, thalamus, cerebellum, area postrema and pituitary. In addition, LR was also expressed in ovary, uterine body, liver, kidney, pancreas, adrenal gland, lung, intestine, bone marrow, muscle and adipose tissue. However, it was not found in thyroid, thymus or superior vena cava. These results support the idea that leptin plays a role in regulating numerous physiological functions. Further work is needed to identify these functions.

**Key Words:** leptin, receptor, pig

**415** Comparison of area under the curve and a two-time point method to determine growth hormone (GH) response to growth hormone releasing factor (GRF). W. J. Weber, L. H. Baumgard, and B. A. Crooker*, University of Minnesota, St. Paul.

A retrospective analysis of four studies was conducted to compare a simplified two-time point (TTP) method with area under the curve (AUC) to determine GH response to GRF. Each study utilized animals from a breeding project that developed control (CL) and select (SL) lines of Holstein cows that differed (> 3,000 kg/905 d lactation) in their ability to produce milk. Objectives were to determine effects of dose (Study 1, Study 2, Study 3, 4) and stage (Study 3, 4), and line (all studies) on GH response. Studies 2, 3, and 4 used 4 µg GRF/100 kg BW. Growing heifers, bulls, steers and mature cows (68 CL, 75 SL; 919 dosings) were sampled (n=14 from a laboratory and specific to the intracellular domain, was used to evaluate the long form receptor (LR) is the major form capable of signal transduction. The LR was expressed in brain, hypothalamus, cerebral cortex, amygdala, thalamus, cerebellum, area postrema and pituitary. In addition, LR was also expressed in ovary, uterine body, liver, kidney, pancreas, adrenal gland, lung, intestine, bone marrow, muscle and adipose tissue. However, it was not found in thyroid, thymus or superior vena cava. These results support the idea that leptin plays a role in regulating numerous physiological functions. Further work is needed to identify these functions.

**Key Words:** leptin, receptor, pig

**416** Increased concentrations of IGF binding protein-1 in bovine luteal tissue during PGF2α-induced luteolysis. B. L. Sayre*, R. Taft, E. K. Inskeep, and J. Killefer, West Virginia University, Morgantown.

A novel message that increased during PGF2α-induced luteal regression was identified as insulin-like growth factor binding protein-1 (IGFBP-1) by RT-PCR (Taft et al., J. Reprod. Fert. Suppl. 54: 1999). The objective of this experiment was to determine if expression of IGFBP-1 differed when luteal regression was induced on d 4 or d 10. Cows were treated with PGF2α (15 mg) or saline (3 ml) every 8 h on d 4 (n=15) or d 10 (n=15) after estrus until tissue collection 24 or 48 h later. Jugal blood samples were collected every 8 h from 24 h before treatment and until tissue collection. Corpora lutea were collected via supravaginal incision. Concentrations of progesterone, and of IGFBP-1 and its mRNA were determined by RIA, Western ligand blot analysis, and RT-PCR, respectively. Concentrations of progesterone were decreased (P < .05) 8 h after treatment with PGF2α began on d 10 (2.54, 1.38, .63, and .39 ng/ml), but were not decreased until 24 h on d 4 (.44, .42, .31, and .21 ng/ml) for 0, 8, 16, and 24 h, respectively. IGFBP-1 mRNA was increased (P < .05) 24 h after treatment with PGF2α began on d 10 (10, 490, and 190 arbitrary densitometric units), but not until 48 h on d 4 (213, 196, and 512 arbitrary densitometric units) for control, 24 and 48 h of treatment with PGF2α, respectively. Concentrations of IGFBP-1 were increased (P < .05), in a pattern similar to expression of mRNA, on d 10 (140, 718, and 980 arbitrary densitometric units), and d 4 (398, 541, and 1074 arbitrary densitometric units) for control, 24 and 48 h of treatment with PGF2α, respectively. Increased luteal IGFBP-1 may inhibit the steroidogenic effects of IGF-1 on secretion of progesterone during luteal regression.

**Key Words:** Insulin-like growth factor binding protein-1, Corpus luteum, Cattle

**417** Does anterior pituitary responsiveness to GnRH predict age at puberty in beef heifers? R. L. Stanko*,1,2 and G. L. Williams1,3 Texas A&M University Agricultural Research Station, Beeville, Texas, 2 Texas A&M University-Kingsville, Kingsville, Texas.

Anterior pituitary responses to GnRH were determined in prepubertal beef heifers to assess statistical distributions of LH response variables relative to the mean of the sample population. Santa Cruz heifers (n =110) were challenged with GnRH (22 µg/kg, i.v.) at 271 (254.6 ± 2.3 kg BW) and 336 (292.9 ± 2.9 kg BW) days of age in two consecutive years (n = 55/year). Single blood samples were collected via jugular or coccygeal vein at 0, 10, 30, 60, 120, and 240 min from GnRH treatment. Additional blood samples were collected twice weekly, beginning at 240 days of age, for determination of puberty. Blood samples were placed immediately on ice, with serum was harvested and stored at -20°C within 8 h. Serum from intensive samples were analyzed for LH and biweekly samples assayed for progesterone via radioimmunoassays. Responses to GnRH were averaged across the 2 challenges for each heifer. Over both years, individual peak concentrations of LH exceeded or were less than the mean of the population by at least 1 SD in 16.4 and 14.6 (yr 1), and 18.2 and 12.7% (yr 2) of heifers, respectively. Based on the following statistical criteria, heifers were classified as Low, Intermediate, or High responders within each year. Across year, peak LH (ng/ml) and AUC (ng·ml⁻¹·h) were greater (P < .05) in the High (37.7 ± 2.2, 17.8 ± 1.0) than the Intermediate (20.9 ± 0.6, 8.1 ± 0.4) and Low (10.7 ± 0.3, 4.5 ± 0.2) heifers. Age at puberty (d) was similar (P > .1) among High (367 ± 13), Intermediate (356 ± 6) and Low (346 ± 13) heifers. Prepubertal beef heifers exhibit intrinsic variation in anterior pituitary responsiveness to GnRH. This variation may provide a physiological indicator for reproductive efficiency in heifers selected for this response over time. In an unsellected population, phenotypic responses were not related to one measure of puberty, age at puberty.

**Key Words:** Anterior Pituitary, Puberty, Bovine

**418** The role of estradiol on the frequency of release of pulses of LH from 4 months of age to puberty. J. W. Koch*, M. L. Mussard, L. R. Ehnis, H. Jimenez-Severiano, V. Vega-Murillo, and J. E. Kinder, University of Nebraska-Lincoln.

The objective of this study was to evaluate the role of estradiol (E2) in regulation of LH pulse frequency in heifers from 6 to 8 mo of age (when
precocious puberty was previously detected in some heifers) to frequencies of LH pulses preceding and subsequent to this time until the typical ages of puberty (about 14 mo of age). Prepubertal heifers were randomly assigned to one of three treatments: control (n=7), ovarioectomized (n=6, OVEX), and ovarioectomized plus E2 (n=6, OVEX+E2).

Serum samples were collected once each day at 20-min intervals for 24 h from 4 to 14 mo of age to evaluate concentrations of E2 and frequency of LH pulses. Throughout the study serum E2 was greater (p<0.05) in heifers of the OVEX+E2 than CONT and OVEX heifers and in heifers of the CONT group than OVEX heifers. Serum E2 increased in CONT heifers between 7 and 8 (0.83 vs 1.37 pg/mL serum; p=0.008), 9 and 10 (1.21 vs 1.71 pg/mL serum; p=0.04) and 12 and 13 (1.58 vs 2.44 pg/mL serum; p=0.01) mo of age. Serum E2 increased (p=0.0001) after implantation with E2 and declined with increases in body weight in heifers of the OVEX+E2 group. From 4 to 14 mo of age, OVEX heifers had greater (p=0.0001) pulse frequencies of LH (# pulses/24 h) compared with those of the CONT and OVEX+E2 groups. From 6 to 13 but not at 14 mo of age, CONT heifers had greater (p≤0.05) LH pulse frequency than those of the OVEX+E2 group. Heifers of the CONT group had greater (p<0.05) frequency of pulses of LH at 6 mo (4.1±1.0) than 5 mo (9.0±1.8), 8 mo (4.0±1.9) than 7 mo (2.2±0.9), 11 mo (7.0±0.9) than 10 mo (4.7±0.9), and 14 mo (10.3±1.0) than 13 mo (7.3±0.9) of age. Heifers of the OVEX+E2 group had greater (p≤0.0004) frequency of LH pulses at 11 mo (2.2±1.0) than 10 mo (1.0±1.0) and 14 mo (8.5±1.0) than 13 mo (3.8±1.0) of age. Frequency of LH pulses changed between 5 and 10 mo of age in CONT heifers that may explain why some heifers have precocious puberty at this age.

Key Words: Prepubertal heifers, Estradiol, LH pulse frequency

419 Neonatal handling permanently altered behaviour and basal and stressor-induced hypothalamic-pituitary-adrenal axis activity in pigs. S. A. Weaver*, J. M. Meaney1,2, W. T. Dixon3, and A. L. Schafer1, 3

Neonatal handling in rats resulted in a permanent attenuation of hypothalamic-pituitary-adrenal (HPA) responses to stressors (Meaney et al. 1985). Our objectives were to determine whether neonatal handling would permanently alter HPA function and behaviour in pigs. Six litters of pigs were separated from the sows daily for 10 minutes during the first 14 days of life (H). Six additional litters were left undisturbed (NH). Boars were tested at 7 months of age. Locomotor behaviour in an open field test (OFT) was evaluated. Boars were implanted with indwelling ear vein catheters and basal and stressor-induced plasma ACTH and cortisol concentrations were measured using radioimmunoassays. Plasma corticosteroid-binding capacity (CBC) and glucocorticoid receptor (GR) concentrations (western blotting), in specific brain regions, were also examined. OFT revealed that H boars entered significantly (P<0.03) more inner squares than NH boars (36.18 ± 3.86 vs 25.67 ± 2.05 squares). Using ANOVA with repeated measures analysis, H boars had significantly (P<0.02) higher plasma CBC concentrations (546.29 ± 29.27 vs 352.10 ± 19.73 fmol/mg protein) and significantly (P<0.05) reduced basal plasma cortisol concentrations (13.82 ± 1.22 vs 18.09 ± 1.00 ng/ml) compared to NH boars. ANCOVA analysis, with the age at sacrifice as the covariate, revealed significantly (P<0.02) higher plasma ACTH responses (270.34 ± 43.10 vs 145.71 ± 14.52 pg/ml) in H boars at slaughter. GR levels in the pituitary gland, hypothalamus, prefrontal cortex, or hippocampus did not differ between H and NH boars. GR levels in the prefrontal cortex, or hippocampus did not differ between H and NH boars. GR levels in the hypothalamus declined with increases in body weight in heifers of the OVEX+E2 group. From 4 to 14 mo of age, OVEX heifers had greater (p=0.0001) pulse frequencies of LH (# pulses/24 h) compared with those of the CONT and OVEX+E2 groups. From 6 to 13 but not at 14 mo of age, CONT heifers had greater (p≤0.05) LH pulse frequency than those of the OVEX+E2 group. Heifers of the CONT group had greater (p<0.05) frequency of pulses of LH at 6 mo (4.1±1.0) than 5 mo (9.0±1.8), 8 mo (4.0±1.9) than 7 mo (2.2±0.9), 11 mo (7.0±0.9) than 10 mo (4.7±0.9), and 14 mo (10.3±1.0) than 13 mo (7.3±0.9) of age. Heifers of the OVEX+E2 group had greater (p≤0.0004) frequency of LH pulses at 11 mo (2.2±1.0) than 10 mo (1.0±1.0) and 14 mo (8.5±1.0) than 13 mo (3.8±1.0) of age. Frequency of LH pulses changed between 5 and 10 mo of age in CONT heifers that may explain why some heifers have precocious puberty at this age.

Key Words: Injection, cortisol, pig


Previous work indicated that a majority of gilts and sows in commercial swine units with hungry and weak litters show signs of infection. The objective of the present study was to determine the pattern of rectal temperature, plasma prolactin and clinical signs after intramammary (IMM) endotoxin infusion in lactating gilts. Yorkshire crossbred gilts (n=15, in 5 groups of 3) with mean body weight of 188 kg received either 0, 0.5 or 1.5 ug of endotoxin (ET)/kg body weight into a single mammary gland. Adhesive tape was used to seal the teat so the infusate was not removed by a piglet, but other nursing activity continued. Blood samples were collected from indwelling cannulae every 15 min for 2 h prior to 8 h post IMM infusion. Prolactin in plasma was analyzed by radioimmunoassay. Covariance analysis of data was used to correct for differences among gilts pretreatment. The model included block of gilts, treatment, time and treatment by time interaction. Rectal temperatures from h 3 through 8 post IMM infusion in 0, 0.5 and 1.5 ug ET/kg gilts averaged 38.9, 39.7 and 40.0 °C, respectively; with peak rectal temperatures at 3-5 h post-infection. At 8 h post infection rectal temperatures remained elevated in gilts receiving 1.5 ug, but not in 0.5 ug gilts. There were also significant reductions in plasma prolactin concentration after IMM ET infusion, as prolactin averaged 27.4, 26.8, and 22.5 ng/ml in the control, 0.5, and 1.5 ug groups, respectively. The largest differences in prolactin among treatments were from 3.5 to 5.5 h post-treatment, with the 0.5 ug group not different from the control gilts after 6 h. Results suggest that this is a model to study inadequate milk production in early lactation gilts. This is the first direct evidence that intramammary endotoxin administration (to mimic a field case of mastitis) leads to decreased plasma prolactin, and that reduced prolactin is coincident with a febrile response. This model will be used to examine new management strategies to prevent or treat lactation failure in swine.

Key Words: Porcine lactation, Endotoxin, Prolactin

422 Effect of vitamin E and chromium-methionine supplementation on serum levels of immunoglobulin G and M, and aspartate aminotransferase enzyme in calves recently arrived to feedlot. L. Almeida* and R. Barajas, Universidad Autonoma de Sinaloa Mexico.

To determine the effect of Vitamin E and Chromium methionine supplementation on serum levels of immunoglobulin G (IgG), immunoglobulin M (IgM), and aspartate aminotransferase enzyme (AST) in calves recently arrived to feedlot. Sixty drought Master bull calves (BW=134 kg) just arrived to feedlot after 330 km truck transported, were used in a 28 days randomized design experiment with a 2x2 factorial arrangement of treatments. Fifteen calves (three groups of five calves) were
assigned to consume the diets in that consist the treatments: 1) Re-ception corn based diet (14% CP) with 35-65 roughe:concentrate relationship (control); 2) Control diet supplemented with 150 IU of Vitamin E/kg(Vit.E); 3) Control diet supplemented with 1.0 PPM of Chromium from Chromium-Methionine(Cr); and 4) Control diet supplemented with Vit.E and Cr(Vit.E+Cr). Blood samples from jugular were taken at days 0, 7, 14, and 28 of experiment. Vitamin E supplementation consistently increased (P<0.04) serum IgG levels in more than 10% with values of 1,718 vs 1,910 mg/dL; 1,860 vs 2,125 mg/dL and 1,985 vs 2,190 mg/dL for days 7, 14, and 28 respectively. And had not effect on IgM serum concentration levels (P>0.14). Vitamin E treatments, tended to diminished (P=0.06) the serum values of AST in day 7; the serum values of AST (25.43 vs 19.29 U/L) in day 28. Chromium Methionine supplementation, had not effect on IgG serum values (P>0.25), but increased (P<0.01) in 8% or more the IgM serum concentration values, with values of 260 vs 295 mg/dL; 270 vs 322 mg/dL; and 246 vs 267 mg/dL. Chromium treatments decreased (P<0.01) 24% the serum values of AST (25.43 vs 19.29 U/L) in day 28. One interaction (P=0.01) Vit.E x Cr was observed in day 7. It is concluded that both Vitamin E and Chromium Methionine supplementation improve the immunoglobulin response of calves recently arrived to feedlot, but they are actuating by different pathways.

Key Words: Chromium, Calves, Immunoglobulin

423 Streptozotocin-induced diabetes mellitus in beef cows. H. L. Higdon III*, J. C. Spitzer, S. N. Johnson, S. P. Kennedy, G. L. Burns, and W. C. Bridges, Jr., *Clemson University, SC, USDA, ARS, Roman L. Hruska US Meat Animal Research Center. Since insulin has been implicated to play a role in many physiological events in cattle, our laboratory has pursued development of a diabetic cow model for the study of reproduction. Our objective in this preliminary study was to determine if diabetes mellitus could be induced in beef cows with streptozotocin (STZ). Streptozotocin was intravenously administered at 75(n=1), 85(n=1), and 100(n=1)mg/kg BW with corresponding amounts of carrier solution given to matched controls (CON=n=3). Intravenous glucose tolerance tests (IVGTT) were conducted biweekly following initial IVGTT to monitor diabetic condition. Intravenous glucose tolerance tests were performed by collecting a baseline blood sample (time 0), followed by glucose infusion (0.5/kg BW; 50% glucose solution) and blood samples collected at 20, 40, 60, 90, 120, 180, and 240 min. Means reported are from IVGTT conducted at 1-2 wk, 1 mo, 2 mo, and immediately prior to euthanasia. Analysis of variance with repeated measures design was used to compare dosages of STZ and controls followed by separation of means by pairwise t-tests. Least square means of glucose (GLU) and insulin (INS) concentrations for CON and dosages of STZ during IVGTT are compared in the accompanying table. Severe side effects involving multiple organ systems were observed in STZ treated cows. Of physiological laboratory abnormal values, tubulointerstitial nephritis was most pronounced ranging from mild to severe with each increasing dosage of STZ. Results of this study demonstrate susceptibility of bovine pancreas to intravenously administered STZ, but insults to other organ systems were also observed.

Time (min) 0 20 40 60 90 120 180 240
GLU CON 61a 251a 135a 91a 68a 63a 60a 59a
     mg/dL 75mg 77b 291ab 227ab 190b 147b 121b 94b 79b
     85mg 99b 338b 240b 186b 154b 129b 108b 80b
    100mg 139b 485b 409b 384b 356b 332b 229b 260b
INS CON 0.87 8.95 7.23a 3.11a 1.33 1.01 0.72 0.74
    mg/mL 75mg 0.67 1.59b 1.47b 1.51b 1.32 1.18 0.94 0.67
     85mg 0.67 1.49b 1.29b 1.03b 0.95 0.64 0.59 0.67
    100mg 0.58 0.58b 0.45b 0.45b 0.43 0.45 0.4 0.42

Key Words: Cattle, Insulin, Streptozotocin

424 Factors affecting fetal hematocrit (HC) and fetal plasma iron (PI) at 105 days of gestation in swine. J. L. Vallet*, G. A. Rohrer, H. G. Klemcke, and R. K. Christenson, USDA, ARS, Roman L. Hruska US Meat Animal Research Center. Most neonatal pigs are iron deficient. This deficiency may be worsened in large litters where uterine crowding occurs. To test this idea, high White crossbred, half Meishan gilts were unilaterally hysterectomized-ovariectomized (which increases intrauterine crowding) at 100 d of age and then were mated after at least one estrous cycle. At 105 d gestation, gilts were slaughtered and the uterus was recovered and opened. An umbilical arterial blood sample was obtained from each fetus and measured for HC and PI. Each placent, fetus and fetal liver was weighed. There was a relationship between HC and PI (r = 0.3, P < .01). Analyses using HC and PI as dependent variables and dam, placental weight, fetal, and fetal liver weight as independent variables indicated that all four independent variables were statistically significant (P < .01). Thus, HC and PI are lower in small fetuses attached to small placentae, suggesting that intrauterine crowding impairs blood cell synthesis and iron transport. The greatest source of variation in HC and PI was maternal (47 and 53%, respectively). To identify regions of the maternal genome that influenced fetal HC and PI, a genome scan was performed on a subset (n = 69) of the gilts. The least squares means for fetal HC and PI for each gilt adjusted for placental weight, fetal weight, fetal liver weight and PI (HC only) were used as phenotypes. A quantitative trait locus (qtl) was detected on chromosome 12 for PI. The average Meishan allele increased PI .34 µg/mL and explained 9.3% of the variation in PI and 2.8% of the variation in HC. These results suggest that (1) blood cell synthesis and iron transport are decreased by uterine crowding, (2) maternal factors, placental, fetal, and fetal liver weight all influence HC, and PI and (3) a qtl for fetal PI is located on chromosome 12. This qtl could be used to improve fetal PI, possibly resulting in improved piglet survival.

Key Words: Erythropoiesis, Uterus, Pregnancy

425 Withdrawn...

426 Effects of locoweed toxin (swainsonine) on bovine oocyte fertilization in vitro. S. Wang1, K. E. Panter2, G. R. Holooy3, G. Liu4, R. J. Molyneux5, R. C. Evans1, and T. D. Bunch1, 1Utah State University, Logan, UT, 2USDA-ARS, Poisonous Research Laboratory, Logan, UT, 3USDA-ARS, Western Regional Research Center, Albany, CA.

Swainsonine, a plant indolizidine alkaloid and inhibitor of α-mannosidases, is found to be responsible for locoweed intoxication (toxicois) and reproductive dysfunctions when animals continuously graze certain species of Astragalus and Oxytropis. A randomized complete block design with three treatments (TRT) was used to investigate the effects of swainsonine on the fertility capability of bovine oocyte and spermatozoa by the use of in vitro fertilization (IVF) procedures. Bovine oocytes (n = 527) were aspirated from abatior ovaries and in vitro matured (IVM) for 24 h in M199 plus 10% fetal bovine serum (FBS), penicillin G 100 IU/mL, streptomycin 100 µg/mL, .5 µg/mL FSH, 5.0 µg/mL LH, 1.0 µg/mL estradiol in a humidified 5% CO2 atmosphere at 39°C. Cryopreserved bovine semen was thawed and the live spermatozoa separated by a Percoll gradient. Spermatozoa were added to the fertilization medium (fert-TALP) at a final concentration of 1.5 x 106 per mL. Capacitation occurred in fert-TALP containing 10 µg/mL heparin. The IVM oocytes were removed into IVF media containing swainsonine at 0 ng/mL (TRT1, Control), 10 ng/mL (TRT2) and 20 ng/mL (TRT3), respectively. The IVF culture lasted approximately 17 h in a humidified 5% CO2 atmosphere at 39°C. The IVM/IVF derived zygotes were then in vitro cultured (IVC) using modified CR2 medium in a humidified 5% CO2 atmosphere at 39°C. Preimplantation embryo development was evaluated at d 2, d 6, and d 8 of IVC (IVF = d 0). The cleavage rates were 83.8%, 86.3% and 84.8%; the percentage of morulae at d 6 of IVC was 24.0, 23.1, and 20.7; and the percentage of blastocysts at d 8 of IVC was 8.7, 10.8 and 7.1 for TRT1, 2 and 3, respectively. There was no significant difference (P > .05) between treatments. In conclusion, swainsonine did not appear to have significant adverse effects on fertilization capability of bovine oocyte and spermatozoa in vitro.

Key Words: Bovine, In vitro fertilization, Swainsonine
**427** Fish oil supplementation decreases average daily gain and changes the immune response in orphaned, milk-fed lambs. J. L. Bardugon*, J. H. Herbein, M. C. Walster-Raddcliffe, and C. S. Lewis, Virginia Polytechnic Institute and State University, Blacksburg.

After in vivo ω-3 fatty acid supplementation, in vitro lymphocyte blastogenic response can be either up-regulated or down-regulated, depending on the concentration of fetal calf serum in the culture medium. The purpose of this experiment was to determine whether fish oil (FO; General Nutrition Corp., Pittsburgh, PA), a preparation rich in ω-3 fatty acids, altered the immune status of orphaned, milk fed lambs. Lambs (n = 30) were weaned on d 1 of age and fed milk replacer (35% crude fat; Land O’ Lakes, Fort Dodge, IA) for ad libitum consumption. After a 12-d adjustment period, lambs were assigned to randomized treatments in a 2 × 2 factorial array; FO and phytohemagglutinin (PHA) were main effects. On d 12 to 28, lambs received either 1 g of FO, in a casein capsule orally, twice daily (total dose 2 g/d) or nothing. On d 7, 12, 19, and 26, jugular blood was collected, and lambs were weighed. The blastogenic response of peripheral blood lymphocytes to mitogens was determined to evaluate the immune status of the lambs. On d 26, each lamb received either an intradermal injection of PHA (10 mg) diluted in 2 mL of saline or 2 mL of saline. Skin fold thickness was measured at 0, 6, 12, and 24 h relative to PHA or saline. The FO decreased (P < .01) ADG (FO vs control, 218 vs 317 g/d). Intradermal PHA, but not FO, increased (P < .01) skin fold thickness. The FO tended (P < .07) to decrease lipopolysaccharide (LPS)-stimulated blastogenesis. The FO × day interaction was significant (P < .01) for concanavalin A- and LPS-stimulated blastogenic responses. Fish oil altered the cell-mediated and humoral immune responses in milk-fed orphaned lambs, and it reduced the rate of gain in the lambs.

**Key Words:** Lambs, Fish oils, Immune response

**428** Interaction of Nutrition and *Acacia berlandieri* on Cortisol Production in Female Goats. K. N. Livingston*, J. W. Koch1, C. M. Hensarling2, S. S. Siecknus3, T. D. A. Forbes4, R. D. Randle5, T. H. Welsh, Jr.6, and H. R. Vera-Avila7, 1 Texas Agricultural Experiment Station, College Station, 2 Uvalde, 3 Overton, TX, 4Uvalde, 5Overton, TX, 6NIFAP, Mexico.

Phenolic compounds are sympathomimetic compounds which, when consumed, can adversely affect growth and reproductive parameters. These compounds are found throughout the plant kingdom including the guajillo shrub *Acacia berlandieri*. Mature Angora nannies (31± 1.1 kg BW) were randomly assigned to one of four dietary regimens to evaluate the effects of phenolicamines and high and low energy diets on cortisol production over a 60-day period. Diets consisted of: 1) 3.6% BW of a leaf (LG, n=10), or 4) 1% BW of the diet with ad-lib fresh *A. berlandieri* leaf (HG, n=10). Phenolic amine content and intake of guajillo was measured daily and body weight were obtained weekly. At the conclusion of the study, goats were euthanized and tissues obtained for histomorphometric analysis. Pituitary gland, anterior pituitary gland, and paired adrenal gland weights did not differ among treatments. Total adrenal gland area, adrenocortical area, and adrenocortical area did not differ among treatments. Cortisol production was evaluated both in vivo and in vitro. Concentrations of cortisol in blood samples collected during the four weeks prior to exsanguination were higher (p ≤ 0.005) in the HG group (9.96 ± 3.78 ng/ml) compared to those in the LC, HC, and LG groups (5.54 ± 1.73, 6.07 ± 2.42, and 7.11 ± 1.77 ng/ml respectively). In addition, HG nannies had the highest cortisol concentration in incubations of adrenocortical slices prior to ACTH challenge. Addition of ACTH (10 and 100 pg/ml) increased medium cortisol for all groups with the greater response (p ≤ 0.02) noted for HG goats. Relative to the HG goats, guajillo consumption (HG) increased basal cortisol in vivo and in vitro, but reduced ACTH-induced in vitro production of cortisol. Guajillo ingestion may alter adrenal gland responsiveness in goats.

**Key Words:** HPA Axis, Goats, *Acacia berlandieri*


A new estrous synchronization treatment (7-11 Synch) was developed to synchronize the first follicular wave and timing of ovulation in postpartum beef cows. The 7-11 Synch protocol consisted of feeding MGA (5.5 mg; 25 mg d−1) for 7 d with an injection of PGFα (PG: 25 mg) on the last day of MGA. Cows received an injection of GnRH (100 µg) 4 d after PG, and a second injection of PG 11 d after the last day of MGA. Multiparous beef cows were stratified by breed and postpartum interval and were randomly assigned to the 7-11 Synch (n = 44) or Select Synch protocols (100 µg GnRH followed by PG 7 d later: n=45). Cows were observed for estrus 3 times/d and artificially inseminated 12 h after estrus for 7 d following GnRH and 7 d after the last PG. Fertile bulls were introduced beginning 2 wk after the AI period for 60 d. Pregnancy was determined by transrectal ultrasonography 60 d after the last AI. Timing of estrus after the last PG (0 h) ranged from 42 to 102 h in 7-11 Synch and -30 to 114 h in Select Synch treated cows. Eight cows (18 %) in the Select Synch group exhibited estrus 30 h before to 18 h after PG. Synchronized estrus was peaked between 42 to 66 h after the last PG with a maximum response at 54 h for both treatment groups. Synchrony of estrus from 42 to 66 h was greater (P < .05) in 7-11 Synch (91 %; 41/44) than for Select Synch treated cows (69 %; 31/45). AI pregnancy from 42 to 66 h was greater (P < .05) in the 7-11 Synch group (66 %; 29/44) than the Select Synch group (40 %; 18/45). Overall AI pregnancy and pregnancy rates did not differ (P > .10) between treatments (7-11 Synch: 66 %; 29/44 and 89 %; 39/44, respectively; Select Synch: 60 %; 27/45 and 91 %; 41/45, respectively). In summary, 7-11 Synch improved synchrony of estrus with resulting high fertility. This protocol provides potential future application in estrous synchronization and timed AI programs for use in beef cattle production systems.

**Key Words:** Estrous Synchronization, Artificial Insemination, Beef Cows

**430** Addition of GnRH to a meleagrostin acetate (MGA) prostaglandin F2α (PG) estrous synchronization treatment improves synchrony of estrus and maintains high fertility in postpartum suckled beef cows. D. J. Patterson*, F. N. Kojima, and M. F. Smith, University of Missouri, Columbia.

This experiment was conducted to determine whether addition of GnRH to a MGA-PG protocol would improve synchrony of estrus with resulting high promising fertility in postpartum suckled beef cows. Multiparous Angus crossbred cows (n=120) were assigned by age, body condition score (BCS) and days postpartum (dpp) to one of two treatments. Cows in each treatment were fed meleagrostin acetate (0.5mg kg−1 d−1) for 14 d followed by an injection of PG (25 mg Lutalyse®) 17 d after MGA withdrawal. MGA was delivered in a ground corn carrier of 1.8 kg BW of water. Cows received an injection of MGA (5.5 mg Cystorelin®) 7 d before MGA withdrawal and 7 d before PG. Control cows received only MGA-PG. Adjusted BCS and dpp for cows in each group at the initiation of treatment were 5.5 and 39 d, respectively. Blood samples were collected from all cows 10 d before and on the first day of MGA and 7 d before and on the day PG was administered. Concentrations of P4 in serum at the initiation of treatment were elevated (> 1 ng/ml) in 45% of controls and 38% of GnRH-treated cows, respectively. Cows were detected for signs of behavioral estrus for 7 d after PG and insemination was performed 12 h after observed estrus. Estrous response did not differ (P > .1) between treatments (control = 80%, 48/60; GnRH = 83%, 50/60). However, the peak synchronized period for both treatments was observed between 48 and 96 h after PG, during which time 48% (29/60) of control cows and 80% (48/60) of GnRH-treated cows exhibited estrus (P<.05). Synchronized conception (SCR; no.pregnant/no. inseminated) and pregnancy rate (SPR: no. pregnant/no. treated) did not differ between treatments [SCR=83% (40/48), 78% (39/50); SPR=67% (40/60), 65% (39/60) for control and GnRH-treated cows, respectively].

In summary, addition of estrous synchronization to a 14-d MGA-PG treatment in postpartum suckled beef cows improved synchrony of estrus and maintained high fertility during the synchronized period.

**Key Words:** Progesterin, GnRH, Prostaglandin F2α
431 Effect of royal jelly on estrus synchronization and pregnancy rate of ewes using fluorogestone acetate sponges. M. Q. Husein1, R. T. Kridli1, and W. D. Humphrey1. 1Jordan University of Science and Technology, Irbid/Jordan, 2Arkansas State University, State University.

The objective of the study was to examine the effect of using natural royal jelly (RJ) paste on estrus synchronization and pregnancy rate of Awassi ewes. Royal jelly treatment has been known to enhance libido in male cattle (McGavin et al., 1987). Sixteen Awassi ewes (3- to 5-year-old, 52 ± 2 kg) were treated with 40 mg fluorogestone acetate (FGA) intravaginal sponges for 12 d. Half of the ewes were administered orally with a total of 3 g of RJ paste given in 12 equal doses of 250 mg per day starting at the time of FGA sponge insertion. Ewes were exposed to two fertile Awassi rams at the time FGA sponges were removed (0 h, 0 d) for 5 d. Blood samples were collected on d 19 and frozen in .5 ml straws. Replacement heifers (n=865) were estrous synchronized prior to AI on d 19. Incidence of estrus was greater (8/10 vs 4/10; P < .001) in RJ-treated than in control ewes and intervals from 0 h to onset of estrus were similar (55 ± 2 h vs 53 ± 2 h, respectively) between the two groups of ewes. Progestrone concentration increased at d 5 in all ewes and remained elevated through d 19 in 6/10 RJ-treated and 2/10 control ewes (P < .1). These ewes lambed 149 d following o d and the number of lambs born was similar between the two groups of ewes (P > .1). In conclusion, results demonstrate that RJ treatment in conjunction with a source of exogenous progestrone can be used to induce estrus and increase first service conception rate in sheep.

Key Words: Royal jelly, Ewes, Reproduction

432 Evaluation of a two-part melengestrol acetate regime to synchronize estrus in beef cattle. S. Wright*, D. Kreider, R. Rorie, N. Huber, and G. Murphy, University of Arkansas, Fayetteville.

An experiment was conducted to evaluate a method of estrus synchronization by orally administering melengestrol acetate (MGA). Cows and heifers (n=41 and 43, respectively) were ranked by days postpartum and lactational status, and randomly assigned to two treatment groups. Body weights for the two treatments were 480.9 ± 9.02 kg for treatment 1 and 460.5 ± 13.16 kg for treatment 2 and body condition scores were 4.7 ± .095 and 4.6 ± .063 receptively. Animals in each treatment initially received .5 mg per day of MGA contained in 2.26 kg of supplement for fourteen days. Both treatment groups then received 2.26 kg per day of supplement without MGA for the next 17 days. On day 17, after the MGA withdrawal, Treatment 1 received an intramuscular injection of PGF2α, (25mg) while Treatment 2 was given MGA orally at .5mg per day for an additional five days. A Heatwatch estrous detection system was used to determine the number of cows that exhibited estrus. After the first MGA withdrawal, 76.7 ± .046% (mean ± S.E.) of the 84 cows showed estrus. In the 10 day period following PGF2α administration, 76.7 ± .064% of cows exhibited estrus, while 87.8 ± .051% of cows in Treatment 2 exhibited estrus in the 10 days following the second MGA withdrawal. Days from treatment to estrus cycle in both groups were not significantly different. (P>0.05) We conclude that MGA fed for 14 days, followed by a 12 day withdrawal, followed by 5 days of MGA feeding, causes a high percentage of cows to display estrus.

Key Words: MGA, estrus, cows

433 Artificial insemination outcomes in beef females using bovine sperm with a detectable fertility-associated antigen. L. R. Sprott1, M. D. Harris1, D. W. Forrest1, H. M. Zhang2, J. N. Oyarzo2, M. E. Bellini2, and R. L. Axel2. 1Texas A&M University, College Station, TX, 2University of Arizona, Tucson, AZ.

Previous trials indicate that bulls with a detectable 31 kDa protein, known as fertility-associated antigen (FAA), on spermatozoal membranes were 9 to 40% more fertile in multiple-sire pastures than they were hermaphrodites producing sperm devoid of FAA. This field trial used AI to compare pregnancy rates to first AI service in females inseminated with extended, frozen semen from bulls either with (FAA+) or without (FAA-) the peptide on sperm. Fresh semen samples from 25 bulls that had passed an estrous soundness evaluation were analyzed for the presence of FAA. Fresh semen samples from 25 bulls that had failed being detected in estrus during a 45-d breeding period. Pregnancy rates (pooled) to first AI service for females (n=764) inseminated with FAA+ sperm and for females (n=386) inseminated with FAA- sperm were 65.6% and 49.7%, respectively (P<0.005). Among estrous synchronized heifers, pregnancy rates to a single AI service for heifers (n=550) inseminated with FAA+ sperm and for heifers (n=315) inseminated with FAA- sperm were 62% and 45.7%, respectively (P<0.005). This is the first trial that used AI to compare fertility differences between FAA+ and FAA- bulls, and results corroborate previous reports of higher fertility in FAA+ bulls compared to FAA- bulls used in natural mating programs. FAA is an important determinant for fertility potential of sperm from bulls to be used in AI programs, as well as natural breeding.

Key Words: Artificial Insemination, Fertility Associated-Antigen

434 Artificial insemination outcomes in beef females using bovine sperm with a detectable fertility-associated antigen. L. R. Sprott1, M. D. Harris1, D. W. Forrest1, H. M. Zhang2, J. N. Oyarzo2, M. E. Bellini2, and R. L. Axel2. 1Texas A&M University, College Station, TX, 2Texas A&M University, College Station, TX.

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Key Words: Artificial Insemination, Fertility Associated-Antigen

435 Effects of dosage of estradiol benzoate given at time of administration of an intravaginal progesterone-releasing device on conception rates to a fixed-time insemination. D. L. Funk1*, H. D. Hafs2, and L. H. Anderson1. 1University of Kentucky, Lexington, 2Rutgers University, New Brunswick, NJ.

We hypothesized that conception rates may be increased if follicular development was synchronized prior to an induced ovulation for fixed-time insemination in beef cattle. The objective of this experiment was to determine the effect of dosage of estradiol benzoate, administered coincident with the insertion of an intravaginal progesterone-releasing device, on conception rate to a fixed-timed insemination in beef females. Postpartum cows (n = 417), 2 year old cows (n = 107) and yearling heifers (n = 212) at four locations were randomly assigned by calving date to receive either 0, 1 or 2 mg of estradiol benzoate (EB) on the day of insertion of an intravaginal progesterone-releasing device (controlled internal drug releasing (CIDR) device). On d 7 (day of CIDR insertion = 0), CIDR devices were removed and all cows were administered 25 mg PGF2α. To induce estrus and ovulation, cows were administered 1 mg EB and heifers were administered .5 mg of EB on d 8. All females were inseminated the following day (d 9). Beginning on d 14, all heifers that were exposed to a 46-day natural breeding season. Conception to the timed insemination was determined by transrectal ultrasonography on
approximately day 90. Conception rates to the fixed-time insemination were similar (P > .1) among mature cows (50%, 45%, 49%), 2 year olds (19%, 41%, 48%) and heifers (48%, 38%, 50%) administered 0.1 or 2 mg of EB, respectively. Significant (P < .05) location and treatment by location effects were observed for conception rate. We conclude that synchronization of follicular development using estradiol benzoate at the time of insertion of an intravaginal progesterone-releasing device has no effect on conception rates.

Key Words: Estrus, Synchronization, Cattle

436 Effects of pre-synchronization and bST treatment on pregnancy rates to a timed artificial insemination protocol in lactating dairy cows

Department of Dairy and Poultry Sciences, University of Florida, 2 College of Veterinary Medicine, University of Florida.

Objectives were to: 1) determine if pre-synchronization of cows to initiate a timed artificial insemination (Ovsynch/TAI) protocol during early diestrus increases pregnancy rates (PR), 2) investigate if treatment of cows with bovine somatotropin (bST; Posilac®, Monsanto Co., MO; 500 mg, sc) affects PR, and 3) examine if bST influences PR when administered prior to or at TAI. Lactating dairy cows (n=543) were assigned to a 2x3 factorial experiment. The Ovsynch/TAI protocol was initiated at random stages of the cycle in half the cows (Control) whereas bST was administered at 21st, 42nd, or 63rd d after calving (bST). Significant differences were observed in PR between treatments with no difference (P > .10) in PSA compared to those transferred on d2.5. Additionally, conceptuses transferred to d1.5 recipients had heavier fetuses (1.57±.09 vs 1.23±.04 kg, P<.001) larger PSA (1812±106 vs 1458±53 cm², P<.01) and occupied longer IS (34±3 vs 25±1 cm, P<.001) than those transferred to recipients on d1.5 or 2.5. Additionally, conceptuses transferred to d1.5 recipients exhibit no difference (P>.10) in PSA compared to those transferred on d2.5. These data demonstrate that transfer of embryos to a uterine environment as little as 24 h more advanced can result in dramatic alterations in placental growth and function during gestation.

Key Words: Pig, Placenta, Embryo

439 Effect of breed on endocrine responses to ergotamine in steers


Seven Polled Hereford (302 kg) and seven Red Brahman steers (294 kg) were used to assess endocrine responses of heat-sensitive and heat-tolerant cattle to an ergopeptide alkaloid associated with fescue toxicity. Steers were paired one Hereford to one Brahman and received an i.v. bolus of ergotamine tartrate at .02 mg/kg body weight. Plasma was sampled every 15 min for 2 h after treatment to determine plasma concentrations of cortisol, triiodothyronine, insulin, and glucagon. Risa

Key Words: Pigs, ACTH, Prenatal Stress

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Key Words: Pig, Placenta, Embryo

438 Administration of ACTH to pregnant sows alters their hypotalamic-pituitary-adrenal (HPA) axis


When a pregnant sow is stressed, cortisol will cross the placenta to possibly affect the fetal hypothalamus. Because modern livestock production has the potential to stress sows, this study examined the physiology of sows whose dams were injected with ACTH during gestation. Control sows (CONT, n=8) were given no treatment while the treatment sows (ACTH, n=8) were administered an i.v. injection of ACTH (1 IU/kg BW) weekly from 6- to 12-wk of gestation. Three male pigs from each sow were sacrificed at either 1-, 2-, or 3-mo of age. The hypothalamus, pituitary gland and adrenal glands were immediately obtained and frozen. Hypothalamic corticotropin releasing factor (CRF) and β-endorphin as well as mRNA for pro-opiomelanocortin (POMC) and the adrenal gland ACTH receptor were quantified. At 2.5-mo of age a blood sample was taken from one pig from each litter and then the pig was placed in a pen with unfamiliar pigs for 10 d. Blood samples were drawn every other day to determine plasma cortisol concentrations. At 1-mo of age, ACTH pigs tended to have greater mRNA for the ACTH receptor than CONT pigs (1.27±.16 vs .82±.15 relative units; P = .08) and concentrations of CRF (1.26±.11 vs .77±.25 ng/g; P = .08), but they had a lower concentration of β-endorphin (9.6±1.5 vs 17.8±2.5 ng/g; P < .02). There was a treatment by period interaction for mRNA for POMC, with ACTH pigs expressing less than CONT pigs at birth (1.29±.17 vs 1.88±.20 relative units; P < .007) and greater concentrations in 2 months (3.06±.28 vs 2.27±.28 relative units; P < .007). The ACTH pigs tended to have heavier pituitary glands than CONT pigs at 2-mo of age (.007±.009 vs .005±.001 g/kg BW; P < .08). In response to mixing, ACTH pigs had greater concentrations of plasma cortisol than CONT pigs (70.79±3.79 vs 59.61±3.84 ng/mL; P = .03). These data indicate that exogenous ACTH during gestation alters the HPA axis of the sow's subsequent offspring.

Key Words: Pig, Placenta, Embryo
Hereford (5.5 vs 4.8 ± 0.6 μU/mL) with Brahman having a more prominent decline. Hereford had higher glucose than Brahman throughout the study. Respiration rates for Hereford increased from 16.2 ± 1 breaths/15 s before ergotamine to 23.6 ± 1 breaths/15 s by 4 h after ergotamine, whereas respiration rates did not change for Brahman in response to treatment. Brahman had lower hourly respiration rates than Hereford throughout the study. Results indicate Brahman and Hereford are both generally sensitive to ergotamine in terms of altered plasma concentrations of hormones governing metabolism and body temperature. However, respiration rates hint at a breed difference for response to ergotamine.

**Key Words:** Cattle Breeds, Tall fescue ergoepigone, Hormones


Growth hormone (GH) is released from the anterior pituitary gland under the influence of two hypothalamic hormones: growth hormone-releasing hormone (GHRH), which stimulates release; and somatostatin (SS), which inhibits release. In addition, catecholamines regulate release of GHRH and SS. For example, we showed previously that activation of α2-adrenergic receptors stimulated release of GHRH in vitro. In the current study, we hypothesized that the α2-adrenergic receptor agonist, clonidine, would increase activity of GHRH neurons. Eight Holstein steers were allocated to two groups (n = 4). Blood samples were collected at 20-min intervals for 80 min and assayed for GH. Clonidine was injected i.v. (8 μg/kg BW) into 4 steers after the first 20-min sample was collected. At 80 min, steers were euthanized with pentobarbital and their brains processed for immunohistochemistry. Dual-label immunohistochemistry was performed on 40 μm thick hypothalamic sections using antibodies to GHRH and SS together with antibodies to Fos and Fos-related antigens (Fos/FRA), which were used as markers of neuronal activity in TRH-immunoreactive (IR) neurons. Steers treated with clonidine had a higher percentage of GHRH neurons with Fos/FRA detected in their nuclei. We conclude that α2-adrenergic receptor-mediated secretion of GH is associated with decreased activity of SS neurons, rather than increased activity of GHRH neurons.

**Key Words:** Growth Hormone-Releasing Hormone, Somatostatin, α2-Adrenergic Receptors

441 Neuropeptide Y: A possible link between LH and GH secretion in the gilt. C. R. Barb1, R. R. Kraeling1, G. B. Rampacek2, and J. B. Barrett1, USDA Agricultural Research Service, SAA, Athens, GA, 2University of Georgia, Athens.

We previously reported that leptin treatment increased GH secretion and inhibited feed intake and stimulated in vitro GnRHR secretion from hypothalamic tissue in the pig. The action of leptin on the neuroendocrine system is attributed to neuropeptide Y (NPY). Therefore, the objective of the present study was to determine if central administration of NPY affects LH and GH secretion. Orotrachealized prepuberal gilts, 140 to 150 d of age and 76.9 ± 3.2 kg BW, were fed each day at 0800 and 1700 h over a 2 wk period before the experiment. On the day of the experiment, pigs were fed at 07:30 h and at 08:00 h, blood was collected every 15 min for 3 h before and 4 h after intracerebroventricular injections of 0% saline (S; n = 8), 10 μg (n = 9), 50 μg (n = 7) or 100 μg (n = 7) of NPY in S. Before injection, serum LH and GH concentrations were similar among groups. Serum LH levels decreased (P < 0.05) by 45 min after injection of 50 μg (8.2 ± 2.2 ng/mL) and 100 μg (8.2 ± 2.2 ng/mL) of NPY and by 75 min after treatment with 10 μg (8.2 ± 2.2 ng/mL) of NPY compared to S (1.4 ± 2.2 ng/mL) treatment. LH secretion remained suppressed for 4.5 h, 2 h and 3 h in the 10 μg, 50 μg and 100 μg treated pigs, respectively. Serum GH concentrations increased (P < 0.05) by 15 min after treatment with 50 μg (3.5 ± 0.5 ng/mL) and 100 μg (4.9 ± 0.5 ng/mL) of NPY compared to S (1.9 ± 0.5 ng/mL) animals. However, GH secretion was not affected by the 10 μg dose of NPY. These results support the idea that NPY modulates LH and GH secretion and may act as a link between the reproductive and growth axis.

**Key Words:** NPY, LH, GH, pig

442 Dopamine antagonist affects growth hormone secretion during the follicular and metestrus phases of the estrous cycle in Holstein cows. A. Ahmadzadeh*, R. M. Akers, and M. A. Barnes, Virginia Polytechnic Institute and State University, Blacksburg.

Fluphenaazine (FLU), a dopamine receptor antagonist, was used to investigate the role of endogenous dopamine on serum growth hormone (GH) and prolactin (PRL) concentrations during the follicular and metestrus phases of the estrous cycle. In Exp.1, 15 lactating Holstein cows received 25 mg progastlandin (PGF2α) and on day 9 or 10 post-estrus, all cows received a second dose of PGF2α (25 mg). Thirty-three h post-PGF2α (early follicular phase), cows were randomly assigned to receive either saline (n=7) or 0.3 mg FLU/kg BW i.v. (n=8). Blood samples were collected at 15-min intervals for 4 h before and 5.5 h after treatment. Mean serum progesterone concentration was 0.5 ± 0.3 ng/mL. Fluphenaazine transiently increased (P < 0.05) GH concentration from 4.7 ± 8.6 ± 0.7 ng/mL but serum GH concentration did not change in saline-treated cows. Fluphenaazine increased (P < 0.01) PRL concentrations in saline-treated cows. Fluphenazone increased (P < 0.01) percent of SS neurons, rather than increased activity of GHRH neurons.

**Key Words:** Dopamine antagonist, Growth hormone, Daily cycle


Thyrotropin-releasing hormone (TRH) released from the hypothalamus increases secretion of growth hormone (GH) from the anterior pituitary gland. Feeding steers ad libitum for 2 h each day increases basal concentrations of GH after feeding. If feeding-induced inhibition of GH secretion occurs via a mechanism involving TRH, then TRH-induced secretion of GH or activity of TRH neurons would be reduced after feeding. Therefore, our objectives were to determine: (1) a dose of TRH that induces maximal release of GH; (2) if this dose induces similar increases in concentrations of GH before and after feeding; and (3) if activity of TRH neurons changes from before to after feeding. In experiment 1, steers were injected i.v. with either saline (control), or TRH (1.1, 3.1, 3, or 10 μg/kg BW) in a 6 × 6 Latin square design balanced for residuals. Injection of 3 μg TRH/kg BW increased the greatest area under the GH response curve (AUC, P < 0.001) as well as greatest peak concentration of GH (P = 0.011). In experiment 2, steers (n = 6) were injected with .3 μg TRH/kg BW at either 0900 (1 h before feeding) or 1300 h (1 h after feeding) in a switchback design. Relative to 1300 h, injection of TRH at 0900 increased greater AUC (964.4 ± 667.2 ± 167.3 ng min-ml-1), P = 0.058) as well as peak GH concentration (21.1 vs 9.0 ± 2.7 ng/mL, P = 0.01). In experiment 3, presence of immediate-early gene proteins Fos and Fos-related antigens (Fos/FRA) was used as an index of neuronal activity in TRH-immunoreactive (IR) neurons. Steers were euthanized at 0700, 0900, 1100, and 1300 h (n = 5 per time). The percentage of TRH-IR neurons containing Fos/FRA decreased from 16.3 ± 3.9% at 0700 h to 3.7 ± 3.4% at 1300 h (P = 0.04). We conclude that feeding reduces activity of TRH neurons and suppresses TRH-induced release of GH.

**Key Words:** Thyrotropin-releasing hormone, Growth hormone, Cattle
We tested the hypothesis that GH response to a challenge dose of GHRH is predictive of rapid, lean growth in the beef heifer. GH response to a challenge of GHRH was measured in 67 Angus heifers averaging 225 d (SD = 21) of age. Blood samples were taken immediately prior to and 10 min following a clearance dose of 4.5 µg GHRH/100 kg BW (injected i.v.) and, 2 hr later, immediately prior to and 10 min following a challenge dose of either 1.5 or 4.5 µg GHRH/100 kg BW. The GHRH was a bovine analog (1-30) GHRH. Each animal received both challenge doses, which were randomly assigned across the 2 d of blood collection. Concentrations of GH in serum were measured by RIA. BW was measured every 28 d, and ADG was calculated at the end of a 140-d growth test. The clearance dose stabilized the within animal variation of response to the challenge doses (P < .0001). There was a dose response to the two GHRH challenges (P < .05). A positive relationship (r = .52, P < .0001) was found between the heifers’ rankings for each dose, i.e. high responders to the low dose were high responders to the high dose. The correlation between ADG and predicted ADG was .21 (P < .07) for a model based on treatment (1.5 µg GHRH/100 kg BW). For heifers (n = 28) whose sires (n = 3, HI; n = 2, LO) were selected for their GH response to GHRH, the correlation was .47 (P < .01) for a model including the effect of sire and treatment (both doses). As in a similar study with Angus bulls, our results suggest that GH response to an injection of GHRH may be used as a predictor of growth in beef heifers. Further studies will be done to determine the relationship between carcass composition and maternal ability (e.g. milk production) of beef heifers and their GH response to GHRH challenge.

Key Words: Beef Cattle, Growth Hormone, Predicting Growth

Effects of provision of the anti-inflammatory ketoprofen alone or with local anesthesia during castration of bull calves on cortisol, in vitro interferon (IFN)-γ production, and growth, M. A. Crowe* and B. Earley, 1 University College Dublin, Ireland, 2 Teagasc, Grange Research Centre, Co. Meath, Ireland.

To determine the effects of ketoprofen (K) alone or in combination with local anesthesia (LA) during castration of calves on plasma cortisol, keyhole limpet hemocyanin (KLH)- and concanavalin A (Con A)-induced in vitro interferon-γ (IFN-γ) production, and ADG 40 Friesian bull calves (215 ± 3.5 kg) were assigned to five treatments on d 0: 1) control (C); 2) surgical castration (S); 3) S following K (S + K); 4) S following LA (S + LA); and 5) S following a combination of K and LA (S + K + LA). Ketoprofen (3 mg/kg BW i.v.) and/or LA (9 ml lidocaine to each testis) were administered 20 min before castration. The area under the cortisol curve was greater (P<.05) in S, S + LA and S + K + LA than in C calves; and was not different between C and S + K calves. Peak cortisol concentrations were higher in S than in C, S + K, S + LA and S + K + LA calves. Within the castration treatments, the interval to peak cortisol was longer (P<.05) for S + K + LA calves than for either S or S + K; the interval for S + LA was intermediate, but not different (P>.05) from S or S + K and S + K + LA. There was no difference (P>.05) between treatments in either KLH- or Con A-induced IFN-γ production from lymphocytes collected on d 1 and 7. However on d 3, KLH-induced IFN-γ production was lower (P<.05) in S than in C calves, while there was no difference between controls and bulls castrated following either LA and/or K administration. Con A-induced IFN-γ production was lower (P<.05) in all castration groups than in C on d 3. ADG was higher (P<.05) in S + LA + K calves than in C and S calves; but was not different (P>.05) between C, S + LA and S + K calves or between S + K, S + LA and S + K + LA calves. In conclusion, the castration-associated increase in cortisol was suppressed by the administration of K but not LA. Ketoprofen and LA prevented the suppression of KLH-induced IFN-γ production, while Con A-induced IFN-γ production was suppressed in all castration groups on d 3 following castration.

Key Words: Cattle, Castration, Cortisol

Seasonal effects on estrous behavior and time of ovulation in beef cows, F. J. White*, M. L. Looper, and R. P. Wettemann.

Estrous behavior and time of ovulation were determined in Angus x Hereford cows. The HeatWatch® system (an electronic sensor which records mounts) was used to determine estrous behavior for two consecutive estrous cycles in summer-1 (n=17), winter (n=20), spring (n=17), and summer-2 (n=21) seasons. Onset of estrous behavior was defined as the first mount. Times between mounts were characterized. To evaluate normal luteal activity, blood samples were obtained twice weekly, and progesterone was quantified by RIA. The first estrous cycle was used to quantify behavior, and the second cycle was used to determine time of ovulation. Commencing 16 h after the onset of the second estrus, transrectal ultrasonography was performed every 4 h until the dominant follicle was no longer present on the ovary did not influence season. Duration of estrus (P < .1), intensity of estrus (P < .05), and the greatest length of time between mounts (quiescence; P < .05) was influenced by season. Duration of estrus was longer in summer (17.9 ± 1.3) than in winter (14.4 ± .8 h). Duration of quiescence was shorter in winter (2.1 ± .3 h) than in summer (4.1 ± .7). Cows exhibited fewer mounts per estrus in summer (43.7 ± 6.9) than in winter (69.8 ± 9.5). We conclude that season of the year alters estrous behavior of beef cows; however, time of ovulation relative to the onset of estrus is similar during all seasons.

Key Words: Beef Cow, Estrus, Ovulation


Twenty-nine cows with an average postpartum interval (PPI) of 60 d and body condition score (BCS; scale 1-9) of 5.0 were used to examine the effectiveness of EB administered on d 0 of a 7-d INSERT (Eazi-Breed™ CIDR®) to initiate follicle turnover and synchronize follicular development for a timed-AI in conjunction with GnRH. Cows were randomly assigned to each of 4 treatments by cycling status, PPI and BCS. INSERTs were administered on d 0 of the experiment. Treatments were: 1) INSERT + PG on d 7 + GnRH 48 h after INSERT removal (n=7); 2) INSERT + PG on d 7 + GnRH 60 h after INSERT removal (n=8); 3) INSERT + 2 mg EB on d 0 + PG on d 7 + GnRH 48 h after INSERT removal (n=6); and 4) INSERT + 2 mg EB on d 0 + PG on d 7 + GnRH 60 h after INSERT removal (n=6). All cows were AI at GnRH injection. Ultrasound examinations were performed every other day from d 0 until INSERT removal and then every day until ovulation. Pregnancy was diagnosed by ultrasonography 30 d after AI. Follicle turnover was quantified in cows that had follicles ≥10 mm on day 0. Treatment with EB (n=12/12) increased (P<.05) follicle turnover compared to no EB (n=7/15). Independent of follicular turnover, there were no differences (P>.05) in follicle size (mean = 11.4 mm) at AI across treatments. There were no differences (P>.05) for estrus (57.1, 37.5, 37.5 and 42.9 %) or pregnancy rates (42.9, 25.0, 62.5 and 66.6 %) between treatments 1.3, 4 and 4, respectively. However, EB-treated cows (64%) tended to have increased (P=.09) pregnancy rates than cows not receiving EB (33%), irrespective of time of AI. Administering EB on d 0 of a 7-d INSERT significantly increased follicle turnover and tended to increase pregnancy rates to a TAI in conjunction with GnRH in crossbred Bos indicus cattle.

Key Words: Bos indicus, follicle, GnRH

Effects of passive immunization against inhibin on superovulation in cattle. B. M. Pannag* and W. Hansel, Pennington Biomedical Research Center.

Antisera were developed to three synthetic inhibin antigens: human αC, bovine αC and bovine αN. These sera were harvested and, after purification by ammonium sulfate precipitation were injected subcutaneously into 30 crossbred, estrous cycle-synchronized Hereford-Angus cows divided into 6 groups of 5 animals each, as follows: 1) superovulated
Exogenous oxytocin (OT) dilates the cervix in ewes and aids the process of transcervical (TC) AI. In our previous work, OT did not affect fertilization rates, although combined with cervical manipulation (CM), the fertilization rate (FR), or pregnancy rate (PR). Ewes were assigned to treatments in a 2 × 2 factorial arrangement; OT and CM were main effects (n = 8 ewes/group). To synchronize estrus, progesterone-treated ewes were inseminated 11 d after pessary removal followed by a PGF2α (2 × 5 mg i.m., 4-h interval) injection. At pessary removal, PMSG (400 IU i.m.) was injected. A laparoscopic procedure was used to AI ewes 48 to 52 h after pessary removal. All AI was laparoscopic, OT tended to reduce (OT, 62 h vs saline, 66 h; P < 0.06) the interval to ovulation (i.e., disappearance of largest CL on day of GnRH and on day of PGF2α injection and synchronization rate, αPovulated within 3 weeks after injection compared to the other groups. The hypothesis is that CR increases LH pulses and delays the turnover of the dominant follicle, increasing the number of cows with presence of dominant follicles at the time of injections of GnRH and Estradiol Benzoate and ovulations. This study was designed to evaluate whether CR (48 to 52 h) before GnRH (100 mg) injection and /or after PGF2α (25 mg) injection affected the ovulation rate and synchronization rate after the Estradiol Benzoate (1 mg) injection. Lactating Nellore cows (N=140), blocked by calf sex, suffered or not CR before GnRH injection and between PGF2α injection and AI, in a 2 x 2 factorial. Ovarian morphology was evaluated by ultrasound, to determine: ovulation rate, by comparing the presence of follicle and CL on day of GnRH and day of PGF2α injection and synchronization rate, by the presence of follicle on day of AI and ovulation 24 h later. The effects of treatment (CR) on ovulation rate and synchronization rate were analyzed by Chi-square analysis. Cows that received calf removal had higher (P<0.01) ovulation and synchronization rates than cows that were not exposed to calf removal, 74.6% (50 in 67) and 85.9% (55 in 64) vs. 52.1% (38 in 73) and 57.1% (40 in 70), respectively. Six cows ovulated before AI. Ovulation and synchronization rates were influenced by CR, probably due to increase in LH pulsatility and maintenance of the dominant follicle, thereby increasing the presence of dominant follicles at injection time.  

545  Synchronizing estrus in replacement beef heifers using GnRH, melengestrol acetate, and PGF2α. J. S. Stevenson1*, G. C. Lamb2, J. A. Cartmill1, B. A. Hensley1, S. Z. El-Zarkouny1, and T. J. Marple1, 1Kansas State University, Manhattan, 2University of Minnesota, Grand Rapids.

Our objective was to determine if a 7-d, GnRH + PGF2α protocol (Select Synch) was effective for synchronizing estrus in replacement beef heifers compared to traditionally used programs. Heifers (n = 588) at three Kansas locations consisting of Angus, Hereford, Simmental, and Hereford x Angus breeding were assigned randomly, but unequally, to each of three treatments: 1) two, 25 mg injections of PGF2α (Lutalyse®), were given 14 d apart (d-14 and 0; 2xPGF2α; n = 139); 2) melengestrol acetate (MGA; 0.5 mg per head per day for 14 d) starting on d -31 plus 25 mg of PGF2α administered 17 d later (d 0; MGA+PGF2α; n = 289); or 3) 100 µg of GnRH (Fertagel®) was injected (d -7) followed by 25 mg of PGF2α (d 0; GnRh+PGF2α; n = 160). Twice-daily observations for estrus began on d -5 and continued at varying durations thereafter. Inseminations were performed 30 to 14 h after first detected estrus. Pregnancy was diagnosed by transrectal ultrasonography between 33 and 37 d after insemination. Percentages of heifers detected in estrus (in order of treatments defined above) before (9, 6, and 12%), during (75, 82, and 72%), or after (9, 8, and 9%) the target breeding week were not different among treatments. Percentage of heifers day one in estrus and day one in estrus not detected (n = 4, 6, and 6%). Overall conception rates (proportion pregnant of those inseminated) were 69, 68, and 64% and pregnancy rates (proportion pregnant
of those treated) were 52, 56, and 46%, respectively. Pregnancy rates tended to be greatest in the MGA + PGF2α treatment; but treatment x location interactions were evident for estrus-detection, conception, and pregnancy rates. All three programs synchronized estrus, but overall, the Select Synch protocol tended to be least effective.

**Key Words:** Heifers, Estrus Synchronization, AI

### 453 Estrous synchronization in beef heifers using MGA and PGF2α, or GnRH and PGF2α


Our objective was to determine whether a GnRH and PGF2α protocol was an effective system for synchronizing estrus in replacement beef heifers compared to heifers synchronized with MGA and PGF2α. A heifer development operation in eastern Minnesota wintered 471 crossbred heifers from two separate locations. Prior to the breeding season, heifers were assigned randomly to two treatments: 1) heifers were offered MGA daily at 5 mg per head for 14 d, followed by a 25-mg injection of PGF2α administered 17 d after MGA withdrawal (MGA); or 2) heifers received a 100-µg injection of GnRH on d -7, followed by a 25-mg injection of PGF2α on d 0 (GnRH). Heifers were inseminated artificially for 96 h after heifers that were detected in estrus for 72 h after PGF2α was administered at a fixed time (84 h). Ultrasonography was used to determine the presence of a viable fetus. Overall pregnancy rates between treatments were similar (36.7% vs 35.0% for MGA and GnRH treatments, respectively). Conception rates for MGA-treated heifers detected in estrus were 48.7% compared to 14.4% for their counterparts that were inseminated at a fixed time. Similarly, heifers assigned to the GnRH treatment had conception rates of 45.7% after a detected estrus and 10.0% for those heifers inseminated at a fixed time. The average insemination time after PGF2α administration differed (P < .05) in the GnRH treatment (66.8 ± 1.38 h) compared to the MGA treatment (71.8 ± 1.43 h). At initiation of treatments, BW for GnRH heifers were greater (P < .05) than for MGA heifers (291 ± 1.86 kg vs 218 ± 1.82 kg, respectively). However, MGA-treated heifers exhibited faster ADG which resulted in a similar final BW for the two groups. We conclude that there are no differences in conception rates between the GnRH and MGA treatments, however the average interval to detection of estrus was shorter in GnRH-treated heifers.

**Key Words:** Synchronization, MGA, GnRH

### 454 Effect of GnRH/PG combinations in synchronizing estrus in lactating crossbred cows of Bos indicus breeding


Lactating crossbred cows across three locations were utilized to determine the efficacy of a 7-d GnRH/PG combination for estrus synchronization. Cows were randomly allotted to each of three treatments (TRT) by body condition score (BCS; scale 1-9) at all locations and postpartum interval (PPI) at two of three locations on d 0 (d 0 = GnRH administration): 1) GnRH + PG on d 7 and inseminated 12 h after detected in estrus for 5 d (n=198); 2) GnRH + PG on d 7 + GnRH 48 h later and timed-AI (TAI; n=196); 3) GnRH + PG on d 7 and inseminated 12 h after detected in estrus for 72 h, cows not detected in estrus were administered GnRH and TAI at 72 h after PG (n=200). Animals were bled at d -7 and 0 for determination of cycling status (progesterone > 1 ng/ml at either bleeding were considered cycling). Location, AI sire and AI technician were not significant (P>.05) for any of the parameters tested and were removed from the statistical analysis. Mean body condition score (4.5), PPI (61.3 d) and percentage of cows cycling (39.2%) had no effect (P>.05) on estrous, conception and pregnancy rates among treatments. Estrus rates (45.5, 18.9 and 33.0%) were similar (P>.05) for cows in TRT 1, 2, and 3, respectively. Conception rates were greater (P<.05) for TRT 1 (44.4%) than TRT 2 (31.1%), but were similar to TRT 3 (35.5%) which was not different (P>.05) from TRT 2. Pregnancy rates were greater (P<.01) for TRT 2 and 3 (31.1 and 35.5%, respectively) compared with TRT 1 (20.7%). Pregnancy rates for animals bred by detected estrus in TRT 1 and 3 were similar (44.4 and 59.1%, respectively; P>.05), but greater (P<.05) compared with TRT 2 (31.1%). Pregnancy rates for animals not detected in estrus for TRT 3 but TAI at 72 h after PG was 23.9%. In conclusion, TRT 2 and 3 are a more effective method of synchronizing estrus in lactating crossbred cows of Bos indicus breeding compared with TRT 1 cows in a 7-d GnRH/PG protocol.

**Key Words:** Bos indicus, Estrous Synchronization, GnRH

### 455 Timed artificial insemination in dairy heifers fed melengestrol acetate

S. M. Pancaro¹, J. Vonk², F. Moreira³, and W. W. Thatcher¹, ¹University of Florida, ²Wageningen Agricultural University.

Two experiments were designed to improve synchronization of ovulation with a timed artificial insemination (Ovsynch/TAI) protocol by feeding melengestrol acetate (MGA, 0.5 mg). After estrus induced by prostaglandin F2α (PGF2α, Lutalyse®, 25 mg, im), cows were injected with GnRH (Cystorelin®; 100 µg, im) on d3 (n=10), d5 (n=10), d15 (n=10) or d18 (n=9) of the cycle. MGA was fed daily for first 5 days of the Ovsynch/TAI protocol, PGF2α injected on d7, GnRH injected on d9, and heifers inseminated 14 h later. Ovulation to first GnRH injection did not differ (P>.05) for d3, 1/5 for d5, and 2/9 for d18 (P>.05). Feeding MGA concurrently with injection of GnRH reduced incidence of induced ovulations from expected for d5 and d18 groups with a dominant follicle. Pregnancy rates (PR) did not differ (35.9±7.8%; P>.10). Frequency of premature ovulations prior to the second GnRH injection was greater for the d18 (4/9) and d15 (2/10) groups (P<.01) compared to d3 and d5 (0/20) and contributed to low pregnancy rate. Heifers (n=34) of experiment 2 were injected with PGF2α to induce estrus. Heifers in estrus (n=24, 71%) were assigned to initiate the Ovsynch/TAI protocol at d5 of cycle. Remaining non-responsive heifers (n=10, 29%) began the Ovsynch/TAI protocol at 10 days after PGF2α injection. Heifers received the Ovsynch/TAI protocol and were assigned to treatments: control (n=12), 6d-MGA feeding (n=11) and 5d-MGA feeding (n=11). MGA feeding was initiated at first GnRH injection in the 6d-MGA group and 1 day after GnRH injection in the 5d-MGA group. In MGA groups, last MGA feeding was 1 day before PGF2α injection. Ovulation rates to the first GnRH injection were: control=91.6±10.4%, 6d-MGA=72.7±10.8% and 5d-MGA = 63.6±10.5%. No premature ovulations occurred prior to the second GnRH injection, and PR was 63.6±8.7%. Feeding MGA for 5 days, beginning 1 day after the initial GnRH injection and ending 1 day prior to PGF2α injection, may improve synchronization without compromising fertility to the Ovsynch/TAI protocol.

### 456 Extending prostaglandin F2α administration from 17 to 19 d in a melengestrol acetate-prostaglandin F2α estrus-synchronization system for beef heifers

G. C. Lamb¹, D. W. Nick², J. S. Stevenson², and L. R. Corah³, ¹University of Minnesota, Grand Rapids, ²Kansas State University, Manhattan, ³Certified Angus Beef, Manhattan, KS.

Our objective was to determine whether extending the interval between melengestrol acetate (MGA) feed removal and prostaglandin F2α (PGF) administration from 17 to 19 d would alter conception rates, pregnancy rates, and degree of synchrony in replacement beef heifers. A commercial heifer development operation located in north-central Kansas purchased 591 Angus x Hereford heifers from 12 sources. Prior to the spring breeding season, 14% of the heifers were culled. The remaining heifers were assigned randomly to two MGA-PGF synchronization systems. All heifers were fed MGA (0.5 mg per head per day) for 14 d and PGF was administered either 17 or 19 d after MGA feeding was complete. Heifers were inseminated artificially for 30 d followed by 30 d of natural mating. Based on each source, first-service conception rates ranged from 66% to 90%, whereas overall pregnancy rates ranged from 91% to 100%. Heifers given PGF on d 17 after MGA had first-service conception rates of 75.9% compared to 81.4% for heifers administered PGF on 19. In response to the PGF injection, 90% of the d 19 heifers, which were detected in estrus, were inseminated artificially by 72 h after the PGF injection, whereas 74% of the heifers in the d 17 treatment were inseminated by 72 h after PGF. Average interval to AI after PGF was greater (P<.01) in the d 17 heifers (73.1 ± 1.1 h) than in the d 19 treatment (56.2 ± 1.1 h). No differences in conception rates or overall pregnancy rates occurred; however, heifers from the group that had shorter intervals to estrus and a greater proportion were inseminated within 72 h after PGF, thus possibly facilitating successful
timed inseminations of remaining heifers not yet inseminated by 72 h after PGF.

Key Words: Replacement Heifers, Artificial Insemination, Synchronization

457 Improved synchrony of estrus with addition of GnRH to a melengestrol acetate (MGA; 14 d) - prostaglandin F2α (PG; 19 d) estrous synchronization treatment in beef heifers. S. L. Wood, M. C. Lucy, M. F. Smith, and D. J. Patterson, University of Missouri, Columbia, MO.

The objective of this experiment was to determine whether addition of GnRH to a MGA-PG protocol would improve synchrony of estrus by initiating a new follicular wave after withdrawal of MGA and prior to PG-induced luteal regression. Pubertal crossbred heifers (n=34) were randomly assigned to one of two treatments. Both treatments were fed MGA (5 mg·hd⁻¹·d⁻¹) for 14 d followed by an injection of PG (25 mg Lutalyse⁶) 19 d after MGA withdrawal. MGA was delivered in a supplement of 1.8 kg·hd⁻¹·d⁻¹. Seventeen heifers received an injection of GnRH (100 µg Cystorelin⁷) 12 d after MGA withdrawal and 7 d prior to PG. The control group (n=17) received only MGA-PG. Estrus was detected 4 times/d for 7 d beginning on the day PG was administered. Transrectal ultrasonography was performed daily on 8 heifers from each treatment to monitor ovarian activity and characterize changes in follicular dynamics after MGA withdrawal and until ovulation after PG. GnRH-treated heifers ovulated or luteinized the dominant follicle following injection and initiated a new follicular wave (8/8, 100%). All GnRH-treated heifers (17/17, 100%) and 94% of controls (16/17) exhibited estrus after PG. Estrus was exhibited over a 132 h period (12 to 144 h) for control heifers compared with 60 h (48 to 108 h) for GnRH-treated heifers. The peak synchronized period for both treatments was between 48 and 72 h after PG during which time 76% (13/17) of GnRH-treated heifers exhibited estrus compared to 59% (10/17) of controls. Seventy-one percent (12/17) of the GnRH-treated heifers exhibited estrus from 48 to 60 h after PG, compared to 35% (6/17) of controls (P<.05). In summary, addition of GnRH to a 14-19 d MGA-PG protocol centered estrus during the synchronized period and reduced the time required to detect estrus. This protocol may offer potential for fixed-time insemination of replacement beef heifers.

Key Words: Progestin, GnRH, Prostaglandin F2α

458 Follicular dynamics, estrus and pregnancy after fixed-time insemination in beef cows treated with intravaginal progesterone inserts and estradiol benzoate. P. J. Bridges, P. E. Lewis, and E. K. Inskeep, West Virginia University, Morgantown, WV.

The effects of three short term treatments with progesterone and estradiol benzoate (EB) on follicular dynamics, synchrony of estrus and pregnancy rate after fixed time insemination were compared in lactating, postpartum beef cows on two farms. One week prior to, and at the onset of treatments, blood was collected to determine ovulatory status. In treatment 1, each cow received an intravaginal progesterone insert for 7 d with injection of EB (2 mg, i.m.) at the time of device insertion. In treatment 2, the insert was used for 5 days with injection of EB (2 mg, i.m.) at insertion. Cows in treatment 3 received an insert alone for 5 d. All cows received PGF₂α (25 mg, i.m.) at insert removal and an injection of EB (1 mg, i.m.) 30 h later. Cows were inseminated 28 to 30 h after treatment with EB (58 to 60 h after insert removal). Ovarian follicular dynamics were monitored in a random subset of cows within each treatment group. Treatment with 2 mg EB terminated growth of the largest ovarian follicle (>5 mm in diameter) at device insertion in 16/16 and 14/15 cows in treatments 1 and 2, respectively. The follicle destined to ovulate was larger in treatment 1 (11.8 ± 0.7 mm) than in treatment 2 (9.8 ± 0.3 mm, P<.05). Estrus was detected within an 8-h target period (48 to 56 h after insert removal) in 93, 87 and 81% of cows in treatments 1, 2 and 3, respectively (P>.05). Pregnancy rates at 39 d post insemination were 60, 50 and 51% for treatments 1, 2 and 3, respectively (P>.05). Pregnancy rates did not differ between cows that were anovulatory or had ovulated prior to initiation of treatments (54 vs 53%), nor among cows that were 28 to 40, 41 to 60 or >60 d postpartum at insemination (43, 59 and 54%, respectively). Injection of PGF₂α at insert removal and 1 mg EB 30 h later induced the high degree of synchrony of estrus and ovulation necessary for fixed time insemination in lactating beef cows, regardless of ovulatory status.

Key Words: Cattle, Postpartum, Fixed time insemination

459 Ovulation responses, progesterone concentrations, and pregnancy rates in dairy cows after GnRH treatment at 7, 14, or 7 and 14 days after timed insemination. J. D. Ambrose*, J. P. Kastelic⁵, Y. Kappe⁴, J. Small⁵, H. Mohamed⁵, R. Rajamahendran⁵, and L. Goonewardene⁵. ¹Alberta Agriculture, Edmonton, ²Agriculture and Agri-Food Canada, ³Lethbridge, ⁴Brandon, ⁵University of BC, Vancouver, Canada.

Treatment with GnRH 7 or 14 d after insemination (AI) often causes ovulation, increases peripheral progesterone (P₄) concentrations, and may increase pregnancy rates. Our objectives were to determine these responses when GnRH was given 7, 14, or 14 d after timed AI in cows treated to synchronize ovulation. Lactating Holstein cows (n=78; 79±37 DIM) were given GnRH on d-10, PGF₂α (Lutalyse 25 mg, im; Pharmacia-Upjohn) on d-7, GnRH on d-1 and timed-inseminated about 16 h later (d 0). Cows were then randomly allocated to receive: saline on d 7 and 14 (SS; n=20); saline on d 7 and GnRH on d 14 (SG; n=19); GnRH on d 7 and saline on d 14 (GS; n=19); or GnRH on d 7 and 14 (GG; n=20). All GnRH treatments were Fortilin (Vetoquinol, 100 µg, im). Blood samples were collected on d 0, 7, 14, 18, and 21 for P₄ analysis. Ovulation occurred in 30/39 (76.9%) and 10/39 (25.6%) of cows given GnRH on d 7 and 14, respectively (P<0.01). Mean P₄ concentrations (ng/ml) were higher (P<0.05) in SG (5.7), GS (6.2) and GG (6.1) than in SS group (4.4). Pregnancy rates at 60 d (determined by palpation per rectum) were 50.0, 47.4, 31.3 and 50.0±0.12% for cows in SS, SG, GS and GG groups (P>0.05). Sixty five (83.3%) of the 78 cows responded to the synchronization treatment as determined by P₄ on d 0 (<1.0 ng/ml) and d 7 (≥1.0 ng/ml). When only these cows were considered, pregnancy rates were 52.6 (SS), 52.9 (SG), 37.5 (GS) and 61.5 (GG)±0.06% (GG>GS, P=0.10). Administration of GnRH 7 and 14 d after timed AI may increase pregnancy rates in cows that respond to the treatment to synchronize ovulation. The low incidence of ovulation following treatment on d 14 (25.6%) warrants further study. Research supported by Alberta Milk Producers, Vetoquinol NA, Inc., and Pharmacia-Upjohn Animal Health.

Key Words: GnRH, Timed insemination, Pregnancy rate

460 A nonlinear model for mammary gland growth in lactating sows. S. W. Kim*, M. Grossman, and R. A. Easter, University of Illinois, Urbana IL.

The objective of this study was to characterize mammary gland growth using an empirical dynamic model. Nonlinear mathematical functions can provide tools necessary to construct more flexible and realistic biological models. Mammary gland growth has been modeled in rats and mice, goats , guinea pigs, and cows. No similar model has been constructed for mammary gland growth in sows. Data from 61 sows were used to construct and to illustrate the use of empirical dynamic models to describe mammary gland growth during lactation. Sows were fed four diets during lactation: low energy low protein, LELP; low energy high protein, LEHP; high energy low protein, HELP; high energy high protein, HEHP. Data on weights and composition were collected from individual suckled mammary glands of sows by slaughtering throughout 31 days of lactation. Mean values of weights and composition variables (y) for each sow were computed for each day of lactation (x) and fitted by nonlinear regression. A logistic function was modified to have different rates of growth (d) and decay (f), y=a/(exp[(x-c)/2d]+exp[(x-c)/2f])², and was used to explain the asymmetric change in the mammary gland for each diet. Model parameters, a, c, d, and f, were used to derive the maximum value for each variable and the day of lactation at maximum. Sows fed a HEHP diet reached a maximum mammary gland weight of about 600 g on about day 23 of lactation. R-square of the model was .75. It was also possible to describe mammary gland growth of sows fed other diets for other variables, i.e., dry weight, protein amount, dry fat-free tissue amount, and DNA amount in individual suckled mammary glands with maximum values and day of lactation at maximum. A nonlinear asymmetric model is more flexible and closer to biological reality than a linear model. It should be possible to describe mammary gland change patterns in other species with this model.
461 Relationship among genotype at the BM1500 microsatellite, performance and carcass traits and plasma leptin concentration at slaughter determined by a multi-species RIA in cattle. A. G. Van Kessel1, C. F. Buchanan1, H. C. Block1, J. J. McKinnon1, S. M. Schmutz2, and B. Laarveel1, 1Department of Animal and Poultry Science, University of Saskatchewan, Saskatchewan, SK, CANADA.

Genotype at the BM1500 microsatellite, which is 3.5 kb downstream of the leptin gene, has been associated with fat deposition in cattle (Fitzsimons et al., 1998, Mamm. Genome 9:432). To examine the relationship among plasma leptin concentration, BM1500 genotype and carcass traits in cattle, blood samples were collected 24 h prior to slaughter in 96 head homogously for the 138 bp putative fat allele (n=50) or the 147 bp putative lean allele (n=46). Cattle were predominantly of Angus (n=29), Hereford (n=34) and Charolais (n=33) breed types. Cattle were limited fed to achieve 1 kg/d live weight gain for a 70-d background period. During finishing, animals were fed ad libitum such that half the animals within each breed type were slaughtered at 8 or 12 mm back fat determined by ultrasound. Plasma leptin was determined by a commercial multi-species RIA kit (LINGCO, St. Charles, MO). Animals homozygous for the 138 bp allele had greater (P<0.05) backfat depth at the beginning (2.34±0.19 vs. 1.79±0.20 mm) and end (2.98±0.16 vs. 2.37±0.17 mm) of the backgrounding period and reached target finishing back fat depths at lighter (P=0.001) weights (550.0±7.5 vs. 588.0±7.9 kg) and in fewer (P<0.05) total days on feed (180.6±4.7 vs. 195.2±5.0 d). Plasma leptin (ng/ml) was not affected by genotype but was significantly (P<0.001) higher in animals fed to 12 (6.26±10.19 vs. 5.20±10.20 mm) back fat. In animals fed to 8 mm back fat, no correlation between plasma leptin and carcass or production traits were found. In the 12 mm backfat group, leptin concentration correlated positively with ADG during backgrounding (r=0.37, P<0.01) and average carcass fat depth (r=0.31, P<0.05). The multi-species leptin RIA detected only minimal variation in leptin concentration associated with marked differences by body fat content and failed to differentiate rate of fat deposition predicted by genotype at the BM1500 microsatellite.

Key Words: Nonlinear Model, Mammary gland, Lactating sows

463 Relationship between concentrations of ovarian steroids and insulin-like growth factor-I in the follicular fluids of the female camel (Camelus dromedarius). G. F. Bashour1*, King Faisal University, Al-Hofuf, Saudi Arabia.

The main objective of this study was to investigate whether ovarian follicular fluid concentrations vary with the oestrogenic status of the follicles in an induced ovulator, i.e., the female camel. For this purpose, ovaries from 12 female camels were collected after slaughter. All the follicles ≥ 2.5 mm were dissected and their diameter recorded. Follicular fluid was aspirated separately from each follicle and stored at -20°C until analyzed for oestradiol (E), testosterone (T) and IGF-I. A total of 117 follicles were studied. A bi-modal distribution of follicles was observed when their frequency was plotted against oestradiol:testosterone (E:T) ratio. As a result, individual follicles were classified as oestrogenic or non-oestrogenic if they had E:T ratio ≥ 7.1 or ≤ 7.1, respectively. The mean diameter did not differ between oestrogenic (9.1±1.5 mm) and non-oestrogenic (9.4±1.0 mm) follicles. Similarly, follicular fluid IGF-I concentrations were not different between oestrogenic (95.8±9.7 ng/ml) and non-oestrogenic (120.5±10.0 ng/ml) follicles. As expected, E concentrations were significantly (P<0.001) higher in oestrogenic, while T concentrations were significantly (P<0.02) higher in non-oestrogenic follicles. The results of this study suggest the lack of any relationship between follicular fluid IGF-I concentrations and oestrogenic status of ovarian follicles in the female camel.

Key Words: Ovarian Steroids, Insulin Like Growth Factor-I, Follicular Fluid

464 In vitro production of bovine embryos in a single medium system. A. P. Gandhi* and R. L. Krisher, Purdue University, West Lafayette, IN.

Production of bovine embryos in vitro has traditionally utilized a complicated combination of culture media. Oocytes and embryos are exposed to varying culture conditions (such as pH and osmolarity) and may have to expend energy adjusting to the changing environment. This production system is also labor intensive and thus difficult to maintain. In the present study, a single base medium synthetic oviductal fluid (SOF; J. Blaschek, J. A. B. Joly, Culture System, Davie, FL) was used with the ability to support maturation, fertilization and pre-implantation development of bovine embryos. Four treatments were examined: control (a standard production system; Mol Reprod Dev 44:193) and three SOF treatments; maturation in SOF with BSA (SOFBSA), SOF with bovine calf serum (SOFBCS) or the control maturation medium (TCM199 with BCS; 190SOF) followed by fertilization and culture in SOF medium. Oocytes were inseminated using standard fertilization and sperm wash media (Biol. Reprod. 38:1171) or SOF medium without glucose or glutamine (fertilization) and supplemented with additional lactic acid (sperm wash). Control zygotes were cultured for 72 h in mM3 medium (Hum. Reprod. 6:64) with amino acids followed by 96 h in TCM199 with 10% BCS. Zygotes fertilized in the SOF system were cultured for 96 h in SOF with EDTA and taurine followed by 96 h in SOF with vitamins. The percentage of cleaved embryos and of embryos developing to the morula and blastocyst stage of total oocytes inseminated was not different between treatments (n=97-120)/treatment: control 47.5±8.6, 27.4±5.3; SOFBSA 55.9±6.3, 21.7±4.5; SOFBCS 48.4±6.2, 14.8±3.9; 190SOF 52.6±7.6, 20.8±3.7, respectively. The average cell number of morulae and blastocysts was also not different among treatments (n=17-26)/treatment: control 76.3±5.7; SOFBSA 66.3±6.8, SOFBCS 78.8±5.8, 190SOF 67.1±8.8). These results indicate that although bovine oocytes and embryos appear to be capable of withstanding variations in culture environment without compromising development, quality blastocysts can be easily and successfully produced in a single base medium system.

Key Words: Embryo, Culture, Bovine
465 Localization of zona pellucida receptors on porcine sperm by fluorescence microscopy. H. R. Burkin and D. J. Miller, University of Illinois, Urbana-Champaign.

During fertilization, the first molecular interactions between the sperm and egg occur at the zona pellucida. The zona pellucida is composed of three glycoproteins which form a protective extracellular coat that surrounds the egg and appears to limit egg access to homologous sperm. Upon binding the zona, mammalian sperm undergo the acrosome reaction, an exocytotic event which releases hydrolytic enzymes that allow the sperm to penetrate the zona and reach the egg plasma membrane. Although several candidate zona binding proteins have been identified on porcine sperm, their roles in fertilization and the sperm acrosome reaction are not clear. In addition, the specific region of the sperm that initially binds the zona pellucida is controversial. Our objective was to use transgenic mice expressing green fluorescent protein (GFP) in zona-free acrosome-reacted porcine sperm. We used fluorescence microscopy to visualize biotinylated solubilized zona proteins bound to sperm. The zona proteins consistently bound to the plasma membrane over the acrosomal region of the sperm head. Surprisingly, labeling was also detected on the post-acrosomal region at the base of the sperm head. When sperm were treated with the calcium ionophore A23187 to induce the acrosome reaction, acrosomal labeling was lost although labeling at the base of the sperm head remained. We have used this technique to show that solubilized porcine zona proteins can also bind bull and stallion sperm, exhibiting a similar labeling pattern to that seen in boar sperm. Our results support the hypothesis that a sperm plasma membrane receptor initially binds the zona, inducing the sperm acrosome reaction. After the acrosome reaction, these zona receptors are lost from the acrosomal region of the sperm head. The labeling that remains at the base regardless of sperm acrosomal status may indicate the presence of secondary zona receptors on sperm. Finally, our results indicate that these receptors may be conserved between porcine, bovine, and equine species.

Key Words: Sperm, Zona Pellucida, Receptor

466 Effect of maturation medium, stage of estrous cycle on in vitro maturation, fertilization and cleavage of bovine and buffalo oocytes. H. Abdel Rahman, F. Elkeraby, A. Nebbar, and S. Shamiah, 1Faculty of Agriculture, Shbin El Kom, Egypt; 2Animal Production Research Institute, Ministry of Agriculture, Giza, Egypt.

A total number of 500 buffalo and 329 bovine oocytes, collected by aspiration of medium sized follicle (3-10 mm). Ovaries were obtained at 3 stages of estrous cycle (stage II, III and IV). Oocytes were cultured in vitro in two maturation culture media (TCM 199 or MEM). Rate of oocyte maturation (IVM) and fertilization (IVF) were tested. Cleavage rate (CR) and cleavage index (CI) were studied by in vitro culture and insemination of further 600 buffalo and bovine oocytes (300 of each species). Thyroid albumin lactate pyruvate medium (TALP) was used for fertilization and sperm capacitation. Heparin (20 µg/ml) was added to coculture of oocytes and sperm. Percentage of bovine oocytes used for fertilization and sperm capacitation. Heparin (20 µg/ml) was added to coculture of oocytes and sperm. Percentage of bovine oocytes reached metaphase II was 52.3% versus 43.2% in buffalo. Difference was insignificant. Percentage of degenerated buffalo oocytes was significantly greater (30.6%) than that in cattle (18.2%), P < 0.01. Neither maturation medium nor stage of estrous cycle significantly affected rate of IVM or IVF. Rate of IVF was 61.9% in cattle versus 27.8% in buffalo, P < 0.01. Oocyte CR was 41.0% in cattle versus 22.3% in buffalo, P < 0.01. CI was 64.2% versus 65.0% in buffalo. Only 6.7% of initially cultured bovine oocytes and 3.3% of buffalo oocytes reached morula stage.

Key Words: In vitro oocyte maturation, Fertilization, Buffalo and cattle diet plus 30% of corn grain (G). The feed was offered in individual cages from 8 a.m. to 4 p.m. and after that all animals were allocated in the same pen. Live weight were recorded at monthly intervals. Serum progesterone concentrations were determined from blood samples obtained twice a week since month 5. Starting at month 6 (week 1), frequent blood samples (10 min. during 6 h) were collected weekly to assess episodic LH secretion. Puberty was defined as occurrence of serum progesterone exceeding 1 ng/ml in at least two consecutive samples. Kruskal-Wallis test was used to analyze frequency and amplitude of LH pulses. Although the LH pulse amplitude was higher than 1 ng/ml throughout the experimental period in animals G treatment, only differences was found among groups in week 5 (P < .0004). Furthermore, lower (P < .027) LH pulse frequency was also detected in G animals in the same week. Daily weight gain were higher in G (46.5 g/d) than H (49.8 g/d) and F (36.2 g/d) groups (P < .01) during the fifty last days. None of the diets was able to trigger puberty during the experimental period. Results indicate that only the grain stimulates LH pulse amplitude but target weight gain of 50 g/d is not adequate to attain puberty in female Creole goats.

Key Words: Luteinizing hormone, energy, prepubertal goats

468 The effect of flushing hair sheep ewes during the rainy season on St. Croix. R. W. Godfrey*, B. M. Pannagl, and H. A. Buroker, Agricultural Experiment Station, University of the Virgin Islands, St. Croix.

St. Croix White hair sheep ewes were used to evaluate the effect of supplemental nutrition around the time of breeding during the rainy season on St Croix on reproductive performance. Beginning 21 d prior to the start of the breeding season and during the 35-d period, 13 ewes were fed a pelleted complete ration (14% crude protein) at a level which provided 150% of the nutrient requirements, in addition to grazing guinea grass pasture (FLUSHED) and 12 ewes grazed pasture only (CONTROL). All ewes were bred to one ram. On day 6.7 or 8 (estrus = day 0) ovulation rate was determined laparoscopically in each ewe. Ewes were examined by transrectal ultrasound on days 24, 28, 32, 36 and 40 to monitor fetal number. The day of conception was determined by non-return to estrus. Kilograms of forage dry matter/ha, was measured at the start and end of the grazing period in pastures during the 56-d period. The FLUSHED ewes were heavier (P < .0001) than CONTROL ewes during the entire study. There was no difference (P > .10) in the cumulative percent in estrus or conception during the breeding period between CONTROL and FLUSHED ewes. Ovulation rate at first estrus was similar (P > .10) between FLUSHED and CONTROL ewes (1.9 ± 2 vs 2.1 ± 2 ovulations, respectively). Fetal number on days of ultrasonography was not different (P > .10) between FLUSHED and CONTROL ewes (1.75 ± 1 vs 1.75 ± .1 fetoles, respectively). There was a positive correlation between ovulation number and fetal number all in the first estrus in FLUSHED ewes (R = .881, P = .0001) but not in CONTROL ewes (R = .566, P = .055). Because this study was conducted during the rainy season on St. Croix, it is hypothesized that the forage availability was high enough to provide adequate nutrition to allow the CONTROL ewes to achieve ovulation rates and fetal numbers similar to those of the FLUSHED ewes. The supplemental nutrition provided to the FLUSHED ewes does not appear to enhance ewe reproductive performance at this time of the year on St. Croix.

Key Words: Sheep, Flushing, Ovulation


To determine the impact of exogenous somatotropin (ST) on folliculogenesis in beef heifers, eight yearling heifers were rectally palpated twice/wk for one month. Ultrasonography was then conducted every other d for two wk to assess follicular populations. Based on the outcome of these sessions, animals were then assigned to either a control (C) group or a ST (33ng/kg BW/d) group, with mean number of observed follicles being similar between groups. Each animal then underwent additional ultrasonography sessions every other d for an additional two wk to assess the presence and rapidity of ovarian response to ST. Each animal then underwent twice weekly ovum pick-up (OPU) sessions for 9 wk, for a total of 18 sessions per animal. A total of 1,871 follicles were observed, 993 during the pre-OPU ultrasonography sessions, and 878 during the OPU sessions. A total of 302 oocytes were recovered from the OPU
sessions. One heifer was removed from data analysis due to statistically excessive follicle numbers, and subsequent data was covaried with pre-OPU follicle numbers. Due to variations in ovarian dynamics and small animal numbers, statistical significance was not noted, although several trends emerged. Prior to treatment, follicles/session in the first wk after ST administration were similar for C and ST heifers at 9.1 and 8.3 +/- 1.7, respectively. Follicles in the second wk after ST administration tended to increase in ST heifers, with 7.9 and 12.0 +/- 1.6 for C and ST heifers, respectively (p=0.22). This trend continued throughout the study sessions, with 5.8 and 8.5 +/- 1.5 follicles for C and ST heifers, respectively (p=0.20). Control heifers yielded numerically more oocytes/session than ST heifers (2.5 vs. 2.0 +/- 0.8, respectively, p=0.64). Oocyte quality and percentages of small, medium and large follicles were similar between treatments. In conclusion, in agreement with our earlier work, ST increased follicles and decreased recovered oocytes. Ovarian response was measurable as early as the second week after ST commencement.

Key Words: Somatotropin, Ovum pick up, Follicle

470 Effect of season on behavioral estrus, ovulation and estrous cycle length in Angus, Brahman and Senepol cows in a subtropical environment. J. V. Velich*a, C. L. Barnett1, J. K. Fullenwider1, J. R. Kemper2, J. W. Lemaster3, and C. C. Stass, Jr.2 1University of Florida, Gainesville, 2 USDA-ARS, Brooksville, FL

Open, non-lactating Angus (A; n=10), Brahman (B; n=10) and Senepol (S; n=10) cows were used during the summer (solstice), fall (equinox) and winter (solstice) to determine the effect of breed and season on the intensity and duration of estrus during a synchronized and spontaneous estrus; estrus cycle length after a synchronized estrus; and interval to ovulation after a spontaneous estrus. Estrus was synchronized using PG with 25 mg PG administered to cows on d 0 and 12.5 mg PG administered on d 11 and 12. Initiation, duration and intensity (total number of mounts received - mt) of the synchronized and spontaneous estrus were determined by HeatWatch®. Twelve hours after the initiation of the spontaneous estrus, ultrasonic examinations were performed every 1 h to determine time of ovulation. There was a season x breed effect (P=0.02) on synchronized estrus intensity for A (42.4, 36.4 and 29.1 mt), B (22.1, 24.0 and 34.3 mt) and S (38.1, 19.8 and 16.6 mt) for summer, fall and winter, respectively. Synchronized estrus duration was similar (P>0.05) between fall (12.9 h) and winter (14.1 h) which were longer (P<0.05) than summer (9.8 h). The synchronized estrus duration in the A (13.7 h) and B (13.3 h) were similar but longer (P<0.05) than S (10.1 h). Spontaneous estrus intensity was similar (P>0.05) between summer (29.4 mt) and winter (29.6 mt) which were both greater (P<0.05) than fall (16.8 mt). The B (18.8 mt) and S (22.1 mt) had fewer mt (P<0.05) compared with A (35.0 mt) during the spontaneous estrus. Season had no effect on duration of the spontaneous estrus, but the B (8.3 h) and S (10.2 h) had similar but shorter (P<0.05) duration of estrus than A (13.7 h). There was a season x breed effect (P=0.05) on estrus cycle length for A (21.5, 22.7 and 25.0 d), B (21.2, 20.0 and 21.5 d) and S (23.8, 19.9 and 21.5 d) for summer, fall and winter, respectively. Season and breed had no effect (P>0.05) on interval from the initiation of HeatWatch® spontaneous estrus to ovulation (30.8 h) or on ovulatory follicle size (14.4 mm). In conclusion, significant breed x season effects were observed for estrous behavior of beef cattle in a subtropical environment.

Key Words: Beef Cattle, Ovulation, Subtropical


Growth patterns in many species of fish are sexually dimorphic with one sex growing more quickly and reaching larger sizes. Development of mono-sex populations via sex reversal (changing the developed gonad) or by sex inversion (changing the undifferentiated gonad) would allow the aquaculture industry to produce an economical market-sized fish in less time. As compared to other methods, administration of steroids via the diet produces a higher percentage of sexually inverted individuals. However, hormone-enriched commercial diets are unsuitable for larvae of fish species that require live zooplankton (such as Artemia salina) as their initial diet. Steroids have been added to zooplankton at larger stages of development, but size made them unsuitable for larval fish requiring very small zooplankton. This experiment was conducted to determine the effect of incubation of Artemia nauplii with steroids prior to the first feeding instar II stage of Artemia development. Decapsulated Artemia cysts were incubated at a concentration of 3 g cysts/L in hatching media (1 L seawater at 1.030 SG, 0.08 g highly unsaturated fatty acid supplement) and either 20 mg 17β-estradiol (E2) or 17α-methyltestosterone (MDHT) dissolved in 3 mL 70% ethyl alcohol or ethyl alcohol alone (control). Cysts were cultivated at 18-20°C for 24 h. Nauplii were collected by filtering culture media, and were rinsed in 1 L fresh water. Artemia cultivated in control media contained 0.07 ± 0.01 ng E2/mg dry weight, and E2-treated Artemia contained 401 ± 40 ng E2/mg dry weight (P<0.0001). MDHT treated Artemia contained 546 ± 31 pg/mg dry weight and controls were below the level of detection (4pg/mL; p<.0001). Thus, steroid hormones can be incorporated into Artemia prior to the first feeding instar II stage. Enrichment of Artemia at this smaller size will allow them to be used as the initial diet of fish species that require small zooplankton, which may cause functional sexual inversion. Hormone enrichment of live zooplankton diets could be a useful tool in the development of mono-sex stocks of economically important species of fish.

Key Words: Artemia salina, Steroid, Sex inversion

472 Effects of genetic group and dietary treatment on initial reproductive performance of Targhee ewe lambs. W. Pittroff*a, V. LaVoie1, D. Keisler2, H. D. Blackburn3, and J. Stellwig4 1 U.S. Sheep Experiment Station, Dubois, 2 University of Missouri, Dept. of Animal Sciences, Columbia.

Onset of female puberty is thought to be influenced by degree of maturity, body weight and body condition. The discovery of leptin and its effects on the reproductive axis suggested a link between body composition and onset of puberty and initial reproductive performance. This experiment studied effects of body composition and development at the time of first service on onset of female puberty. Targhee ewe lambs of two different genetic lines (41: selected for total weight of lamb weaned; 42: random mating control) were assigned to 3 treatments: LEAN designed to maximize growth and development (2.35 Mcal/kg ME; 20.3% CP) fed ad lib, FAT, designed to provide energy surplus while protein-limiting growth (ME concentration 2.86 Mcal/kg; 7.9% CP), fed ad lib, and CONT, chow alfalfa hay ad lib and 250 g barley/head/day. Ewe lambs were bred for two cycles. Weight and gain data were analyzed with linear models with genetic line and nutrition treatments as main effects; reproductive performance was analyzed within genetic groups and treatments with categorical response models. For the line selected for high fertility and growth (41) pregnancy percentages were 75% (LEAN), 68.4% (FAT), 77.8% (LEAN); for unselected line 42: 50% (CONT), 83.3% (FAT) and 72.2% (LEAN). The value observed for 42-LEAN was the highest percentage ever obtained for that line here; these animals also had the lowest weight of all groups. Effect of treatment on average daily gain in the week prior to begin of mating was highly significant, with the lowest value observed for FAT animals, and highest for LEAN. Only line effects were significant for Age at the start of the period bracketing the mating period with 41 higher than 42. Line and treatment effects were highly significant for weight at begin of mating; the contrast between LEAN and FAT was highly significant. Differences in reproductive performance were significant only for 42 FAT vs. 42 CONT. This is due to small subcell size varying from 16 to 19 animals and a clear line by treatment interaction. The fact that the group with the lowest average weight had the highest initial reproductive success raises the possibility that attributes such as weight, degree of maturity or ADG prior to mating may be unsuitable predictors for initial female reproductive performance in sheep.

Key Words: Sheep, Female Puberty, Growth

473 Growth and the initiation of steriodogenesis in porcine follicles after weaning are associated with unique patterns of gene expression for individual components of the ovarian insulin-like growth factor (IGF) system. J. Liu*, A. T. Koenigsfeld5, T. C. Cantley6, and M. C. Lucy, University of Missouri, Columbia, MO.

Follicular growth and steroidogenesis are controlled by the interaction of IGF and gonadotropins. The objective was to measure mRNA for steroidogenic enzymes, gonadotropin receptors, and IGF systems in
porcine follicles during preovulatory follicular development after weaning. Follicles were collected at 2-3 mm (n = 5 sows), 4-5 mm (n = 4 sows), 6-7 mm (n = 4 sows), and 8 mm (n = 5 sows). Messenger RNA for LH receptor (LHR), FSH receptor (FSHR), cytochrome P450 17α-hydroxylase (P450α17α), aromatase (P450αromo), growth hormone receptor (GHR), IGF-I system genes (IGF-I, IGF receptor), IGF-II system genes (IGF-II and type II IGF receptor), and IGF binding protein (BP)-2 were measured in situ hybridization and quantified by image analysis. The LHR mRNA (theca and granulosa) and steroidogenic enzyme mRNA (P450α17α and P450αromo) increased as follicles grew from 2-3 mm to 6-7 mm but then decreased abruptly at 8 mm (P < .01). The FSHHR mRNA (granulosa) underwent a rapid decline as follicles grew (P < .01) and was undetectable in follicles greater than 4-5 mm. The expression of IGF-I system genes (IGF-I in granulosa and stroma and type I IGF receptor in granulosa) or GHR (granulosa) failed to change as follicles grew (P > .10). The IGF-II mRNA (theca cells) increased (P < .01) from 2-3 mm (4.2 ± 1.8) to 6-7 mm (15.3 ± 2.0) and then decreased in 8 mm follicles (11.4 ± 1.8). The type II IGF receptor mRNA (granulosa), however, increased six-fold from 6-7 mm (5.5 ± 5.7) to 8 mm (33.4 ± 5.1). The IGFBP-2 mRNA (granulosa and theca) decreased (P < .001) as follicles grew. In summary, steroidogenic enzyme mRNA and LHR mRNA were coordinated during follicular growth. This suggests that LH is required for steroidogenesis. The IGF-I system mRNA was constitutive whereas the IGF-II system mRNA underwent developmental regulation in precocious porcine follicles collected from weaned sows.

**Key Words:** Sow, Ovary, IGF

### 474 The effect of a GnRH agonist on plasma levels of steroid hormones in neonatal intact male pigs and its relation to the compounds associated with boar taint. J. Raeside, J. Squires, J. Britt, V. Hedgepeth, and J. Squires. 1University of Guelph, Guelph, Ontario, Canada, 2University of Tennessee, Knoxville, Tennessee, USA.

Two studies examined the effects of a GnRH agonist (Leuprolide 734) in a depot or chronic injection administration, on plasma concentrations of steroid hormones, 16-androstene steroids and skatole in fat, as well as testicular development of intact neonatal male pigs. The depot study involved 60 neonatal male pigs assigned to 1 of 4 treatments: intact males, Leuprolide treated (100μg/kg or 200μg/kg), and castrates. The injection study involved 20 neonatal male pigs assigned to 2 different treatment groups: daily 200μl injection of Leuprolide (0.5mg/ml), and intact controls injected with saline. Blood samples were taken weekly during the first 4 weeks and then monthly up to 6 months of age for quantification of testosterone in both studies as well as androsteneone and DHEAS in the injection study. Backfat and salivary glands were collected post slaughter on day 164 for quantification of skatole and 16-androstene steroids. Plasma steroid hormone concentrations significantly decreased (P < .0001) to castrate levels within 7 days of Leuproide treatment. Following cessation of treatment, steroid levels returned to control levels and remained constant until the final rise at 5 months. By 164 days, testosterone levels of the 100μg/kg depot treatment group were significantly higher than that of the control and 200μg/kg group. This trend was not observed in the injection study where there were no treatment differences in steroid hormone profiles at 164 days. There were no differences (P > .05) in concentrations of 16-androstene steroids in fat between any of the treatment groups within the two studies. Skatole concentrations in the 100μg/kg and 200μg/kg depot treatment groups were significantly lower (P < .05) than that found in the intact control, however these differences were not observed in the injection study. Testicular development showed a significant suppression during Leuproide treatment, however by day 164 testicular size and weight were at control levels. The results of these studies indicate that administration of Leuproide in either a depot formulation or multiple injection significantly decreases testicular development and steroidogenesis in neonatal male pigs, but this did not affect growth performance or steroid hormone levels at 6 months of age.

**Key Words:** GnRH Agonist, Boar Taint, Androstenone


First-litter Camborough sows were fed to lose three levels of protein during lactation to test whether ovarian function declines upon mobilization of a threshold level of body protein. Twenty-five sows were randomly allocated to be fed an isocaloric diet (62 ± 2.6 MJ DE/d) containing either high (HP: 868 g CP/d & 50 g lys/d; n = 8), moderate (MP: 650 g CP/d & 35 g lys/d; n = 7), or low (LP: 519 g CP/d & 26 g lys/d; n = 10) levels of protein and lysine. Sow weight and backfat depth were measured every 5 d, and feed intake daily during lactation. Sows were slaughtered on d 23 of lactation, and the reproductive tract was recovered. The number and diameter of all follicles > 2 mm were recorded and follicular fluid (FF) from the largest 16 follicles was collected and weighed. Standardized batches of oocytes were matured in vitro in culture media containing 10% pooled FF from each sow. There was no difference (P = .20) in backfat loss (-1.3 ± 29mm) among treatments, however LP sows lost more weight (P = .002) than MP and HP sows suggesting that LP sows lost more body protein. LP sows had fewer (P < .05) to 6 mm ovarian follicles, less FF/follicle, and lower FF IGF-1 levels compared to MP and HP sows. Nuclear maturation was less advanced in oocytes cultured in FF from LP sows as evidenced by a higher proportion (P < .05) of oocytes arresting at the Metaphase I (MI) stage of development. In conclusion, the sharp decline in ovarian function seen between LP sows and MP and HP sows suggests that mobilization of greater than a threshold level of body protein during lactation has an adverse affect on ovarian follicle maturation at weaning.

**Key Words:** Sow, Ovary, IGF


Postweaning growth and sexual development were determined for Romosinuano bulls from germplasm collected in Costa Rica (CR; n = 13) and Venezuela (VE; n = 31) that, prior to weaning (96 d), were either allowed to creep graze chiapu perennial peanut (Arachis glabrata; RPP; n = 23) or no creep grazing (n = 21). Postweaning, bulls were managed as a single group on mixed bahiagrass (Paspalum notatum) and RPP pastures (hay) and fed 4.5 kg/d concentrate. Growth measurements were collected at the start of the study and at 28-d intervals for 357 d. Simultaneously, semen collection was attempted by electroejaculation when the scrotal circumference (SC) of a bull was ≥ 23 cm. Traits were evaluated when first sperm was detected in an ejaculate (FS), when 50 million sperm with at least 10% motility were detected (PU), and when 500 million sperm with at least 50% motility were detected (PP). At the start of the study, Romosinuano bulls from CR were older (243 ± 14 vs 211 ± 20 d; P < .01), heavier (250 ± 10.2 vs 205 ± 6.2 kg; P < .001), taller (PP 1.6 ± 0.4 vs 1.4 ± 0.2 mm; P < .001) than bulls from VE. At the end of the study, Romosinuano bulls from CR were heavier (512 ± 14.0 vs 452 ± 8.9 kg; P < .001) and had larger SC (33.5 ± 5.9 vs 31.3 ± 3.8 cm; P < .01) than bulls from VE, but hip height did not differ. There was no effect of preweaning treatment on postweaning growth. Analysis of the difference between final and initial growth measurements revealed that Romosinuano bulls from CR had similar gains in BW and growth in hip height with a tendency (P < .10) for larger growth in SC of bulls from VE than CR. At FS, age,
BW, hip height and SC were similar between bulls from CR and VE. At PU, bulls from CR and VE did not differ in age (381±11.6 vs 361±7.5 d) and hip height, but bulls from CR were heavier (348±13.9 vs 312±9.0 kg; P < .05) and had larger (P < .05) SC (28.4±6.3 vs 26.6±4.1 cm) than bulls from VE. By PP, bulls from CR were 53 d older (P < .01), 69 kg heavier (P < .01), tended (P < .10) to be taller (3.2 cm) and had 2.6 cm larger (P < .01) SC than bulls from VE. In conclusion, postweaning growth performance was similar between Rosomuano bulls from CR and VE, and was not influenced by preweaning creep grazing. However, Rosomuano bulls from VE may reach sexual maturity sooner and at a smaller body size and SC.

**Key Words:** Bulls, Tropics, Puberty

**477 Effect of mifepristone (M) and/or PGF<sub>2α</sub>, on 90 day ovariectomized (OVX) pregnant ewes. E. Weems*, Y. Weems, P. Bridges, B. LeaMaster, and D. Vincent, University of Hawaii, Honolulu, Hawaii.**

Trilostane, a 3-OH-steroid dehydrogenase inhibitor, decreases progesterone (P<sub>4</sub>), increases estradiol-17β (E<sub>2</sub>), increases PGF<sub>2α</sub>, and aborts 90 day OVX pregnant ewes but does not affect prostaglandin E (PGE) secretion (C. Weems etal. Biol. Reprod. 58 (Suppl.1): 123, 1998). Ninety day OVX pregnant ewes were treated with M, a P<sub>4</sub> receptor antagonist, PGF<sub>2α</sub> or both M and PGF<sub>2α</sub> to determine the effect on pregnancy and Placental secretion of P<sub>4</sub>, E<sub>2</sub>, PGF<sub>2α</sub>, and PGE. Ewes were treated with vehicle (V), PGF<sub>2α</sub> (8 mg/58 KG/BW) M (50 mg), M (100 mg), M (50 mg) + PGF<sub>2α</sub> or M (100 mg) + PGF<sub>2α</sub>. Mifepristone was given intra-jugular at 72, 84, 96 and 102 hr and PGF<sub>2α</sub>, was given IM at 84 hr post OVX. Jugular vein plasma was collected at 0, 24, 48, 78 hr; every 6 hr from 72 to 102 hr; every min from 107-110 hr; 114 hr and every 6 hr from 114-168 hr for analysis for P<sub>4</sub> and E<sub>2</sub> by RIA. Inferior vena cava plasma was collected via a catheter 5 cm anterior to the juncture of the ovarian vein and vena cava for analysis for PGF<sub>2α</sub> and PGE by RIA at the same times for jugular vein plasma collection. Uterine venous plasma was collected at 0 and 168 hr for analysis for P<sub>4</sub>, E<sub>2</sub>, PGF<sub>2α</sub>, and PGE by RIA. Data for pregnancy status were transformed and analyzed by a factorial ANOVA; data for P<sub>4</sub>, E<sub>2</sub>, PGF<sub>2α</sub> and PGE in uterine venous plasma were analyzed by a factorial ANOVA, and profiles of P<sub>4</sub>, E<sub>2</sub>, PGF<sub>2α</sub>, and PGE in jugular or vena cava plasma were analyzed by a split plot design for ANOVA for repeated measures. Abortion by treatment was: V (0/5), PGF<sub>2α</sub> (0/5), M-50 mg (3/5), M-100 mg (3/5), M-50 mg + PGF<sub>2α</sub> (4/5) and M-100 mg + PGF<sub>2α</sub> (6/5) (P<.<05). PGF<sub>2α</sub>, in uterine venous plasma was increased (P<.<05) at 168 hr but not P<sub>4</sub>, E<sub>2</sub> or PGE (P>.05). Profiles of PGF<sub>2α</sub> in M-treated ewes were increased (P<.<05) but not profiles of P<sub>4</sub>, E<sub>2</sub> or PGE (P>.05). It is concluded that M induces abortion by increasing endogenous secretion of PGF<sub>2α</sub>.

**Key Words:** Pregnant, Sheep, Mifepristone

**478 Performance measures and pulmonary lesions at slaughter in feedlot cattle, E. M. Whiteley¹, F. T. McCollum, III¹, D. L. Montgomery¹, R. W. Sprovis¹, and C. J. Vogel², ¹Texas A&M University System, ²Elanco Animal Health.**

At slaughter lungs were collected from 371 steers in the Texas A&M Ranch to Rail program to evaluate the relationship between pulmonary lesions, medical history, feedlot performance and carcass traits. Lungs were examined by a veterinary pathologist and assigned a score based upon lesion type and severity, and the amount of total lung capacity involved. For purposes of analysis, steers were assigned to one of six categories based upon severity of the lung score (0=no lesions, 6=most severe). Thirty-one percent of the steers (n=32) with no lung lesions had been pulled and treated at least once during the finishing period. Of the steers with mild lesions (categories 1 and 2; n=170) and moderate lesions (categories 3 and 4; n=121) 35.9 and 51.2% had been pulled and treated, respectively. Twenty-four percent of the steers (n=48) with the most severe lesions (categories 5 and 6) had never been pulled and treated. Performance data were analyzed using general linear models. The model included lung category and when appropriate (P<.05) initial weight as a covariate. Days on feed was fewer (182; P<.05) for steers in lung category 2. Days on feed was greatest for lung category 5 (199) but not different than (P>.05) categories 1, 4, and 6 (mean = 193.5). Pulmonary medical cost tended to reflect pulls with category 6 having the highest cost ($40.35/hd; P<.05), while category 2 had the highest frequency of pulls (1.67/hd; P<.05). Calculated yield grade did not differ among lung score categories (mean=2.6; P>.05). Marbling score decreased as the severity of lung lesions increased. Lung lesions at slaughter were associated with performance and carcass measurements.

**Key Words:** Pulmonary Lesions, Feedlot Cattle

**479 Delayed implant strategies using Synovex Plus for finishing yearling steers, C. T. Miller¹, R. J. Conklin¹, and F. L. Prouty², ¹University of Nebraska, Lincoln, NE, ²Fort Dodge Animal Health, Overland Park, KS.**

Two hundred twenty-five crossbred steers (avg. BW 301 kg) were allotted to five weight blocks and stratified to one of five implant strategies in a 152-d finishing trial to evaluate a single initial versus two delayed, single implant strategies and two reimplant strategies on performance and carcass traits. Implant strategies were Synovex<sup>®</sup> Plus<sup>TM</sup> d 1 (SP1), 35 (SP35), or 70 (SP70), or Ralgro<sup>®</sup> d 1 followed by Synovex Plus d 70 (RSP1), or Synovex<sup>®</sup> 8 d 1 and 70 (SS). The finishing diet contained 64.5% corn (70% high-moisture;30% dry-rolled), 20% wet corn gluten feed, 17% alfalfa hay, 17% fat and 5% supplement, and was formulated to contain 13% CP, .7% Ca, .4% P, .7% K, 27 g/t Rumensin<sup>®</sup>, and 10 g/t Tylan<sup>®</sup> (DM basis). Treatment means were separated using t-tests with a protected F-test. Contrasts were used to test linear and quadratic effects of delaying Synovex Plus and SS vs other strategies. Steers implanted with SP70 had a lower (P<.10) DMI than other implant strategies (10.5 vs 11.0 kg/d). Daily gain (kg) of steers implanted with 5.75% (1.85) was higher (P<.10) than steers implanted with SP70 (1.73) and SS (1.75), but similar to those implanted with SP1 (1.80) and RSP (1.80). Gain/feed was similar among Synovex Plus implant strategies, but improved 3.7% (P = .01, .165 vs .159) compared with SS. Yield grade (P = .01), 12th rib fat (P = .05), and marbling score (P = .01) were decreased linearly by delaying Synovex Plus. Steers implanted with SS had a smaller (P<.01) ribeye area and higher yield grade (P = .02) and marbling score (P = .10) than other strategies. Dressing percent and percentage of Choice carcasses were unaffected. However, SP70 reduced the percentage of Choice carcasses by 10 percentage units compared with SP1, SP35, and RSP. Performance and carcass traits were similar for a single implant of Synovex Plus on d 1 or 35 or a reimplant program using Ralgro and Synovex Plus for steers fed the diet of 70. Delaying a single dose of Synovex Plus until d 70 appears to reduce ADG, but maintains feed efficiency.

**Key Words:** Implants, Feedlot, Steers

**480 Explaining to determine the response-life of a combination implant. B. A. Gardner¹, H. G. Dalezal¹, F. N. Owens¹, and B. Freking², ¹Oklahoma State University, ²Kerr Center for Sustainable Agriculture.**

To evaluate the response-life of a combination (120 mg TBA + 24 mg estradiol 17b; REV) anabolic implant, Angus x Senepol yearling steers (n=100, 333 kg), that had received no prior implants, were assigned to one of five regimen designs during a 140-d feeding trial. Treatments consisted of 1) no implant during the finishing period; 2) a single implant of REV on day zero; 3) as 2 but removal of that implant on day 56 and replacement with a second REV; 4) as 3 but replacement on day 84, 5) as 3 but replacement on day 112. Steers had ad libitum access to a corn based concentrate diet (2.12 Mcal/kg NEm and 1.36 Mcal/kg NEd). Steers were weighed at 28-d intervals to determine whether implant replacement improved performance. Throughout the trial, implanted steers, regardless of implant regiment, had greater (P<.05) daily gains (1.52 vs 1.05 kg/d), consumed more DM (9.01 vs 7.56 kg/d), and converted DM to live weight more efficiently than non-implanted cattle (.16 vs .13 gain/feed). Subsequently, implanted steers yielded heavier

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(P<0.01) carcasses (334 vs 294 kg) that had more advanced (P<0.01) skeletal maturity scores (A48 vs A20) and larger (P<0.01) longissimus muscle areas (LMA) but not when expressed per unit carcass weight (P=0.67). No differences (P>0.10) in marbling score (377 vs 396), percentage U.S. Choice (28.4 vs 41.7%), or YG (3.3 vs 3.4) were detected among implanted vs non-implanted treatments. No differences (P>0.10) in performance or carcass characteristics were detected among single vs any of the multiple implant regimes. A single implant administered at the beginning of the finishing period enhanced gain, gain:feed, carcass weight, and skeletal maturity without negatively affecting quantitative carcass traits or marbling score. Because replacement of implants at up to 112 days on feed did not improve performance, implant lifespan must have exceeded 112 days. Performance responses often seen with re-implanting may be due to hormone stacking, not to exhaustion of previous implants.

Key Words: Beef, Implant, Performance


To determine the effect of bunk management strategies on performance in a commercial feedlot during the Australian summer, 6000 Hereford and Hereford x Angus cross year old steers (average initial weight 430 kg) and fed for an average of 162 days were selected and randomly allocated to four bunk management treatments. The four treatments, each replicated six times, consisted of (1) ad libitum feeding with four deliveries daily, (0800, 1000, 1400 and 1730), (2) ad libitum feeding with one delivery am (0730), (3) clean bunk at midday with one delivery pm (1530) and (4) clean bunk at midday with two deliveries daily, (0530 and 1600) divided into proportions of 30% am and 70% pm. The bunks of the ad lib treatments were assessed in the morning and the clean bunk treatments assessed at midday. All steers were fed a concentrate diet based on 74% steam flaked barley. The frequency with which feed bunks required cleaning, feed wastage and feeding cost were all significantly greater (P<0.05) for the ad lib treatments than the clean bunk treatments. Expenditures for the ad lib period were 32.0, 31.0, 2.0 and 1.0; feed wastage in tonnes dry matter were 7.5, 7.3, 0.2 and 0.2 and feeding costs (A$/hd/d) were $2.12, $2.17, $2.06 and $2.03 for treatments 1, 2, 3 and 4 respectively. Animal performance was not significantly different between bunk management strategies. A clean bunk at midday management strategy encouraged animals to clean the bunk of feed by midday and was designed to provide delivery of feed in proportions which meet animals natural feeding activity pattern, i.e. initiation of feeding corresponded closely with sunrise and sunset with minimal feeding activity during the midday period. Bunk management incorporating a clean bunk at midday has the potential to reduce feeding cost and maintain animal performance compared to ad lib feeding, particularly during the summer period when these aspects can be compromised due to environmental stress.

Key Words: Cattle, Feedlot, Bunk management

482 Validation of a radio frequency identification system used to monitor patterns of feeding by feedlot cattle. K. S. SchwartzkopfGenswein1, C. Huisman2, and T. A. McAllister3, 1Alberta Agriculture, Food and Rural Development, Lethbridge, AB, 2GrowSafe Systems Ltd., Airdrie, AB, 3Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB.

Feed bunk attendance data collected using radio frequency (RF) technology (GrowSafe Systems Ltd.) were compared against videotape surveillance data and across multiple transponders borne by individual animals, to assess the validity of the RF methodology. Feed bunk attendance by six heifers (481±22 kg) and six steers (471±44 kg) fed 80% steam-rolled barley grain, 15% barley silage and 5% supplement was monitored for 52 d by RF and by videotape. In addition, the relationship between bunk attendance and average feeding time was analyzed. Total daily error of the RF system over 24 h (including time present and time absent) was 6%, compared to videotaped data. Incidence of errors due to RF interference and false antennae readings were 2.4 and 3.6%, respectively. The RF system was concluded to be highly effective for documenting bunk attendance. Feeding durations recorded by duplicate transponders borne by individual animals were highly correlated, averaging 88.4±1.5 and 84.5±1.5 min d-1 (R2 = 0.96). Frequency of bunk visits was also highly correlated (R2 = 0.96). Attendance at the bunk comprised 84% eating time and 16% non-feeding activity. Visits per day averaged 29±11.8, with 55.8% associated with feeding activity and 44.2% with non-feeding activity. Thus, duration of attendance at the bunk may be a better indicator of an animal’s feed intake than frequency of attendance. Future studies with GrowSafe or other RF systems that do not record feed intake simultaneously with detecting attendance should incorporate a correction factor to relate attendance to feeding time. This study identified factors, such as non-grounded, metal material (connected in a loop configuration) that could introduce error into the GrowSafe system, particularly when associated with the feed bunk area. Consideration of these factors may impact decisions taken during installation of the system in other facilities.

Key Words: Feeding behaviour, Radio frequency, Feedlot cattle

483 The effect of value-added calf programs on morbidity rates and feedlot performance through the reimplant period. J. G. Gentry*1, N. C. Speer2, G. F. Jones3, C. D. Smith4, and J. C. Whittier3, 1Texas Tech University, Lubbock, TX, 2Western Kentucky University, Bowling Green, KY, 3Colorado State University, Ft. Collins, CO.

Feeder cattle from three separate value-added calf (VAC) programs were evaluated for feedlot performance from arrival through the reimplant period. The VAC programs spanned one growing season. Kentucky Cattleman’s Association including Certified: Preconditioned for Health (CPH) (n=95, 253 kg), KCA Gold Tag (GT) (n=90, 256 kg); requirements are similar to VAC45 and VAC34 programs, respectively. A third load included cattle purchased from local sale barns (SB) with no known history (n=88, 250 kg). Cattle were fed in adjacent pens in a commercial feedlot and were weighed, implanted and enrolled in the Rocky Mountain Ranch-to-Rail program following a three week warm-up period. Morbidity rates were 31.6%, 36.7% and 78.4% while medical costs (P<0.05) were $8.78, $9.30 and $10.27 per head for CPH, GT and SB, respectively. Mortality rates were 0%, 1.1% and 10.2%, respectively. Reimplant weight (RW) corresponded to VAC program hierarchy (P<0.05) being 386, 367 and 350 kg, respectively. VAC program did not affect average daily gain (ADG) (P>0.10) during the first implant period indicating that differences in RW were largely affected by initial adaptation and gain during the warm-up period. Steers were categorized by VAC program and number of hospital visits (HOSP): zero (H0), one (H1) and two or more (H2+); RW and ADG trends differed among these categories. RW and ADG was higher for SB and GT with H1 versus H0 or H2+. When considering CPH cattle, RW and ADG decreased with increasing HOSP, as such, H0 had the highest RW and ADG. These trends suggest that subclinical illness is increasingly detrimental with non-preconditioned cattle. Results indicate that VAC programs reduce morbidity and mortality rates while simultaneously improving performance. However, important differences exist among VAC programs with respect to morbidity rates, response to antibiotic therapy and subsequent performance.

Key Words: Cattle, Morbidity, VAC Programs

484 Performance of steer calves fed normal or high oil corn harvested as grain or whole plant silage. K. S. Hendrix* and D. L. Lofgren, Purdue University, West Lafayette, IN.

The objective was to evaluate performance of steers fed two corn types (Normal (N) vs High Oil (HO)) with two feeding regimes (High Grain (HG) vs High Silage (HS)). On a 15% moisture basis, HO corn contained 8.2% oil compared to 3.9% oil for N corn. Thirty days postweaning, 84 Angus or Simmental sired calves (304 kg) were randomly allotted by weight and breed type into 12 pens of 7 hd. The HG diet consisted of 75% corn, 15% corn silage and 10% supplement. The HS diet consisted of 90% corn silage and 10% supplement. The grain or silage in each diet was either HO or N. After 90 days, cattle on the HS diet were gradually converted to the HG diet. Diets were fed until it was estimated by visual appraisal that gain (kg) of 75% of cattle would grade low choice or higher. Cattle on the HG diet were fed an average of 182 d vs 206 d for HS cattle. Live weights at 90 days and at harvest were shrunk 4% for computation of gain, feed/gain and carcass dressing percent. There was no significant (P>0.10) effect of corn type and no significant (P>0.10) interaction between feeding regime and corn type for parameters measured. Daily gain (kg) for days 1-90 and 1-185 was significantly affected (P<0.01) by feeding regime (1.31 vs 1.06 and 1.39 vs 1.30 respectively for HG and HS cattle). Feed/gain was significantly affected

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by feeding regime for days 1-90 (6.93 vs 7.95 for HG and HS cattle, P < 0.05) and days 1-harvest (7.12 vs 7.81 for HG and HS cattle, P < 0.10). Cattle fed HS for 90 days had heavier carcasses (373 vs 362 kg, P < 0.05) and less backfat (.21 vs .26 cm, P < 0.05) compared to cattle fed HG. Dressing percentage, rib eye area, yield grade, and marbling were not significantly influenced by feeding regime. Feeding regime (high silage for 90 days vs high grain feeding throughout the feeding period) had a greater influence on feedlot performance than did oil level of corn grain. There was a trend for cattle fed HO corn to have slightly more rapid and efficient gains than cattle fed N corn, but performance differences were not significant in this study.

**Key Words:** High Oil Corn, Corn Silage, Beef

### 485 Effect of corn harvest technique on harvest yield and costs, beef yield, feeding costs and price received for corn when fed to beef steers.

T. M. Vanzant* and K. S. Hendrix, *Purdue University, West Lafayette, IN.*

Corn acreage was harvested as four different corn products: 1) Whole-plant corn silage (CSP), 2) High-moisture snapped corn (SCP), 3) High-moisture ground ear corn (GECP) and 4) High-moisture shelled corn (HMC). Dry matter yield as a percent of corn grain yield was 204, 119, 104.5 and 100 percent for CSP, SCP, GECP and HMC, respectively. Harvest cost (labor and fuel) per dry ton was highest for the CSP followed by the GECP, SCP and least for the HMC. Harvested products were ensiled and fed to weanling, medium-framed, crossbred steers with 96 head in Experiment 1 and 128 head in Experiment 2. In both experiments, steers were blocked by weight and randomly allotted to 1 of 4 treatments in a complete randomized block design. The treatments were: 1) whole-plant corn silage from cows of five genetic types (n = 150) at one location at calf weaning in percent lean and ancestry were used to evaluate carcass characteristics and pork quality under two rearing environments and two vaccination/antibiotic treatments. Yorkshire-Landrace sows were bred to Yorkshire-Landrace boars (SEW) or conventionally weaned in a continuous flow environment (EUR). Sows were not significant in this study.

**Key Words:** High Oil Corn, Corn Silage, Beef

### 486 Evaluation of cattle breeds for an IgG assay specific to venom of the red imported fire ant (Solenopsis invicta Buren).

J. E. Powell*, A. D. Herring, G. P. Austin*, L. J. Gershwin, S. P. Jackson, and J. O. Sanders, *1Texas Tech University, Lubbock, 2University of California, Davis, 3Texas Agricultural Experiment Station, College Station.*

The objective of this study was to evaluate possible differences across genetic types of cattle in regard to immune response related to the red imported fire ant (RIFA). A bovine IgG ELISA specific to fire ant venom was developed to assess immune response. Blood serum was collected from cows of five genetic types (n = 150) at one location at calf weaning in 1998. Cows were Angus (A), Hereford (H), Brahman-British F1 (BBF1), Boran-British F1 (BOF1) and Tuli-British F1 (TUF1). On each ELISA plate, fetal bovine serum was run as a negative control (NEG) and an aggregate of bovine sera from several different crossbred cows exposed to RIFA was run as a positive control (POS). On each plate, optical density (OD) was recorded for each cow along with that of the NEG and POS. Two corrections were applied to account for variation between plates, one relative to NEG and one relative to POS. Each cow IgG OD value was multiplied by the ratio of the overall POS to the POS of that plate and analyzed (IGGP). Also, each animal IgG OD was deviated from the NEG for its plate and analyzed (IGGN). IGGP and IGGN were analyzed by analysis of covariance with breed and the regression on cow age (in years) as independent variables. Breed differences were seen for IGGP (P < .01) and IGGN (P < .001). Regression on cow age was significant for IGGP and IGGN with increasing OD values as age increased. Across all cows, the simple correlation between IGGN and cow age was .33 (P < .001). Correlations of cow IGGP and IGGN with calf weaning weight (WWT) and adjusted weaning weight (ADJWWT) were not significant in A, H, and BBF1 cows, but had negative signs. Correlations of cow IGGP and IGGN with WWT and ADJWWT were positive in BOF1 and TUF1 cows, but only significant in TUF1 cows. These results indicate possible genetic differences among cattle for RIFA immune response.

**Key Words:** Red Imported Fire Ant, Immune Response, Cattle

### 487 Recruitment of the red imported fire ant (Solenopsis invicta Buren) by different livestock feeds.


The objective of this study was to evaluate recruitment of red imported fire ants (RIFA) to various livestock feeds. Recruitment was investigated in three areas of Texas with one site in Taylor, Smith and McMennan counties. Feeds evaluated were extruded whole cottonseed (EWC), cottonseed meal, a horse and mule ration, a cow calf ration and a commercial cat food (CAT) previously used by researchers for RIFA recruitment. One-g samples of each feed were placed into plastic bait cups. At each location bait cups were placed in a 6 x 6 latin square arrangement with two cups of each feed placed on their sides. Bait cups were recovered after 15 and 30 minutes. Each data set was collected, each site was evaluated for ant mound density and activity. To approximate a normal distribution, the log of ant count per cup was the dependent variable. Data were analyzed through analyses of variance where feed, pasture, feed x pasture, row within pasture and column within pasture were independent variables. Row within pasture was used as the error term. Pasture differences were observed for feed (P < .001), pasture (P < .001) and feed x pasture (P < .05) for ant count after 15 (AC15) and 30 minutes (AC30). CAT had the highest AC15 per cup in five of seven pastures (20.3 to 74.5,) and EWC had highest AC15 in the other two (24.2 to 67.7). EWC had the highest AC30 in six of seven pastures (69.3 to 236.2) and CAT had the highest count in one pasture (17.5). Across all pastures, CAT and EWC had similar AC15 (36.6 and 35.7, respectively) with others ranging from 3.2 to 9.5 ants per cup. For AC30, EWC averaged 114.0. CAT averaged 56.2 and the rest ranged from 1.7 to 15.8. All pastures had higher ant counts at 30 minutes versus 15 minutes except one. AC15 per pasture ranged from 6.0 to 32.2, whereas AC30 per pasture ranged from 3.8 to 57.5. Density of RIFA mounds across pastures ranged from 64 to 197 per ha, but did not match exactly with AC15 or AC30.

**Key Words:** Red Imported Fire Ant, Recruitment, Livestock Feed

### 488 Evaluation of genotype, therapeutic antibiotic and health management effects on swine carcass characteristics and pork quality.

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Two hundred eighty eight pigs from two genetic populations differing in percent lean and ancestry were used to evaluate carcass characteristics and pork quality under two rearing environments and two vaccination/antibiotic treatments. Yorkshire-Landrace sows were bred to U.S. Duroc sires selected for high liveweight gain/day EPDs (Y/Dur). European Landrace-Large White/Duroc sows were mated to European Duroc-Hampshire sires (EUR). Four pigs per litter were cross-fostered with Landrace and early-weaned into an isolated environment (SEW) or conventionally weaned in a continuous flow environment (CON). All pigs received medication up to 51d of age. Half of the pigs were vaccinated (VAC) for mycoplasma hyopneumonia at 30 and 44d of age and fed antibiotics throughout the finishing period (Pulmotil®, Tylan®), or received no vaccination nor medication during finishing (CT). At slaughter, measurements of loin eye area, backfat thickness and vertical uniformity score were recorded for each. Loin and 124 pigs were recovered for Hunter Color Lab scoring, driploss and taste panel analysis. The CON environment pigs had less 10th rib backfat (19.8 vs. 21.3 mm; P < 0.05), and less loin eye area (46.5 vs. 47.7 cm²; P < 0.05) but similar percent lean when compared to the SEW pigs. Y/Dur pigs had higher 24-hour pH (5.58 vs. 5.48; P < 0.01), lower percent driploss (1.6% vs. 3.6%; P < 0.01) and 32% increase in intramuscular fat (IMF: 2.08 vs. 1.76) content than the EUR pigs (P < 0.01). The SEW environment had lower 24-hour pH readings (5.47 vs. 5.60; P < 0.01) and showed...

National Pig Development barrows (n = 1,133) from an off-site Salmonella positive nursery were weighed, individually identified and assigned, by weight, to 36 pens. Each pen of 29 to 32 pigs had pigs of similar minimum and maximum weight and similar variation among pens. Maximum variation within a pen, rather than minimum, allowed progressive selection of the heaviest one-third of pigs for slaughter from each pen after a 12-h feed withdrawal. Slaughter close-out of a barn of pigs where the heaviest third in the barn are sequentially taken to slaughter. Treatments were allocated in a 3 by 3 factorial arrangement of 0, 12, or 24 hours feed withdrawal either once, twice, or three times, prior to ship-ment, were allocated at random, blocked on pen prevalence of Salmonella spp. as determined from fecal sampling in May and June. At slaughter carcasses were evaluated for muscle quality; tenderness, juiciness, backfat weight, gastrointestinal tract lacerations, salmonella, and gastric ulcers. Carcasses were identified by tattoos and evaluated for ultimate pork quality at 24 h post slaughter. Muscle quality measures included ultimate pH (pHu), Japanese Color Score, (JCS), Minolta Color (L*, a* and b*) and water holding capacity (WHC) as evaluated by filter paper absorption of excess fluids determined by weight increase. One chop was cut from each carcass at the tenth rib location. Withdrawal of feed for 0, 12, and 24 h prior to slaughter resulted in linear improve-ments in pHu (5.63, 5.65, and 5.66 ± 0.1; P < .05), JCS (2.99, 3.17, and 3.14 ± .06; P < .1), WHC (894, 915, and 819 ± 30 mg; P < .1), and Minolta L* (53.1, 52.9, and 52.3 ± 2; P < .05). However, repeated feed withdrawal over one, two, and three weeks resulted in linear (P < .01) and quadratic (P < .01) reductions in muscle quality as measured by pHu (5.70, 5.63, and 5.61 ± 0.1), WHC (628, 1,094, and 909 ± 31 mg) and Minolta L* (50.5, 54.3, and 55.3 ± .3). These results suggest that on-farm withdrawal of feed for 24 h prior to slaughter enhances ultimate pork quality. However, in a graded marketing situation repeated withdrawal of feed over time can reduce ultimate muscle quality.

Key Words: Pigs, Weaning, Growing

491 Impact of wean-to-finish facility management on weaned pig performance in the nursery phase. M. C. Brumm1, A. K. Baysinger2, E. T. Clemens1, and R. W. Wills1, 1University of Nebraska, Concord, NE, 2Alpharma, Inc., Ft. Lee, NJ.

An experiment was conducted to determine the impact of a wean-to-finish housing system on pig performance during the nursery phase. Treatments (four replicates in each of two trials) were 1) wean-to-finish (WF) in 2.4 m x 4.3 m pens (15 pigs/pen), b) double stock (DS) in 2.4 m x 4.3 m pens (30 pigs/pen), and c) nursery (N) at .35 sq m/pig (15 pigs/pen). The WF and DS pens were randomized in a fully slatted, naturally ventilated finishing facility with cement slats. Supplemental heat was provided by means of floor mats and suspended heat lamps in the desired sleeping area of the pen. The N pigs were on 5 ga woven wire flooring in a mechanically ventilated nursery facility with heat provided by unvented propane fired furnaces. The 15 pig pens were provided with two feeder spaces, each measuring 35.6 cm wide, and one cup drinker. The DS pens had four feeder spaces and two drinkers. PIC barrows (1.8 kg initial wt) from a single source weaned at 14-18 days of age were transported to the research site at weaning for the 8-wk trial. Commercially available nursery diets were fed. WF pigs were heavier at 8 wk (27.0 vs 25.5 kg, P <.05), grew faster (.397 vs .370 kg/d, P <.05) and ate more feed (.654 vs .605 kg/d, P <.01) with no difference in feed conversion compared to DS pigs. N pigs were intermediate for live weight, daily gain and daily feed intake. There was no effect of treatment on weight variation at 8 wk as measured by CV of within pen weight for any treatment.

Key Words: Segregated early weaning, Biosecurity, Taiwan

492 Ten-year (1986-1995) breeding productivity of U.S. commercial swine recorded in PigCHAMP database. J. L. Xue*, University of Minnesota, St. Paul, MN.

Ten-year (1986-1995) breeding data recorded in PigCHAMP were used for investigation of herd productivity of U.S. commercial swine. The data included 1,476,631 sow-year (average female inventory) and 4,409 herd-year. An observational unit was a herd. Pearson correlation (CORR) and general linear model (GLM) in SAS were used to deter-mine relationships between production parameters in the 10-year period. Year, pigs weaned per litter (PL), and litters per sow per year (LSY) were included in the model as independent variables for pigs weaned per sow per year (PSY) (a dependent variable). Year, born alive litter size (BA), and preweaning mortality (PWM) were included in the model for PL. Year, farrowing rate (FR), average herd weaning age (WA), and average nonproductive sow days (NPD) were included in the model for LSY. Year was treated as a categorical variable. All other variables were continuous. Correlation coefficients between PSY and PL and between PSY and LSY were -.9005 (P <.0001) and -.8574 (P <.0001), respec-tively. Correlation coefficients between PL and BA and between PL and PWM were .6003 (P <.0001) and -.4818 (P <.0001), respectively. Coefficients between LSY and FR, between LSY and WA, and between LSY and NPD were .4520 (P <.0001), .3545 (P <.0001), and -.5000 (P <.0001), respectively. There was a trend that PSY (mean = 19.2) decreased (P <.05) in the 10-year period though no decreased PL (mean = 8.9), BA (mean = 10.0), and PWM (mean = 13.2%) were observed (P >.05) in the period. There was a trend that LSY (mean = 2.2) was decreased (P <.05) in the 10-year period. Accordingly decreased (P <.05 ) FR (mean = 79.2%) and AW (mean = 22.5 d) and increased (P <.05) NPD (mean = 86.5 d), percentage of repeated service (mean = 9.1%), and sow mortality (mean = 3.7%) were observed in the 10-year period. Herd size (mean = 345 sows) continued to increase in the 10-year period. This study demonstrated that during the period of 1986-1995...

The objective was to determine the effect of feed withdrawal on ulceration of the pars esophagea in swine. National Pig Development barracks (n=1133) were weighed and assigned by weight to 36 pens (29-32 pigs/pen of similar maximum and minimum weight) with similar variation among pens. The design was a 3x3 factorial with treatments of 0, 12 and 24 h of feed withdrawal either 1, 2 or 3 times (1x, 2x and 3x, respectively) prior to shipment. Shipments from each pen were about 1 week apart. The third heaviest pigs in each pen, assessed visually, were selected for slaughter on the first week, the next heaviest on the second week and the lightest pigs on the third week. Transport and lairage time were constant for all groups (about 5 h). Gastrointestinal tracts (n=752) were identified before evisceration. The pars esophageal region was scored from 1 (normal) to 7 (completely ulcerated) and evaluated for presence of chronic ulcers and constrictions of the esophagus. The average ulcer scores for 0, 12 and 24 h withdrawal were 3.8, 3.6 and 4.0 (P<0.005), respectively; however, there was no difference between stomachs from pigs on 0 vs 12 and 24 h withdrawal. The average scores for 1x, 2x and 3x were 3.6, 3.8 and 4.1 (P<0.001), respectively. Overall, prevalence of chronic damage was 17.6% with 59.9% of chronic damage in stomachs from animals on the 3x treatment. Overall, prevalence of esophageal constrictions was 9.6% with 72.2% of esophageal constrictions in stomachs from animals on the 3x treatment. Prevalence of chronic damage and esophageal constrictions was not affected by the length of feed withdrawal. Ulcer scores were grouped as mild (1-3.5), moderate (4-5.5) and severe (6-7). Prevalence of severe ulcers was 13.7%. There was an interaction (P<0.01) between the effect of length of feed withdrawal and number of times for carcass weight. Both chronic damage (P<0.01) and esophageal constrictions (P<0.001) increased as carcass weight decreased, most notably for the lowest quartile. Feed withdrawal prior to slaughter did not increase ulcers.

Key Words: Pigs, Ulcers

494 Development of a generalized selection index for profit in Angus sires. W. O. Herring1, V. Pierce1, M. D. MacNeil2, and L. L. Benysek1, 1University of Missouri, 2USDA Agricultural Research Service, 3University of Georgia.

While EPDs have been used for improvement in single traits, strategies are needed to aid producers in multiple-trait selection. Therefore, the objective of this study was to develop a multiple-trait selection index to improve profit for a defined production scenario. Twenty-six Angus sires were randomly mated to commercial Angus females resulting in 675 steer progeny production and carcass records after edits. EPDs were calculated for birth weight, weaning weight, post-weaning average daily gain, marbling score, yield grade and fertility. To estimate relative economic values (REV) for each trait, a bio-economic simulation was performed using the software SIMULATE 3.0. Cost estimates were derived from enterprise budgets developed over the last ten years from The University of Missouri Extension for a cow/calf operation. Cull cow price estimates were determined from USDA Market News 10 year average Oklahoman City price estimates and forecasted 10 year averages based on USDA Market News reports. Carcass quality grade, yield grade, and off-grade price estimates were based on National Carcass Premiums and Discounts For Slaughter Steers And Heifers as reported by USDA Market News service. Backgrounding and feeding cost estimates were based on 10 year average Kansas State University Extension Monthly Performance, Cost of Gain, and Breakeven Prices. The REV estimation procedure included simulating a base herd and then comparing outputs to subsequent simulations driving the variable of interest up by one unit and comparing the differences in profit. Sire differences in profit per progeny were then estimated as the product of each trait EPD with its respective REV. From the twenty-six sires, there was a range of $39.81 from the top to the lowest ranking bull. If these bulls typify the average genetic profile that exists within the Angus breed, differences exist in profit potential.

Key Words: EPD, Profit, Selection index

495 Effects of trainer cows on the health, performance and behavior of newly weaned calves. D. J. Gibb1, K. S. SchwartzkopfGenswein2, J. M. Stookey3, T. A. McAllister1, and R. D. Wiebeimer1, 1Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB, 2Alberta Agriculture, Food and Rural Development, Lethbridge, AB, 3University of Saskatchewan, Saskatoon, SK, 4Utah State University, Logan, UT.

Experiments were conducted to investigate the effects of cow presence on performance, health, behavior and feeding patterns of newly weaned calves. Trial 1 included 297 recently weaned calves (258 ± 17 kg) placed in 22 pens and assigned to trainer cow (TC; one cow/pen) or no cow (NC) treatments. Antibiotic treatments were monitored throughout the trial; weights and rectal temperatures were recorded on d 0, 3, 7, 14, 21, and 28. Blood was drawn on d 0, 3 and 7 for analysis of haptoglobin, white blood cells (WBC) and neutrophil:lymphocyte (NL) ratios. Visual observations were made at 10-min intervals between 0730 and 1700 on d 1, 2, 4, 5 and 6 to monitor calf behavior. Trial 2 included the same measurements as trial 1 (excluding haptoglobin) and used radio frequency technology to monitor bunk attendance of 60 newly weaned calves (269 ± 17 kg). Trainer cow presence did not influence rectal temperatures or antibiotic treatment rates. Haptoglobin levels, WBC counts and NL ratios differed (P < 0.05) between days but were unaffected by cow presence. Significant but inconsistent treatment responses in ADG were observed among weighing periods, but there was no effect over the 28-d trials. Differences in frequency or duration of bunk visits between NC and TC were not detected, although one TC calf did not attend the feed bunk until d 11. Visit frequency and duration differed among weighing periods; they increased (P < 0.01) from 9.6 visits/d and 56.7 min/d between d 0 and 3, to a high of 12.3 visits/d and 108.9 min/d between d 15 and 21. Calves in TC pens were observed lying less frequently (P < 0.01) and standing more frequently (P < 0.001) than NC calves. Although trainer cow presence modified calf behavior, it did not enhance calf health, frequency or duration of bunk visits, or growth rate through the trials.

Key Words: Beef, Weaning, Calf behavior

496 Effects of feeding supplemental fat during gestation on reproduction in primiparous beef heifers. R. A. Bellows1, D. D. Simms2, E. E. Grings3, D. A. Phelps1, S. E. Bellows1, N. R. Bellows1, R. E. Short1, R. N. Funston1, and T. W. Gearsy1, 1USDA-ARS and Montana Agri. Exp. Sta., Miles City, MT, 2Consolidated Nutrition, Omaha, NE.

Primiparous, crossbred beef heifers (n = 149) calving in three calving seasons (February, April, or June) were assigned randomly to one of four gestation diets: Control or added safflower seeds, soybeans, or sunflower seeds. Oil seeds were processed through a roller mill to crack hulls in approximately 90% of seeds but without oil loss. Diets were isocaloric-isonitrogenous and contained 2.0, 4.2, 3.3, or 4.5% fat, respectively. Diets were group fed in dry lot and were fed for an average of 65.3 d precalving. Heifer weights and body condition scores (1-10) were obtained throughout the study; estrous cycling activity was based on progesterone content of blood samples obtained at begin breeding; pregnancy was determined by ultrasound at 60-90 days following 35-37 d estrous-synchronized breeding seasons. Calf data included birth weight, calving ease, sex, and weaning weight. Data were analyzed by SAS-GLM within and pooled over calving seasons. Effects of fat supplementation on dam weight or condition scores throughout the study were nonsignificant as were effects on birth weight, calving ease, and dam estrous cyclicity at begin breeding. Heifers from fat supplemented groups had greater pregnancy rates (P<0.05) and calf weaning weights (P=0.09): Control, 79%, 182.4 kg; safflower seeds, 94%, 193.6 kg; soybeans, 90%, 197 kg; sunflower seeds, 91%, 213.6 kg (mean values pooled over calving seasons). We conclude fat supplementation of the gestation diet in primiparous heifers resulted in positive increases in dam pregnancy rates and tended to increase calf weaning weights.

Key Words: Cattle, Gestation, Fat Supplement

The purpose of this study is to test the hypothesis that readily available information to cow-calf producers, including dam pelvic width (PW), pelvic height (PH), and the fetal coronet band (CB) measurements, can be used to better predict calving ease (CE) scores of first-calf heifers. Data were collected over a 3-year period (684 observations) from heifers on a commercial cow-calf operation, under supervision of a practicing D.V.M. For quality assurance, when feasible, descriptive statistics of the data were compared to, and found to be consistent with, published results. A recursive systems model of two equations was estimated, consisting of a linear model used to predict birth weight (BW) based on the CB measurement and an ordered logit model used to predict a calving ease score from BW and pelvic dimensions of the dam. The linear model demonstrated that BW could be predicted using the CB measurement, where the intercept and slope coefficients were significant at P = 0.001, the model R² = 0.57, and the standard error of the predicted BW was equal to 2.77kg. To account for unordered categorical data in the CE variable an ordered logit model was estimated, which correctly predicted 468 of 684 (68.4%) of the CE scores. Consistent with previous research, male calves significantly increased the probability of calving difficulty. New findings indicate that BW and PW, and the interaction between them, were statistically significant and nonlinearly related to CE. These findings have the potential to provide information that helps producers better balance the economic tradeoffs existing during the birthing process. The technique adopted by several large-scale cow-calf operations in Montana is to predict the level of calving difficulty of a first calf heifer using CB and PW measurements, early in the second stage of parturition. Then, use this information to make more timely and informed decisions that may include obtaining veterinarian assistance. The objectives of this study were to compare hCG to GnRH for synchronization and conception rates of cows synchronized with the Select Synch protocol. Data were collected at one location over a two-year period where cows were bred AI or received embryos (ET). Beef cows (n = 413) were randomly assigned to receive either 2000 IU of hCG (n = 197) or 100µg of GnRH (n = 216) i.m. on d 0 and PGF2α on d 7. Visual observation (3 x daily) was used to identify estrual cows from d 7 to d 12. Cows that exhibited estrus were artificially inseminated (n = 112) approximately 12 hr after initial observation of estrus or received frozen embryos 7 days after estrus (n = 98). Transrectal ultrasound was used prior to ET to determine the presence of corpora lutea. Cows without a visible luteum (n = 8) did not receive an embryo. Six of the eight cows without corpora lutea were hCG treated. Body condition scores were recorded for cows at time of breeding. Bulls were placed with cows in breeding pastures 10 d after the last insemination. Peak estrous response occurred 3 d after PGF2α for both GnRH and hCG treated cows; however, a higher (P < .05) percentage of GnRH treated cows (58%) were observed in estrus than hCG treated cows (46%). Body condition scores did not differ (P > .1) among drug treatment groups, but cows that displayed estrus to either synchronization treatment had a higher (P < .05) body condition score. Conception rates of GnRH (68%) and hCG (62%) treated cows receiving AI were not different (P > .1) nor were conception rates of GnRH (42%) and hCG (35%) treated cows receiving frozen embryos. Conception rates tended (P > .1) to be lower among hCG treated cows than GnRH treated cows. We conclude that hCG is not an effective replacement for GnRH to induce estrus and does not increase conception rates to the Select Sync protocol when used with AI or ET.

Key Words: Beef heifers, Dystocia, Ordered logit
501 The effects of reproductive management systems on luteinizing hormone, estradiol 17-β, cortisol and β-endorphin in mares. C. M. Brady1, C. D. Corn2, J. E. Shelle3, A. J. Zanella4, J. V. Matters5, F. Hüttermann5, B. J. Mertens6, P. Fuglie7, 8 Purdue University, W. Lafayette, IN; 2Michigan State University, E. Lansing, MI.

Feral mares have greater reproductive success than domestic mares. Among domestic mares, reproductive success is associated negatively with increased cortisol and β-endorphin. We hypothesized that management systems with high human involvement would increase secretion of cortisol and β-endorphin to mediate decreased secretion of estradiol 17-β (estradiol) and luteinizing hormone (LH) in mares. Our objective was to determine if different reproductive management systems affect estradiol, LH, cortisol and β-endorphin in mares. Twenty-four Arabian mares were assigned to one of three management systems. Pasture bred mares were maintained on pasture with an experienced stallion. Hand mated mares were bred every other day throughout behavioral estrus. Artificially inseminated mares were examined every other day with ultrasonography until the largest follicle was greater than 35mm. Mares were then examined by ultrasonography and artificially inseminated daily until ovulation. Cortisol, β-endorphin, estradiol and LH in plasma were quantified by radioimmunoassay. β-endorphin concentrations did not differ among treatment groups. Estradiol concentrations tended (P<0.07) to be higher in hand mated and pasture bred mares than in artificially inseminated mares. LH concentration was higher (P<0.0005) in hand mated mares than in artificially inseminated or pasture bred mares. Estradiol concentration in artificially inseminated was higher (P<0.05) than in pasture bred mares. Estradiol concentrations in hand mated mares did not differ from artificially inseminated or pasture bred mares. Among treatment groups, cortisol concentrations were not correlated (P<0.08) with LH or estradiol concentrations. Management system caused changes in estradiol and LH, but cortisol or β-endorphin apparently does not mediate these changes. These changes in LH and estradiol probably do not explain the differences in reproductive success between domestic and feral mares.

Key Words: Mare, Reproductive Management, Fertility

502 Parasite resistance and physiological responses of hair and wool X hair lambs in a tropical environment. R. W. Godfrey1, H. A. Buroker, and B. M. Panagl. Agricultural Experiment Station, University of the Virgin Islands, St. Croix.

Parasite resistance and packed cell volume (PCV) were evaluated in St. Croix White (n = 12; SCW) and Polypay x SCW (n = 13; PSC) lambs while on pasture. Lambs were placed in a .5 ha guineagrass pasture 2 wk after weaning (63 d). Anthelmintic was administered 10 d prior to entering the pasture. Fecal samples were collected weekly for 56 d to determine fecal egg count (FEC). Prior to analysis data was transformed using log10(FEC + 1) (FEC10). On the days of fecal collection a blood sample was collected to determine PCV. At 128 d of age, 6 lambs per breed were subjected to behavior tests. Lambs were placed in partially shaded pens at 0900 and water was withheld for 4 h. Lambs were then placed individually in J X 6 m pens with 30% of the pen shaded. Water (3 L) was placed in the shaded portion of the pen. Lambs were observed for 2 h, and animal location in pen was recorded at 5-min intervals. Immediately prior to and after the 2 h test, rectal temperature (RT) was measured in each lamb. Data were analyzed using SAS procedures. Crossbred lambs were heavier than SCW lambs throughout the entire grazing period (P < 0.0007). There was no breed effect (P > 0.10) on either FEC10 or PCV. Both groups of lambs had increased (P < 0.0001) in FEC10 by 35 d after the first anthelminic treatment. Values for PCV began decreasing (P < 0.0001) by 28 d after anthelminetic in both groups. At 7 d after administration of a second anthelminetic FEC10 declined (P < 0.0001) and PCV increased (P < 0.001) in both groups. Hair lambs had lower RT (P < 0.005) than PSC lambs (39.6 ± 1 vs 40.1 ± 1°C, respectively). Crossbred lambs consumed less water (P < 0.05) than SCW lambs (189.2 ± 50.2 vs 255.8 ± 53.1 mL, respectively) and spent a higher (P < 0.001) proportion of time in shade. These data show that neither SCW nor PSC lambs are parasite resistant under pasture conditions found in the tropics. The elevated RT of crossbred lambs may be due in part to their lower water intake and heavier fleeces.

Key Words: Sheep, Parasites, Breed

503 Effects of supplementing ewes with D-α-Tocopherol on lamb serum and ewe colostrum immunoglobulin concentration, and preweaning lamb growth. C. M. Bridgman1, T. T. Ross, M. W. Salobry, and L. Melton, New Mexico State University, Las Cruces, NM USA.

Two experiments were conducted to determine if supplemental d-α-tocopherol (Vit E) given to ewes prepartum would enhance lamb serum or colostrum immunoglobulin (IgG) concentrations or lamb preweaning growth. Eighteen Suffolk Virgin Commercial (Vit) E (controls) or 1500 IU Vit E administered subcutaneously 28 days prior to parturition. At parturition, 25 ewes (12 control and 13 Vit) were selected for intensive sampling. Immediately following parturition, a blood sample was taken from the 25 ewes and neonatal lambs via jugular veinpuncture. Subsequent samples were taken from the lambs and colostrum from the ewe hourly through 12 h postpartum. Immediately following birth, lambs were dosed via stomach tube with 60 mL of colostrum from the dams to ensure initial equal consumption. All lambs were weighed at birth, 14, 28, and 42 d postpartum. Suplemental Vit E did not alter colostrum (P = .25) or ewe serum (P = .16) or lamb serum (P = .04) IgG concentrations. Also, supplemental Vit E did not influence (P = .1) gain in lambs preweaning. However, when the 25 lambs used in the intensive collection were evaluated separately, those born to Vit E ewes had higher (P = .02) average daily gain through 60 days than lambs born to control ewes. Experiment 2 was conducted at the Corona Range and Livestock Research Ranch and included 200 pregnant Western White Face ewes. Ewes were assigned to two treatments previously described with ewes receiving the Vit E at approximately 40 d prepartum (shearing). Lambs were gained and weighed at 45 d postpartum (flock average). Lambs from Vit E ewes were heavier (P = .03) at 45 d compared to lambs born to control ewes. However, this advantage was lost by 90 d postpartum. Therefore, vitamin E supplementation prepartum may improve early preweaning growth of lambs, especially when lambs have been stressed by intensive handling or environment under range conditions. However, 90 d weights are unaffected.

Key Words: Sheep, Immunoglobulins, Growth

504 Weaning and rearing systems for American dairy sheep. B. C. McKusick1, Y. M. Berger1, and D. L. Thomas1, University of Wisconsin-Madison.

A flock of 132 East Friesian (EF) crossbred ewes and their lambs were used to study the effects of three weaning / rearing systems on milk production and lamb growth. During the first 30 d of lactation, ewes were either weaned from their lambs at 24 h and then machine milked twice daily (DY1), separated from their lambs for 15 hours during the evening and machine milked once daily in the morning (MIX), or not machine milked and allowed access to their lambs (DY30). After 30 d, MIX and DY30 ewes were weaned, and ewes in all three groups were machine milked twice daily. Commercial milk yield and milk composition were recorded weekly until mid-lactation and then twice monthly until dryoff. Average lactation length (suckling + milking periods) was 176 d and was similar between weaning systems. Total commercial milk production differed (P < .005) between weaning systems (240, 205, and 149 L/ewe for DY1, MIX, and DY30 systems, respectively). During the first 30 d of lactation, commercial milk production, percentage of milk fat and protein, and log-transformed somatic cell count (SCC) were lower (P < .05) for MIX ewes than for DY1 ewes (42 and 70 L/ewe of milk; 3.24 and 4.88% milk fat; 5.36 and 5.52% milk protein; 4.65 and 4.91 log SCC, respectively). Litter size was a significant source of variation for most lactation traits, however parity and proportion of EF breeding tended not to be significant. Ewes put on a legume-grass pasture in mid-lactation had greater (P < .05) milk production than ewes fed in drylot. Growth traits of 272 twin-or-greater-born lambs sired by EF or Texel rams were estimated for three rearing systems. Lambs were either raised artificially (ART), allowed access to their dams for nine hours per day (DY30), or allowed unlimited access to their dams (TRAD) for approximately the first 30 d of age. Lamb weights at 30 d were similar, however at 120 d, TRAD lambs were heaviest (P < .05) compared to ART and MIX lambs (47.8, 43.6, and 45.5 kg, respectively). Sex, birth type, sire breed, dam breed, and dam age were significant sources of variation for at least one growth trait. From a simplified economic analysis, the MIX/LMIX system produced the greatest financial returns from milk and lamb production.

Key Words: Dairy Sheep, Milk Production, Lamb Growth
Lactation performance of 16, fall-lambing Polypay ewes (75 kg), each nursing twin lambs and treated with 240 mg of recombinant bovine somatotropin (bST or sometribove, n=8) or an oil placebo (CON, n=8), was evaluated in a 66-d experiment. Preweaning lamb growth was also measured. Estimated 24-h milk production was higher for bST ewes than for CON ewes by d 45 (2685 vs 2005 g; P < .01). The bST ewes continued to produce more milk on each of the remaining collection days [d 52: 2685 vs 2005 g (P < .08); d 59: 2349 vs 1609 g (P < .01); d 66: 2002 vs 1331 g (P < .01)]. Total milk production (d 24 through 66) was 14.4 kg greater (P < .05) for the bST ewes. Milk production was more efficient for bST ewes on d 45 (46 vs 51; P < .05), 59 (58 vs .41; P < .01), and 66 (49 vs .34; P < .05). With respect to lactation persistency, milk yield decreased at a slower rate for bST ewes (121 vs 207 g/d; d 7; P < .05) from d 24 through 66. Milk fat and DM contents were similar for both groups; however, milk protein content was lower (P < .01) for bST ewes on d 45 and 59. Neither ewe weight nor body condition was affected by bST treatment. Creep feed intakes tended to be higher for lamb pairs nursing bST-treated ewes. These same lamb pairs were heavier (P < .08) on d 52 (38.4 vs 34.5 kg), 59 (42.8 vs 38.6 kg), and 66 (47.2 vs 42.6 kg).

Key Words: Ewes, Somatotropin, Lactation


The importance placed on hardiness in the Dorper breed in South Africa has led to the creation of veld ram clubs. In these clubs Dorper rams are performance tested under extensive condition from just after weaning. Animals are sold at an age of about 12 months. At these auctions breeders remain anonymous. The question that arises is, how much does the performance of the animals in the veld ram club influence the prices buyers are getting use of the auctioning percentage were similar (P > .05) among genotypes (32.4, 30.1, and 25.4 ± 2.1 kg; 27.5, 27.7, and 23.3 ± 3.0 kg; 15.0, 14.1, and 11.9 ± 1.0 kg; and 50.6, 51.2, and 51.6 ± 1.3% of empty BW for BS, BA, and S, respectively). Boer x Spanish had greater (P < .005) bone:lean ratio than either BA or S (.45, .50, and .50 ± .01, respectively). Genotype had no effect (P > .05) on percentage of lean or fat in the primal leg (averaged 66.9 ± 1.8% and 68.3 ± 9.7%, respectively). Boer crosses had a lower (P < .05) proportion of bone than S in the primal leg (22.5, 23.8, and 26.5 ± 9.2%, respectively). Boer and crossbred lambs had ad libitum access to guineagrass hay and water and were slaughtered at a weight of 30 kg. Hot and cold carcass weight, fat thickness over the 12th rib, rib eye area (REA) and percentage kidney-heart-pelvis (KHP) fat were measured. All data were analyzed by SAS procedures. St. Croix White and BBSC lambs were on feed longer (P < .07) than BBSC lambs (112.2 ± 5.4 vs 97.2 ± 5.8 d, respectively). Average daily gain was not different (P > .10) between breedtype, but wethers (n=14) gained faster (P < .001) than ewes (n=14) (164.4 ± 3.9 vs 137.1 ± 3.9 g/d, respectively). Feed efficiency was not different (P > .10) between breedtype or sex of lamb. St. Croix White ewes had the highest (P < .05) cost of gain and BBSC ewes had the lowest (3.21 ± 2 vs 2.35 ± 24 kg/d, respectively). Cold carcass weight was greater (P < .02) in ewes than in wethers (15.3 ± 2 vs 14.4 ± 2 kg, respectively). Percentage KHP was higher (P < .005) in SCW than in BBSC lambs (5.7 ± .3 vs 4.5 ± .3%, respectively) and higher (P < .0001) in ewes than in wethers (6.4 ± 3 vs 3.8 ± 3%, respectively). Fat thickness was greater (P < .01) in SCW than in BBSC lambs (.32 ± .02 vs .24 ± .02 cm, respectively) and greater (P < .01) in ewes than in wethers (.32 ± .02 vs .24 ± .02 cm, respectively). There was no difference (P > .10) in REA between breedtype or sex. These data show that crossbred lambs reached slaughter weight earlier and had leaner carcasses than purebred St. Croix White lambs.

Key Words: Sheep, Crossbreeding, Growth

508 Carcass characteristics and composition for Spanish and Boer crossbred goat kids. M. R. Cameron1, T. Sahlu1,*, G. Detweiller2, S. Hart3, and S. Coleman1, 1Kika de la Garza Institute for Goat Research, Langston University, Langston, OK, 2USDA/ARS Grazinglands Research Lab, El Reno, OK.

Eighteen Spanish (S), Boer x Angora (BA), and Boer x Spanish (BS) castrates were used to investigate the effects of genotype on carcass characteristics, body composition and distribution of carcass tissues. Kids were offered ad libitum a concentrate diet (25% CP, 2.71 Mcal DE/kg, 34.7% NDF, and 18% ADF). Animals were slaughtered at 212 ± 5 d of age. Live body weight (BW), empty BW, hot carcass weight, and dressing percentage were similar (P > .05) among genotypes (32.4, 30.1, and 25.4 ± 2.1 kg; 27.5, 27.7, and 23.3 ± 3.0 kg; 15.0, 14.1, and 11.9 ± 1.0 kg; and 50.6, 51.2, and 51.6 ± 1.3% of empty BW for BS, BA, and S, respectively). Boer x Spanish had greater (P < .005) bone:lean ratio than either BA or S (.45, .50, and .50 ± .01, respectively). Genotype had no effect (P > .05) on percentage of lean or fat in the primal leg (averaged 66.9 ± 1.8% and 68.3 ± 9.7%, respectively). Boer crosses had a lower (P < .05) proportion of bone than S in the primal leg (22.5, 23.8, and 26.5 ± 9.2%, respectively). Boer and crossbred lambs had ad libitum access to guineagrass hay and water and were slaughtered at a weight of 30 kg. Hot and cold carcass weight, fat thickness over the 12th rib, rib eye area (REA) and percentage kidney-heart-pelvis (KHP) fat were measured. All data were analyzed by SAS procedures. St. Croix White and BBSC lambs were on feed longer (P < .07) than BBSC lambs (112.2 ± 5.4 vs 97.2 ± 5.8 d, respectively). Average daily gain was not different (P > .10) between breedtype, but wethers (n=14) gained faster (P < .001) than ewes (n=14) (164.4 ± 3.9 vs 137.1 ± 3.9 g/d, respectively). Feed efficiency was not different (P > .10) between breedtype or sex of lamb. St. Croix White ewes had the highest (P < .05) cost of gain and BBSC ewes had the lowest (3.21 ± 2 vs 2.35 ± 24 kg/d, respectively). Cold carcass weight was greater (P < .02) in ewes than in wethers (15.3 ± 2 vs 14.4 ± 2 kg, respectively). Percentage KHP was higher (P < .005) in SCW than in BBSC lambs (5.7 ± .3 vs 4.5 ± .3%, respectively) and higher (P < .0001) in ewes than in wethers (6.4 ± 3 vs 3.8 ± 3%, respectively). Fat thickness was greater (P < .01) in SCW than in BBSC lambs (.32 ± .02 vs .24 ± .02 cm, respectively) and greater (P < .01) in ewes than in wethers (.32 ± .02 vs .24 ± .02 cm, respectively). There was no difference (P > .10) in REA between breedtype or sex. These data show that crossbred lambs reached slaughter weight earlier and had leaner carcasses than purebred St. Croix White lambs.

Key Words: Sheep, Crossbreeding, Growth


We conducted a four-site trial to study effects of estradiol benzoate (EB) and trenbolone acetate (TBA), singly or combined, on performance and carcass traits of finishing beef heifers. The design at each site was
randomized complete block with a 2 x 2 factorial arrangement of treatments. Study sites were in Alberta (n = 432, 12/pen), California (n = 288, 8/pen), Idaho (n = 360, 10/pen), and Nebraska (n = 288, 8/pen). At each site heifers were blocked on BW (initial BW = 371 kg), yielding nine blocks of four pens; within blocks, treatments were randomly assigned to pens. Heifers were sham-implanted, or received implants containing 28 mg EB, 200 mg TBA, or 28 mg EB + 200 mg TBA (Synovex Plus). Performance was measured for 105 to 112 d following treatment, then cattle were killed and carcass data were collected. Analysis of pooled data showed ADG by cattle implanted with Synovex Plus (1.56 kg/d) was superior (P < .05) to that by cattle implanted with EB (1.48 kg/d) or TBA (1.48 kg/d). The ADG by all implanted groups were greater than sham-implanted heifers (1.38 kg/d, P < .05). Compared to sham (.142) or EB (.146), gain/feed by heifers was improved (P < .05) by TBA (.154) or Synovex Plus (.158). Carcass weights (323 kg) and ribeye areas (85.6 sq. cm) were greater (P < .05) among cattle given Synovex Plus than other implants (EB: 315 kg and 82.2 sq. cm; TBA: 315 kg and 83.5 sq. cm), and implanted groups had higher (P < .05) carcass weights and ribeye areas than sham-implanted cattle (309 kg and 80.2 sq. cm, respectively). Marbling was reduced by all implant treatments (P < .05). Longissimus muscle color was highest among cattle implanted with Synovex Plus (P < .05), but incidence of dark cutters was uniform across treatments. Compared to controls, Synovex Plus reduced (P < .05) the portion of carcasses grading Choice and increased (P < .05) portions grading Select and Standard. Study results showed both EB and TBA contributed to the overall effects of Synovex Plus on ADG, carcass weight and ribeye area.

Key Words: Cattle, Anabolic, Implants

510 Whole vs. cracked corn in growing rations for steer calves. I. G. Rush*, B. A. Weichenthal, and B. G. Van Pelt, University of Nebraska, Scottsbluff, Nebraska, USA.

Crossbred steer calves averaging 256 kg initially were fed growing rations formulated for 13.0% CP and 1.01 Mcal/kg of NEg in the DM. Ingredients (DM basis) were: 22.8% corn silage, 48.7% alfalfa hay, 1.9% of a supplement to supply Rumensin at 23 g per ton, and 26.6% dry corn (850 g/kg DM) fed whole or cracked and fed in a total mixed ration or fed separately and cleaned up before feeding the other ingredients in the ration. The cracked corn was coarsely broken with a roller mill. Ration intakes were managed to be the same among treatments, with the mixed rations fed ad lib and setting the intake for the ration fed separate. Corn DMI averaged 2.3 kg/day. There were 3 pens per treatment and 9 or 10 steers per pen during a 120 day growing trial from January 31 to May 31. Daily gains and feed conversions were the same in the total mixed rations. Numerically, but not statistically different, the gain and efficiency of the cattle fed whole corn separate were slightly lower than cattle fed cracked corn. These data would indicate that economically it is doubtful if it would pay to crack corn no matter how it is fed.

Corn physical form

Cracked Corned Whole

Corn feeding method

Mixed Cracked Separate Mixed Separate P

No. of steers

29 29 28 29 29

Daily gain, kg

1.24 1.23 1.25 1.17 .42

Feed DM/day, kg

8.71 8.74 8.72 8.75 .99

Gain/feed

.142 .141 .144 .134 .20

Key Words: whole corn, cracked corn, growing cattle


One-thousand one hundred seventy two (1172) Holstein steers averaging 122 kg BW were randomly allotted to 18 pens and fed monensin at 23.4, 36.7, or 48.9 mg of diet DM in the final diet during a 370 d trial conducted by Bos Technica Research Services. A 3 ration step-up program was used to adapt the calves to the final diets. The final ration, fed from day 17 to slaughter was formulated to contain 1.46 Mcal NEg/kg, 15.5 % CP, 5.2 % CF, 6.9% EE, 0.67% Ca and 0.30% P. All calves were started on monensin at 24.4 mg/kg of diet DM with monensin level being increased 6.1 mg/kg of diet DM at each ration step. Cattle in the highest monensin treatment had additional monensin increases made on d 22 and 27. Tylosin was fed throughout the trial to all cattle at 90 mg/d. All animals were fed twice daily. Cattle pen weights were obtained for each pen at the start of the trial, reimplant time, and at slaughter. All animals which died during the trial were necropsied. Data were analyzed as a randomized complete block design using pen as the experimental unit. Orthogonal contrasts were conducted to evaluate linear and quadratic trends among monensin levels. No differences were noted in DM intake among treatments (7.02, 6.97, 7.01 kg/d; P = .63). Daily gain, expressed on a “deads and rejects out” basis, was greater (1.22 vs. 1.15 kg; P = .03) for steers fed monensin plus tylosin. The incidence of liver abscess was lower (22.2 vs. 25.5%; P < .01) for steers fed monensin plus tylosin. Total (3.0 vs. 5.4%; P = .03) and digestive (1.9 vs. 4.3%; P = .11) death loss was lower for steers fed monensin plus tylosin. These data demonstrate that animal performance was improved, while liver abscesses incidence and death loss were reduced in steers fed monensin plus tylosin.

Key Words: Monensin, Tylosin, Virginiamycin


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Key Words: Monensin, Tylosin, Virginiamycin

513 Effect of poultry blood meal on performance and carcass characteristics of feedlot heifers. B. H. Heiser, B. J. May*, D. R. Shelby, C. R. Engdahl, and C. B. Scott, Angelo State University, San Angelo, TX.

Fourty-four Brangus heifers were used to determine the effect of poultry blood meal as a protein source on the performance and carcass characteristics in a 140-d finishing trial conducted at the Angelo State University, Management, Instruction and Research Center in San Angelo, Texas. Heifers were blocked by weight and randomly assigned to one of two treatments with four replications of each treatment. Treatments consisted of a finishing ration with either (1) cottonseed meal as a control (CON), or (2) poultry blood meal (PBM) as the protein sources. All heifers were fed six successive diets increasing in concentrate and decreasing in roughage starting at 50.0% concentrate and 50.0% roughage for the first diet and finishing at 87.0% concentrate and 13.0% roughage for the sixth diet. All rations among treatments were formulated to be isonitrogenous and isocaloric. Heifer weights were taken every 28 d to adjust feed intake to minimize or maintain near ad libitum intake (3.0% BW). Upon completion of the trial, all heifers were slaughtered for evaluation of carcass data. Average daily gain over the entire trial was higher (P < .05) for the CON fed heifers than PBM. There were no differences in FE. Heifers fed CON had larger (P < .05) rib-eye
areas than PBM. Data from this study indicate that Brangus heifers fed finishing rations containing PBM as an escape protein source will not increase performance or carcass characteristics over heifers fed nutritionally similar finishing rations with cottonseed meal as a protein source.

Key Words: Heifers, Performance, Protein


Four steers (500 kg) were used in a 4 x 4 Latin square to determine the serum calcium response to an oral drench of varying doses of calcium propionate. The dose levels used were: 0 g calcium in 750 mL of deionized water (control), 75 g of calcium in 750 mL calcium propionate gel (CA-75), 100 g of calcium in 1000 mL calcium propionate gel (CA-100), and 150 g of calcium in 1500 mL of calcium propionate gel (CA-150). Indwelling catheters were inserted into the jugular vein of each steer at the start of the period and removed after each 24 h collection. Steers were given a 6-d rest period before the start of the next period. Each steer received one of the dose levels in each of four periods. Blood samples were taken at 0 h before drenching and 1, 2, 3, 6, 12, and 24 h post drenching. Blood samples were allowed to clot and serum removed after centrifugation for determination of total, ionized, and normalized calcium levels. Data were analyzed using the General Linear Model of SAS with dose level and time as main effects. Serum total and normalized calcium values were higher (P < .05) for CA-75 and CA-100 than controls and baseline (0 h) levels at 1, 2, and 3 h post drenching. At 6, 12 and 24 h post drenching, serum total and normalized calcium levels for CA-75 and CA-100 g dose level were similar (P > .05) to control and baseline (0 h) levels. For CA-75 and CA-100, total and normalized calcium levels peaked at 1 h post drenching at 9% and 11% above control. Thus, the optimal dose level of calcium when given as calcium propionate gel is 75 g.

Key Words: Beef, Calcium, Blood

515 Effects of growth implants on the performance of stock heifers grazing irrigated ryed pasture. Dale A. Blasi* and Gerry L. Kuhl1,1 Kansas State University, Manhattan.

One 151-d field study was conducted to compare three anabolic implants for promoting weight gain in stocker heifers grazing center pivot-irrigated pastures of winter rye. Three hundred previously non-implanted British crossbred heifers averaging 191 kg were assigned to one of four treatments: 1) no implant-control (NC), 2) Ralgro (RAL), 3)Revalor-G (REV-G) and Synovec-H™ (SYN-H). Heifers were weighed at monthly intervals to evaluate the growth response curve of each implant type over time relative to NC. Only during the first 32-d period of implantation did heifers on REV-G gain significantly faster (P<.05) than NC. All implant treatments responded similarly (P>.05) during the next three monthly weigh periods. During the last period (d 124-d 151), SYN-H heifers gained faster (P<.05) than all other treatments. All implant types except Ralgro significantly improved gain (P<.05) compared to NC. Although there were no significant differences in overall liveweight gain between RAL and REV-G (P>.05), SYN-H-implanted heifers gained faster (P<.05) over the 151-d trial. Heifer Daily Gain (kg) by Monthly Weigh Periods on Ryed Pasture

<table>
<thead>
<tr>
<th>Treatment</th>
<th>D1-3</th>
<th>D3-6</th>
<th>D6-9</th>
<th>D9-12</th>
<th>D12-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>0.45</td>
<td>0.86</td>
<td>0.65</td>
<td>0.62</td>
<td>0.88</td>
</tr>
<tr>
<td>RAL</td>
<td>0.46</td>
<td>0.91</td>
<td>0.72</td>
<td>0.66</td>
<td>0.89</td>
</tr>
<tr>
<td>REV-G</td>
<td>0.56</td>
<td>0.91</td>
<td>0.71</td>
<td>0.65</td>
<td>0.90</td>
</tr>
<tr>
<td>SYN-H</td>
<td>0.62</td>
<td>0.96</td>
<td>0.79</td>
<td>0.72</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Values in columns not sharing a common superscript are different (P<.05).

Key Words: EPD, Puberty, Reproduction

516 Effect of poultry by-product meal on the performance of growing Angus bulls. M. E. Hall, B. J. May*, D. R. Shelby, G. R. Engdahl, and C. B. Scott, Angelo State University, San Angelo, TX.

Thirty-six weaned Angus bulls were used to compare the effects of poultry by-product (PBM) versus cottonseed meal on performance in a 112-d growth study conducted at the Angelo State University. Management, Instruction and Research Center in San Angelo, Texas. Bulls were blocked by weight and randomly assigned to one of two treatments with four replications of each treatment. Treatments consisted of a grower ration with either (1) cottonseed meal as a control (CON), or (2) poultry by-product meal (PBM) as the protein sources. Rations were formulated to be isonitrogenous (14.0% CP) and isocaloric (Neg 1.15 Mcal/kg). Bull weights were obtained every 28 d to adjust feed intake to minimize ors and maintain near ad libitum intake (3.0% BW). All feeds and refusals were weighed and recorded daily. Average daily gain and FE over the entire trial were similar for CON and PBM fed bulls. Data from this study indicate that growing bulls fed grower rations containing PBM as an escape protein source will not increase performance over bulls fed nutritionally similar grower rations with cottonseed meal as a protein source.

Key Words: Bulls, Performance, Protein

517 Evaluation of female reproductive traits in progeny of high and low scrotal circumference expected progeny difference Angus sires. D. J. Kemp*, W. O. Herring, and D. J. Patterson, University of Missouri, Columbia, Missouri.

Age at puberty (AP) is a major factor influencing the reproductive efficiency throughout the life of a beef female. This study was designed to evaluate the responses to correlated traits with scrotal circumference EPD (SC EPD), in particular AP, in two divergent lines of Angus heifers. The lines were distinguished by the SC EPD of the sires used to develop each line. The average SC EPD of the sires used in the high SC EPD line (HSC) was +1.30 cm and the average for the low SC EPD line (LSC) was -0.87 cm. Birth weight, weaning weight, yearling weight, and milk EPDs of the sires were similar across both lines to aid in minimizing the impact of growth genetics. Traits measured on the heifers included: birth weight, weaning weight, yearling weight, semi-weekly weights from the onset of the study to puberty, and weight at puberty. Blood samples were collected semi-weekly as an indicator of puberty. Puberty was defined as a transient increase in serum progesterone concentration above 1 ng/ml that was followed by a normal estrus cycle. AP was analyzed with a model including a linear covariate for weight at puberty, fixed effects of contemporary group, age of dam, line, and a random effect of sire within line. Preliminary results for the first group indicated no significant difference between HSC and LSC for age at puberty. However, sire within line was significant (P<.05). While early results indicate no differences in age at puberty between LSC and HSC, two additional years of matings are yet to be measured in the study.

Key Words: EPD, Puberty, Reproduction


Eighty-six beef cows were allotted to three similar groups based upon breed, age, postpartum interval, and postpartum fertility. Cows were estrus detection detection (EDR) and pregnancy rates (PR) among three estrus synchronization regimens using GnRH and prostaglandin F2α (PG). All cows received 100 µg GnRH i.m. on d 0 and 25 mg PG i.m. on d 7. All cows were observed for estrus 0700 and 1900 from d 7 to d 12. Cows allotted to the Select Synch (S) group were artificially inseminated (AI) approximately 13 h after detected estrus. Cows in the two Ovax groups received an additional 100 µg GnRH i.m. 48 h after PG and were timed-AI either at the time of the second GnRH injection (T0 group) or 8 h after the second GnRH injection (T8 group). Following
the synchronization period, all cows continued to be observed for estrus until d 32 and bred until d 54. Cows were pregnancy diagnosed by ultrasound on d 51 and d 86. The EDR from d 7 to d 12 was higher (P<.05) for S cows (79.3%) than either T0 (31.0%) or T8 (53.6%) cows. The PR to synchronization was higher (P<.05) for S cows (48.3%) than T0 cows (20.7%) but did not differ (P=.79) from T8 cows (42.9%). T8 cows tended to have higher d 7 to d 12 EDR (P=.11) and PR to synchronization (P=.09) than T0 cows. Overall PR at d 86 did not differ (P>.05) for S (82.8%), T0 (75.9%), and T8 (78.6%) cows. Although the Select Synch estrus detection rate was higher than either of the Ovsync methods, PR to synchronization was only significantly lower for Ovsync cows bred at the time of the second GnRH injection.

519 Outcome of breeding soundness evaluations performed on 2544 yearling beef bulls. S. P. Kennedy, J. C. Spitzer, H. L. Higdon III, F. M. Hopkins, and W. C. Bridges, Jr. 1Clemson University, Clemson, SC, 2University of Tennessee, Knoxville, TN.

Our objective was to perform a retrospective analysis of breeding soundness evaluations (BSE) as classified by the Society for Theriogenology (SFT) 1993 system and ascertain mean scrotal circumference(SC), motility(%) and, normal sperm(%) associated with bulls classified as satisfactory or unsatisfactory potential breeders. Data included BSE information available from four production stations in South Carolina (SC1, SC2) and Tennessee (TN1, TN2) from 1986 through 1996 on 2544 Angus, Charolais, Gallow, Polled Hereford, Santa Gertrudis and Simmental bulls. Analysis was simplified by classifying all bulls as either satisfactory or unsatisfactory potential breeders (unsatisfactory including all bulls originally classified as unsatisfactory or deferred). Analyses of variance of performance data were performed with a model designed to account for bulls evaluated prior to 1993 being treated as a variable to account for bulls evaluated prior to 1993 being originally evaluated under the Society for Theriogenology 1983 system. Mean SC, %M, and %NS for bulls classified as either satisfactory or unsatisfactory breeding were determined using univariate procedures of SAS. Of the 2544 bulls, 76% were classified as satisfactory potential breeders. Proportion of bulls classified satisfactory were influenced by breed(P=.001), year(time)(P=.005) and breed x station(P=.0002) and breed x station(P=.03). Further analysis indicated breed to be a significant variable at all stations with the exception of TN2(P>.01). Year(time) was significant at both TN stations(P<.0006) and breed x time was significant at TN2(P=.03). For satisfactory or unsatisfactory bulls, respectively, SC were 36.0cm±2.8cm and 33.2cm±3.9cm (P<.001), %M were 62.9%±17.8% and 31.5%±24.6% (P<.001), and %NS were 86.3%±7.1% and 66.4%±19.9% (P<.001). This analysis provides benchmarks for expected outcomes of BSE on yearling beef bulls.

Key Words: Breeding Soundness Evaluation, Beef Bulls

520 Effects of supplementation with undegraded intake protein pre- and postpartum on reproductive performance in primiparous heifers. T. A. Strauch, E. J. Schol- jegeerd, D. J. Patterson, M. F. Smith, M. C. Lucy, W. R. Lamberson, and J. E. Williams, University of Missouri-Columbia, Columbia, MO.

Objectives of this study were to evaluate the effects of pre- and postpartum undegraded intake protein (UIP) supplementation on body condition score (BCS), BW, calf weight (CW), milk production (MP), serum concentrations of IGF-1, postpartum interval (PPI), and first service conception rates (FSCR) in primiparous beef heifers (n=38). Heifers were maintained on stocked fescue (11.7% CP, 38% ADF) and individually fed supplement daily beginning 60 d prepartum. Pre- and postpartum supplements provided 20.6% CP, 83.4% TDN (UIP); 16.3% CP, 84.2% TDN (CON); 23.9% CP, 83.8% TDN (UIP); and 19.1% CP, 83.6% TDN (CON), respectively. Bloodstream estradiol benzoate release (IVI) left in place for 7 d plus 1 mg of estradiol benzoate given i.m. at the time of insertion, (2) the Select Synch (SS) combination of GnRH and PG, and (3) control (C). Each treatment group consisted of 29 AN (7 virgin heifers, 22 lactating cows) and 11 BM (3 virgin heifers, 8 lactating cows) females maintained on dry west Texas rangeland with no flushing procedures, which is typical for local ranches. Estrus was detected and monitored by Heat Watch™. The number of females in estrus within 6 d following treatment were 28, 29, and 10 for treatments IVI, SS, and C, respectively. There were no differences between the IVI or SS treatments, but both differed (P<.01) from the C treatment. The number of females cycling was reduced by the drought conditions of the range-land and resulting reduction in availability of palatable, high quality forage. Treatment did not affect (P>.20) duration of estrus, number of mounts, or conception rate (IVI = 633 min, 33 mounts, 89 percent; SS = 654 min, 36 mounts, 79 percent; C = 723 min, 23 mounts, 80 percent). Heifers were in estrus longer and had more mounts (P<.01) than lactating cows (963 min, 49 mounts vs. 557 min, 25 mounts). The treatments were equally effective in synchronizing estrus and achieving pregnancy.

Key Words: Synchronization, Beef Cattle, GnRH

522 Impact of mastitis on the accuracy of the diphasic lactation curve model. E. H. Shim* and R. D. Shanks, University of Illinois, Urbana.

Lost milk production is a costly consequence of mastitis. To effectively gauge the loss in milk yield, lactation curves can be utilized to predict theoretical milk yields in the absence of mastitis. The diphasic logistic function is a proposed model for lactation curves in dairy cattle. Daily milk yields were collected from January of 1994 through January of 1996 at the University of Illinois Dairy Unit. The effect of mastitis diagno- sis (no mastitis [144 records], mastitis within 150 days of freshening [49 records], or mastitis after 150 days of freshening [30 records]) and parity (first, second and later) on the diphasic logistic function was investi- gated. The function was fit on all records individually using NLREG®. The variation explained by the model significantly differed (P<.05) between animals with no mastitis (.670 ± .022) and animals with mastitis (.593 ± .023); and between records for animals with mastitis within 150 days of freshening (.566 ± .026) and animals with mastitis within 150 days of freshening (.644 ± .034). The variance explained by the model significantly differed (P<.05) between first parity (.561 ± .034) and lactations after first parity (.696 ± .016). The diphasic logistic function is most appropriate for first parity records. Mastitis within 150 days of freshening significantly reduced efficacy of the diphasic logistic function and lessened the accuracy of milk yield predictions.

Key Words: Mastitis, Lactation curve, Milk yields
523 The use of electrical conductivity as a measure to determine feed mixing uniformity in feedlot rations. D. R. ZoBell1,2, D. Karren1, R. Atkins1, D. Enstrom1, and L. Goonewardene1. 1Utah State University, Logan UT, 2Raymond, AB, 3Alberta Agriculture Food and Rural Development, Edmonton, AB.

The objective of this trial was to determine if electrical conductivity can be used as a measure to determine feed mixing uniformity in three types of feedlot rations. Rations contained low (48.5%), intermediate (77.1%), and high (85.1%) concentrate levels (DMB). Feedstuffs used were barley grain, barley silage, molasses and feedlot premix. Two feed mixers were used in the study which were padder and auger types although they were not compared against each other. Ten samples were taken for each of the low, intermediate, and high concentrate rations and this was replicated five times over five days for each of the two mixers. A standardization test, which utilized sodium chloride and subsequent electrical conductivity, was developed to determine mixing uniformity of the rations and mixer types. Electrical conductivity calibration curves were developed for each of the feedstuffs used in the rations, for sodium chloride and for the feed mixtures and repeatability tests were also conducted. The data was analyzed to determine means, standard deviation and coefficients of variation (CV) for each ration and mixer type. This trial appears to demonstrate that electrical conductivity can be used to determine mixing uniformity in feedlot diets containing low, intermediate and high concentrate levels.

Key Words: Feed mixing, Electrical conductivity, Feedlot

524 Ruminal in situ degradation of alcohol-fermented feedstuff. J. S. Shin1,2, C. G. Yan2, B. W. Kim1, and B. J. Hong1, Kangwon National University, Korea, 2Yeon-Byeon Agricultural University, China.

The objective of this experiment was to determine effects of yeast treatment on 72-h ruminal in situ dry matter (DM), crude protein (CP) and neutral detergent fiber (NDF) of two diets. The two diets consisted of alcohol-fermented feedstuff (AFF; 100% corn added with 50% water, 77.1% CP) and non-fermented corn. Ten g DM samples of each diet were incubated in four 10x17 cm dacron bags in two of each ruminally cannulated Korean cattle, with the bags removed after 3, 6, 9, 12, 24, 48 and 72 h of incubation. Ruminal DM degradation was faster for AFF than control at all collection hours. Effective DM degradability (K=0.05) of AFF was higher (P < 0.05) than that of control by 3.89%. The NDF and CP degradability in AFF was greater (P < 0.05) for AFF than control by 10.19 and 4.49%, respectively. Effective NDF degradability (K=0.05) of AFF was higher (P < 0.05) than that of control by 5.26%, but the CP degradability (K=0.05) of AFF did not differ with that of control. These data clearly indicate that fermentation with yeast can improve the digestibility of feedstuffs in the rumen.

Key Words: Alcohol-fermented, In situ

525 Resolution of Two Ultrasonic Units, Using a Multipurpose Tissue Mimicking Phantom as the Standard. F. N. Domatob1, J. E. Novakofski2, S. L. Spahr3, A. Mizach3, and E. Maltz2, University of Illinois, Urbana, 2ARO, Volcani Center, Bet Dagan, Israel.

Echo generic point targets of known distances apart, and embedded in a multipurpose phantom of tissue mimicking material were scanned with two ultrasonic units to determine relative machine errors. Typical b-mode images of point targets were recorded at 50-mm depth with Pie medical, and 30-mm depth with Sonomed ultrasonographs equipped with 3.5/5.0 - MHz and 7.5 - MHz transducers respectively. Feasibility of using digitized scans of subdermal fat from the two ultrasonic units for estimation of body condition score (BCS) was also investigated. Split-split-plot analysis of variances indicated differences in measurements of target points. The two ultrasound machines overestimated distances between target points, with no set pattern, and no differences due to transducer frequencies. It was visibly easier to measure the distances at higher transducer frequencies (5.0 and 7.5 - MHz) due to increased attenuation. Regression of BCS from subdermal fat along lactation showed a significant correlation test, which utilized sodium chloride and subsequent electrical conductivity, was developed to determine mixing uniformity of the rations and mixer types. Electrical conductivity calibration curves were developed for each of the feedstuffs used in the rations, for sodium chloride and for the feed mixtures and repeatability tests were also conducted. The data was analyzed to determine means, standard deviation and coefficients of variation (CV) for each ration and mixer type. This trial appears to demonstrate that electrical conductivity can be used to determine mixing uniformity in feedlot diets containing low, intermediate and high concentrate levels.

Key Words: Feed mixing, Electrical conductivity, Feedlot


Compromised immune response has been associated with marginal trace mineral status. To evaluate the claims that southwestern calves have a higher morbidity and mortality rate than calves from other parts of the country due to possible nutritional deficiency, liver biopsies were conducted along with lymphoblastogenesis analysis to evaluate the potential relationship between trace mineral deficiency and immune response. Liver biopsies were obtained from fifty calves off of seven different ranches, at El Sueno Del Corazon Ranch (ESDC, a prefeedlot conditioning operation: Abiquiu, NM) to determine liver copper (Cu) and zinc (Zn) concentrations. In addition, lymphoblastogenesis analysis was conducted 14 d after biopsy. Calves that were sampled had been in residence for 1-12 d prior to biopsy. Upon receiving at ESDC, calves received Cattlemaster 4 and pasturella vaccinations and were treated for any apparent sickness. Calves from four of the ranches were placed in a slow release copper bolus. Liver biopsies were performed using a 14-gauge biopsy needle 15-cm long (Cook Urological Co. Spencer, Indiana). Samples were placed in 1.7-ml micro-centrifuge tubes with attached caps and frozen until prepared for analysis by atomic absorption spectroscopy. Liver Cu ranged from 36-1466 ppm and Zn ranged from 61-1349 ppm. Mineral status was adequate to high for all calves; however, there were some differences in Cu ppm among ranches (P < 0.04). Liver sample wet and dry weights among calves were not different (P > 2, P> 1 respectively). No differences in liver Cu were detected among ranches within calves receiving the Cu bolus (P > 2). Lymphocytes were isolated from jugular blood and proliferation responses to concanavalin A (CONA), phytohemagglutinin P (PHA), and pokeweeds mitogen (PWM) were evaluated. All animals responded positively to lymphoblastogenesis assays (P > 0.05) demonstrating that calves sampled were capable of mounting a cell-mediated immune response.

Key Words: Liver Biopsy, Trace Minerals, Immune response

527 The use of on-farm Quick Tests to estimate manure nitrogen. J. S. Van Kessel* and J. B. Reeves, III, USDA-ARS, Beltsville, MD.

Knowledge of the nutrient content of manure is fundamental in determining appropriate manure application rates. Nutrient analyses performed rapidly, on the farm could be very useful for determining manure nutrient contents. This experiment was designed to evaluate six on-farm Quick Tests for their accuracy in estimating manure N (total) or NH4+-N concentrations. Quick Tests included in the study were the hydrometer, electrical conductivity meter and pen, reflectometer, Agros N Meter (or Nova meter), and Quantofix-N-Volumeter. The hydrometer has been used to predict total N and P while the remaining Quick Tests have been used to predict NH4+-N. Manure samples (107) were collected from dairy farms in five eastern states. The samples were analyzed for total N and NH4+-N by traditional laboratory methods (Kjeldahl and distillation, respectively) and for total N or NH4+-N using each of the Quick Tests. Manure dry matter (DM) ranged from 1.4% to 38.6%; total N ranged from 0.09% to 0.94%; and NH4+-N determined by each Quick Test was regressed against laboratory-determined concentrations. In all cases, linear regressions were significant (P < 0.01). The strongest linear relationship for prediction of NH4+-N was with the Quantofix-N-Volumeter (r2 = 0.95; slope = 0.98). The Agros N Meter and the reflectometer also predicted NH4+-N with relative accuracy (r2 = 0.81 and 0.91; slope = 0.99 and 0.84; for Agros and reflectometer, respectively). The r2 for the relationship between electrical conductivity and NH4+-N was 0.87 and 0.89 for the meter and pen, respectively. The hydrometer did not perform well as a predictor of total N (r2 = 0.48; slope = 0.56). Because some of the Quick Tests were designed specifically for slurries, manure samples were also split into high (> 12%) and low (< 12%) groups; the remaining Quick Tests were then compared. Laboratory N value was significant (P < 0.01) and the r2 for the regression equation was higher for the low DM group than for the high DM
528 Mortality in dual-purpose calves from 0 to 12 months of age in Perija, Venezuela. O. Araujo-Febres and S. Oliveros. The University of Zulia. Animal Science Department.

Calf records (n = 600) for both sexes between 1866 and 1990 were utilized with the objective of estimating mortality (TM) during the first 12 months of age in a dry tropical forest zone in the Perija region of Venezuela. The data was analyzed using distribution frequencies and the chi-square statistics, considering breed type and sex of the calf, year and season of birth, and number of parturitions (dam) as discrete independent variables. Results indicated that the total mortality rate during the period studied was 20.7%. The chi-square analysis determined the TM varied with breed type (P<.001) being greater for predominantly Holstein (42.7%), intermediate for predominantly Brown Swiss (32.3%) and lower for predominantly Brahman (17.8%). The effect of sex on TM was significant (P<.001) with males being more susceptible than females (26.3% vs. 15.4%, respectively). Year and season of birth was also significant (P<.001) as to TM with values which oscillated between 13.7 and 39.0% for year; while for season the major TM occurred during the April-June (27.5%) and the lower TM occurred during dry season December-March (15.0%). Parity had an (P<.001) effect on TM with first calf parturition being the major (29.2%) and lowest in cows with 4 or more parturitions (12.4%). It was observed that highest TM occurred around the natal period (5.6%).

529 Effects of milk replacer feeding level on Alpine kid performance. A. L. Goetsch, R. Puchala, M. Lachica, E. Kika de la Garza Institute for Goat Research, Langston University, Langston, OK, College of Veterinary Medicine, Oklahoma State University, Stillwater, OK.

Seventy-nine Alpine kids (35 female and 44 male) were used to determine effects on ADG of milk replacer (MR) consumed ad libitum (AS/AV) or with restricted consumption of volume alone (AS/AV/R) or of volume and solids (RS/RV). Kids began the 8-wk experiment at 3 to 9 d after birth (3.5 ± .11 and 3.9 ± .08 kg initial BW for females and males, respectively). A commercial MR was fed twice daily. The AS/AV kids received ad libitum access to MR with 18% DM. The RS/RV kids received 18% DM MR, with ad libitum access in wk 1 and approximately 90, 80, and 70% of consumption by AS/AV kids in wk 2, 3, and 4 to 8, respectively. The AS/AV kids received ad libitum access to 18% DM MR in wk 1, thereafter receiving a similar quantity of solids as AS/AV kids but limited volume or water, with a MR DM concentration of 20, 22.5, and 25.7% in wk 2, 3, and 4 to 8, respectively. Milk replacer DMI was 231, 223, and 197 g/d in wk 1 to 4 (SE 7.1) and 276, 260, and 228 g/d (SE 8.2) in wk 5 to 8, and water intake was 1,050, 802, and 699 g/d (SE 30.7) in wk 1 to 4 and 1,258, 846, and 1,039 g/d (SE 32.8) in wk 5 to 8 for AS/AV, AS/AV/R, and RS/RV, respectively. Gain of BW was lowest (P<.07) among treatments for RS/RV in wk 1 to 4 (146, 131, and 118 g/d, SE 5.9) and 5 to 8 (137, 140, and 115 g/d, SE 7.2, for AS/AV, AS/AV/R, and RS/RV, respectively). However, sex influenced (P<.06) treatment effects on ADG in wk 1 to 8 (female: 129, 120, and 117 g/d and male: 155, 151, and 116 g/d for AS/AV, AS/AV/R, and RS/RV, respectively; SE 7.2). Treatment did not affect BW gain in the subsequent 4-wk period after weaning (P>.10). In conclusion, restricting intake of fluid or water alone in MR did not enhance ADG of Alpine kids, and lower growth potential of female vs male kids may lessen susceptibility to effects of limited MR DMI.


Postweaning performance, apparent total tract nutrient digestibility, and plasma metabolite profiles of growing Spanish (S), Boer x Angora (BA) and Boer x Spanish (BS) castrates were investigated. The experiment was conducted on two 8-wk feeding periods: 78 S, 20 BA, and 30 BS were used in the first 8-wk period and 18 kids per genotype were used in the second 8-wk period. Kids were weaned at 8 wk of age and fed a commercial goat starter diet (25% CP, 2.71 Mcal/kg DE, 34.7% NDF, and 39.0% NDF) ad libitum. Feed intake was recorded daily and BW at 2-wk intervals. Digestibility was measured in wk 17 to 18 by weighing and sampling of offered feed, feed refusals, and feces for a period of 5 d. Boer x Angora and BS castrates had greater (P<.001) initial and final BW than S (7.3, 7.2, and 6.6 ± .2 kg; 24.4, 25.2, and 19.5 ± .25 kg, for BS, BA, and S, respectively). Final BW of BA was greater than BS (P<.05). Average daily gain (ADG) was 155, 161, and 117 ± 5.8 (SE 5.68), and 522 ± 21.5 (g/d), and gainfeed (263, 261, and 235 ± 8.0 g of BW gain/kg of feed consumed) were also greater (P<.05) for BS and BA vs S, respectively. Averaged daily gain, DMI, and feedgain were similar (P>.05) between BA and BS. Body weight and DMI increased (P<.001) linearly and quadratically over time; at the rate at which BW and DMI changed over time was greater (P<.001) for Boer crosses than S. Average daily gain increased linearly (P<.001) while feed efficiency decreased (P<.001) linearly and quadratically over the 16 wk feeding period. Genotype had no effect (P>.05) on digestibilities of dietary DM, OM, CP, or gross energy (687 ± 1.4%, 70.6 ± 1.3%, 69.9 ± 1.4%, and 69.3 ± 2.4%, respectively). Genotype also had no effect on plasma concentrations of total protein, glucose, or NEFA (P>.05). However, BA had greater (P<.05) concentrations of plasma urea N compared with S and BS (25.5, 19.6, and 21.3 ± 1.0 mg/dL, respectively). Under intensive management, the use of Boer bucks as terminal sires has the potential to produce crossbred kids which grow faster and achieve heavier BW as compared to fullblood Spanish goat kids.

531 Influence of breed and nutrition on growth rate, scrotal circumference, and onset of puberty in bucks of meat-type goats. S. Wildeus. Virginia State University, Petersburg, VA.

Spring-born bucks (n=30) of the Myotonic (MY), Nubian (NU), and Spanish (SP) breeds were used to determine changes in BW during a 57 d preweaning period (PRE), a 77 d postweaning period (POST) and a 98 d experimental period (EXP). Animals were managed either under a high (HI) or a low quality forage system (LO) during PRE and POST; then reallocated within breed and forage system for EXP and pen-fed a pelleted ration (16% CP) at either 3 or 4% of BW. Onset of puberty (ejaculate containing spermatozoa with a mass motility >10%) was determined from semen samples collected weekly by electroejaculation during EXP. Growth for PRE and POST was analyzed in a model with breed and forage system as main effect and birth type as covariate; for EXP plane of nutrition was added to the model. Preweaning ADG was higher (P<.01) in breeds affected by forage system, but was lower (P<.05) in MY (88 g/d) than NU (150 g/d) and SP (130 g/d). Postweaning ADG was higher under HI than LO (62 vs 33 g/d; P<.01), and higher (P<.01) in SP (74 g/d) than in NU (43 g/d) and MY (34 g/d). During EXP, ADG was higher (P<.05) in NU (134 g/d) than in SP (99 g/d) and MY (87 g/d), and tended to be higher (P>.1) for bucks originating from LO than from HI (120 vs 94 g/d). Growth of SC during EXP tended to be lower for SP (.056 cm/d) than for NU and MY (.075 cm/d), and was higher (P<.01) in animals originating from LO than HI (.085 vs .054 cm/d). Plane of nutrition during EXP had no effect on ADG and SC growth. Age at puberty was earlier (P<.05) in SP (146 d) than in MY (172 d) and intermediate in NU (155 d), and BW at puberty was lower in MY (13.8 kg) than in NU (18.5 kg) and SP (17.5 kg), whereas SC was similar between breeds (18.6 cm). Forage system affected age of puberty (HI: 142 d; LO:172 d; P<.05) and SC at puberty (HI: 18.0 cm; LO: 19.5 cm; P<.05). These data indicate that a higher growth rate early postweaning enhanced the onset of puberty, and that breeds of different mature size varied in age and BW, but not SC, at puberty.

532 Influence of meat method on fowl immune function. J. L. Turner, J. E. Minton, M. J. Arms, and J. A. Pruitt. Kansas State University, Manhattan, KS, Southwest Missouri State University, Springfield, MO.

Previous reports suggest that meat handling methods influence cortisol secretion and fowl immune function in the immediate post-weaning period.
This study evaluated the effect of two weaning methods on plasma cortisol and peripheral blood leukocyte (PBL) population of weaned foals. Twelve Quarter Horse mare–foal pairs were ranked by age (range = 4 to 6 mo) and randomly assigned to two weaning treatments: Abrupt (A: immediate isolation of foal from mare) or Gradual (G: fenceline contact for two days followed by total separation). Six foals per treatment were weaned on the same day (d 0). Foals were weighed on d -23, -16, -9, -2, 7, and 12 relative to weaning to measure changes in ADG. The activity levels of foals were measured with a pedometer at 12 h intervals. Plasma cortisol was measured through five days post-weaning. On d 0, 1, 3, and 5, PBL were differentially counted, and harvested lymphocytes were cultured in a lymphocyte transformation assay. Data were analyzed with the PROC GLM procedure of SAS as repeated measures over time. ADG declined (P < 0.01) after weaning, but did not differ between treatments. Activity level did not differ between treatments, but activity was elevated (P < 0.05) at d 12, 72, and 108 h post-weaning. Plasma cortisol did not differ between A (45.1 ± 3.7 ng/mL) and G (41.8 ± 3.8 ng/mL) or between A and G for the three time points.

Key Words: horse, weaning, immunity

533 Evaluation of vitamin E and selenium supplementation in late gestation on lamb survival and pre-weaning growth performance. A. Ali1, D. G. Morrical2, M. P. Hoffman3, and M. F. Al-Essa4, 1Iowa State University, Ames, IA.

Positive growth responses to supplemental vitamin E and selenium have been demonstrated in many sheep studies. The objective of this study was to evaluate vitamin E injection and selenium (Se) supplementation in late gestation on lamb survival and pre-weaning growth performance. Ewes were randomly assigned to one of three treatments: (1) Control (Ctl), (2) 350 IU vitamin E per week and 0.27 g Se fed as a mineral supplement beginning 4 wk before the first expected lambing and the other 350 IU per week and 90 PPM of Se in a mineral supplement fed free choice, or (3) Ctl or 90 PPM of Se in a mineral supplement fed free choice. Within each pen of ewes (8-10 hd), approximately one half of the ewes received injectable E beginning 4 wk before the first expected lambing and the other one half received no vitamin E. Vitamin E treatments ended at lambing time, however, ewes remained on their respective mineral sources during lactation. Lambs were provided access to creep (16% CP and 83% TDN) and fortified with 35000 IU of vitamin E, 0.27 g Se and 50 g of chlordetracycline per 909 kg) from 10-d of age to weaning. Injectable vitamin E did not effect birth weights of lambs, however, 90 PPM Se improved birth weights of lambs (5.06 ± 4.88 kg, P < 0.10). Improved birth weight was from 90 PPM Se specifically in lambs born to 6-7 compared to 1-5 year old ewes (P < 0.1). Vitamin E specifically increased (P < 0.05) the performance of lambs from 1-2 and 6-7 year old ewes but that effect was not observed in lambs from 3-5 year old ewes. Multiple born lambs from ewes treated with vitamin E had increased survival (P < 0.05). Single born lambs survival was not effected by vitamin E or Se treatment. From this study it was concluded that supplementation of 90 PPM Se to ewes improved birth weights of lambs from 6-7 year old ewes and injectable vitamin E to ewes increased the survival of multiple born lambs and pre-weaning growth of lambs from 1-2 and 6-7 year old ewes.

Key Words: Lamb performance, Vitamin E, Selenium

534 Prickle factor in fleeces of performance-tested fine-wool rams. C. J. Lupton*, D. F. Waldron, and F. A. Pfeiffer, Texas Agricultural Experiment Station, San Angelo, Texas.

Prickle factor (PF, % of fibers > 30 µm) is an indicator of the relative comfort of wool fabrics worn next to the skin. PF, average fiber diameter (AFD), SD, and CV were measured (with an Optical Fibre Diameter Analyser) in three consecutive years on core samples of unskirted fleeces from 524 fine-wool rams completing a central performance test to establish PF in fleeces produced under the unfavorable (from a wool fineness and uniformity perspective) test conditions and to determine relationships among PF, fiber fineness and variability measures. As part of the normal performance test routine, AFD, SD, and CV of side and britch samples were also measured for each fleece because AFD of side samples are used in the index of overall merit and AFD of side and britch samples constitute independent rejection criteria for ram certification. Core sample PF, AFD, SD, and CV averaged 5.5 %, 23.2 µm, 4.4 µm, and 20 % and ranged from 4 to 25.3 %, 17.3 to 26.8 µm, 3.1 to 6.4 µm, and 15.2 to 28.6 %, respectively. PF, SD, and CV did not differ by year (P > 0.05). It has been suggested that only wools having low PF (< 2 %) be used in apparel worn next to the skin. Eighteen percent of the fleeces were in this category. Stepwise multiple regression analysis for PF vs all measured variables plus AFD^2 and differences between side and britch AFD resulted in core AFD^2, core AFD, britch SD, core SD, side CV, and core CV entering the equation. No other variable met the 0.01 significance level for entry into the model. Partial r^2 values for the first three variables were .82, .10, and .03, respectively. This result was essentially unchanged when fleeces (349) having core, side, and britch AFD > 23.6, 24.9, and 27.8 µm, respectively (i.e., from coarse, unce- rtifiable rams) were excluded from the analysis. Most of the variability in PF can be accounted for by core data alone, i.e., PF = 199.57 + .46*AFD^2 - 19.33*AFD + 6.01*SD - 1.01*CV, r^2 = .94.

Key Words: Wool fleeces, Prickle factor, Performance-tested rams

535 Results of skirting and classing fleeces on the value of wool from fine-wool range ewes. F. A. Pfeiffer* and C. J. Lupton, Texas Agricultural Experiment Station, San Angelo.

Fleeces from 1633 (± 337) mixed-age, fine-wool range ewes were skirted (inferior portions separated from bulk of fleece) and classed (fleece portions grouped according to measurable characteristics) at shearing time in April or May of each year from 1992 to 1997 to establish average proportions and values (prices paid) of each classing line and overall value of the annual clip. The wool clips (6765 ± 1340 kg) were prepared in accordance with the American Sheep Industries Code of Practice. Average prices obtained for these classified wools were compared with the extremes of price ranges published in the USDA, AMS Market News for comparable original bag (OB; wool packaged without skirting) Texas wool (64’s grade, 54% yield, ≥ 7.6 cm) during the first week of May in each year of the study. The average proportion ± SD (%) and average price ± SD ($/greasy kg) of the major classing lines were: main 12-mo line (A), 56.1 ± 4.7, 3.02 ± 12.5; 12-mo yearling wool (AL), 8.9 ± 6.3, 3.15 ± 6.1; tender or short wool (AW), 5.7 ± 1.6, 2.13 ± 35; bellies (BLS), 7.2 ± 1.0, 1.34 ± 24; pieces (PCS), 9.9 ± 2.7, 1.54 ± 30; and locks (LKS), 11.2 ± 1.3, 99 ± 33, respectively. Because A and AL were more valuable than the other classing lines, clip value would be maximized by minimizing the amounts of A2, BLS, PCS, and LKS. Average price received for skirted and classed clips ($24.9 ± 50/kg) was not different than either the mean low ($2.35 ± 59/kg; P = 0.46) or the mean high ($2.64 ± 61/kg; P = 0.37) of the ranges for OB wool published in the Market News. Marketing these skirted and classed wools failed to produce more income than would have been generated by selling comparable weights of wool packaged in OB form.

Key Words: Wool, Skirting, Classing


Piglet diarrhea occurs continuously or sporadically in all swine herds in Ontario. Also emerging evidence indicates widespread resistance to antibiotics commonly used to combat neonatal diarrhea. Peptidoglycan (murein dipeptide) derived from bacterial cell wall is a well known immunopotentiator. This study was designed to evaluate the feasibility of producing PG from an alternative inexpensive source E. coli BL-21 and also to determine the immunological consequences of supplementing neonatal pigs with PG derived from this source. PG was derived from E. coli K12 strain BL-21 by modifications of methods described by Sprott et al. 1994. Approximately 100 mg crude PG was recovered from 4 litres of cultured E. coli BL-21 cells. This represented a yield of 0.1 g/litre of culture. Piglets (n=193) from 20 litters were randomly

Key Words: E.coli K12 strains, BL-21, Immunopotentiator, Neonatal pig
allotted to five treatment groups consisting of PG 1 (4% PG, 2 mg/ml); PG 2 (4% PG, 20 mg/ml) manufactured by Ajinomoto Co., Inc. Tokyo, Japan; PG 3 (70% PG, 0.15 mg/ml); PG 4 (70% PG, 1.5 mg/ml) PG derived from E.coli BL-21 and saline. PG or saline (1 ml/piglet) was administered orally for 7 consecutive days from d 3 to 9 of lactation. All piglets were weighed on lactation day 20 or bled at birth, days 3, 10, 15 and 21 postpartum. Concentrations of IgG and IgA in piglet serum were determined by SRID (Mancini et al. 1965). Also piglets were observed and scored for clinical signs of postweaning diarrhea. Day 10 weaning weights were larger (3.00, 3.01, 3.11, 3.05 vs 2.92 kg) for PG 1, PG 2, PG 3, and PG 4 treated piglets compared to controls. However, when birth weight was included as a covariate weaning weights were similar for each group (P=0.48). Body weights on day 21 were also similar for each group (4.68, 4.74, 4.77, 4.67 vs 4.42 kg, P=0.25). Compared to controls, all four treatments resulted in non-significant increases in postweaning serum IgG and IgA concentrations (1032.1, 1009.5, 1094.5, 1031.4 vs 1004.9 mg/100 ml, P=0.18) and (806.7, 878.8, 869.6, 805.6 vs 745.8 mg/100 ml) for days 10 and 21 respectively. These results demonstrated the feasibility of producing large quantities of PG from an alternative, inexpensive and aero-
source E.coli BL-21. Also, the sustained postweaning high levels of serum IgG in treated piglets suggest that PG derived from E.coli BL-21 have invitro-immunopotentiating activity.

Key Words: Peptidoglycan, Immunopotentiator, Neonatal pigs

537 Estrus profile in female swine according to the weaning-to-estrus interval and parity. T. Lucia, M. N. Corea, J. C. Deschamps, G. Gaciba, and L. Caron, Centro de Biotecnologia - UFFPEL.

Short weaning-to-estrus interval (WEI) is associated with long estrus duration (ED). This study characterized the estrus profile (duration and frequency of estrus according to the period of estrus detection) across categories of WEI and parity. We analyzed 98 F1 sows: 28 primiparous (P1); and 70 having parity two or higher (P2+). The WEI was categorized as: Short, when equal to at most 97 h (55.1% of the sows); and Long, when longer than 97 h (44.9% of the sows). Estrus detection was conducted four times daily (8:30 a.m., 3:30 p.m., 6:30 p.m. and 10:30 p.m.). The beginning and the end of the estrus were determined by a positive and a negative response to back pressure in the presence of a boar, respectively. Frequency distributions measured the proportion of females detected in estrus at each period. Effects of parity on WEI, and effects of period of detection, parity and WEI on ED were analyzed by ANOVA through the GLM procedure of SAS. The association between WEI and ED was estimated by a linear regression model. Mean parity was equal to 2.5, whereas mean intervals were equal to 80.4 h for short WEI and to 118.6 h for long WEI. While 40% of the females were detected in estrus at puberty. Results confirm that the direct exposure of gilts to a boar is more effective than fenclomate contact for pubertal stimulation.

Key Words: gilt, boar, puberty


The recent identification of the ob gene and its protein hormone product Leptin has provided new insight in the mechanisms of nutritional signaling to the reproductive system. The objective of this study was to determine whether serum leptin concentrations were predictive of growth, carcass traits and early onset of reproductive functions in gilts. Prepubertal gilts (n=20) were selected at day 120 of age and divided equally between two groups. Gilts were weighed and bled at one weekly interval until 100 kg body weight (group 1) or puberty (group 2). Weekly serum leptin concentrations were determined by RIA using leptin assay kit (Linco Research Inc., Cat. #XL-85K). Gilts were bled after heat detection and sacrificed at approximately d 18 of gestation to collect reproductive and carcass data. Traits measured included age and weight at puberty, urogenital weight and length, embryo number and survival rate, estimated lean yield, fat depth, lean depth, carcass index, and dressing percentage. Also, serum leptin concentrations at puberty and slaughter were recorded. Mean values for growth, carcass and reproductive traits
541  Review of new information on the use of wet and dry milling feed byproducts in feedlot diets.  R. A. Stock1, J. M. Lewis2, T. J. Klopfenstein2, and C. T. Milton2, 1Cargill Corn Milling, Blair, NE 68008-0300, 2University of Nebraska, Lincoln, NE 68583-0908.

The wet and dry milling of grains to produce human foods, beverages, or fuel ethanol is continuing to increase along with an increased production of associated feed byproducts. Within the last 10 years, the feeding of corn gluten feed (CGF; wet milling) or distillers grains (DG; dry milling) in a wet or semi-moist form has received wide acceptance in feedlots. CGF and DG contain 10 to 20% more NFE when fed in the wet form than when fed in the dried form. The nutrient profiles of CGF and DG are often confused by cattle feeders and nutritionists. In addition, the nutrient profiles of these feed byproducts may vary widely from plant to plant because each plant may produce different types of human foods or beverages (wet milling) or use different grain types in the fermentation process (dry milling). Thus, it is important to understand the differences between and within the wet and dry milling industries in order to fully understand the nutritional value of these feed byproducts. In the wet milling process, corn is soaked (steeped), ground, and then separated into several fractions. Human and industrial products are primarily derived from the starch and oil fractions of the grain. The primary feed byproducts are corn gluten meal (CGM) and CGF. CGM contains 66% CP (DM basis) and the protein is high in undegradable intake protein (60% UIP). CGF is comprised primarily of bran and steep. CGF is lower in both CP (14 to 24%, DM basis) and UIP (20 to 25%) than CGM, but it is high in NFE (1.4 to 1.8 Mcal/kg). The NFE content of wet CGF appears to be similar when fed in a range of 20 to 50% of the diet DM. As the proportion of steep increases and bran decreases in CGF, the CP and NFE content of CGF increases. In the dry milling process, grain is ground, fermented, and distilled to produce alcohol. The feed byproducts that are produced include DG and condensed distillers solubles (CDS). On a DM basis, DG and CDS are generally higher in protein (25 to 32%) and higher in NFE (1.5 to 2.3 Mcal/kg) than CGF because corn oil is not removed during processing. Wet CGF and DG also reduce the incidence of subacute acidosis. Because CGF and DG have a high nutritional content and are often economically priced, they are excellent sources of energy and protein for feedlot cattle.

Key Words: Corn gluten feed, Distillers grains, Grain

542  Comparison of corn and wet corn gluten feed in roughage- or concentrate-based diets for growing beef heifers.  J. S. Drouillard*, N. G. Whitham, D. A. Blais, E. C. Titemeyer, C. M. Coetzer, and R. D. Hunter, Kansas State University, Manhattan, Kansas.

Two hundred and sixteen crossbred beef heifers (238 kg) were used in a 99-d experiment to evaluate growth performance when fed roughage- or concentrate-based diets containing corn or wet corn gluten feed. Roughage-based diets contained approximately 60% ground alfalfa hay and were supplemented with either dry-rolled corn and molasses (RUF-CORN) or wet corn gluten feed (RUFCGF). High-concentrate, limit-fed diets contained approximately 15% ground alfalfa hay with corn, molasses, and soybean meal (LFCORN) or with CGF (LFCGFG). Additionally, limit-fed diets were top-dressed with 20 g/d of Smartamine-ML per heifer (LFCORN-AA and LFCGFG-AA). Roughage- and concentrate-based diets were fed once daily at 2.75% and 2.0% of body weight, respectively. Heifers were allotted to pens of six head, with six pens per treatment. All cattle were fed a common diet for 14 d prior to initiating the experiment. Experimental diets were fed for 84 d, after which cattle were fed a common series of step-up diets for an additional 15 d to minimize treatment differences in gastrointestinal tract fill. Average daily gains during the 99-d trial were 1.14, 1.17, 1.15, 1.17, 1.03, and 1.00 ± 0.04 kg/d and gain efficiencies were .133, .130, .185, .189, .166, and .160 ± .004 kg/gain/kg DM for RUF-CORN, RUF-CGFG, LFCORN, LFCORN-AA, LFCGFG, and LFCGFG-AA, respectively. ADG and gain efficiencies were not different (P > .05) for RUF-CORN and RUF-CGFG, but heifers fed LFCORN gained faster (P < .05) and were more efficient (P < .05) those fed LFCGFG. Limit-fed cattle were more efficient (P < .05) than their roughage-fed counterparts. Addition of ruminally protected amino acids did not improve ADG (P > .30) or gain efficiency (P > .30) of heifers fed high-concentrate diets. CGF can effectively replace CORN in growing beef cattle diets, though its value is greater in roughage-based diets than in limit-fed, high-concentrate diets.

Key Words: Limit Feeding, Growing Cattle, Amino Acids

543  Effects of virginiamycin or monensin plus tylosin on ruminal nitrogen metabolism in steers fed corn based finishing diets with or without wet corn gluten feed.  S. E. Ives1, J. M. Lewis1, E. C. Titemeyer1, T. J. Klopfenstein2, D. J. Bindel1, and A. del Barrio2, 1Kansas State University, Manhattan, KS, 2University of the Philippines Los Banos, Laguna, Philippines.

Six ruminally cannulated Holstein steers (345 kg) were used in a 6 x 6 Latin square to evaluate a 2 x 3 factorial arrangement of dietary and antibiotic treatments on ruminal N metabolism. CORN+SBM diet contained ( % of DM) dry rolled corn (72), soybean meal (12), alfalfa hay (10), and molasses (4), and CORN+CGF diet contained dry rolled corn (63), wet corn gluten feed (30), and alfalfa hay (5). Antibiotic treatments included control (C), virginiamycin (175 mg/d, V), and monensin/tylosin (250 and 100 mg/d, respectively, MT). Steers were fed at a daily rate of 2.4% of empty BW at 12 h intervals. Each period was 18 d of adaptation and 3 d of ruminal fluid collections. Samples were collected at 0, 2, 4, 6, 8, and 10 h after the morning feeding on d 1 and 2 of collections. On d 3 of collections, rumens were dosed with 350 g of solubilized casein 2 h after the morning feeding to evaluate ruminal protease and deaminase activities. Ruminal fluid samples were collected 1, 2, 3, 4, and 6 h after the casein dose. Antibiotics created few differences in ruminal α-amino N and peptide N on d 1 and 2. After casein dosing, peptide N was unaffected by antibiotics, but α-amino N was increased (P < .05) for V compared to MT and C (8.99 vs 6.61 and 6.98 mM). Relative to MT and C, V reduced ruminal isovalerate (2.85 vs 3.63 and 3.62 mM) and increased ruminal propionate (43.8 vs 27.7 and 33.4 mM) on d 3. CORN+CGF fed to higher (P < .05) ruminal α-amino N (2.11 vs 1.36 mM) and peptide N concentrations (3.09 vs 1.82 mM) compared to CORN+SBM on d 1 and 2. After casein dosing, ruminal peptide N concentrations were similar, but α-amino N was lower (P < .05) for CORN+CGF than CORN+SBM (6.3 vs 9.0 mM). Overall, virginiamycin appeared to depress deaminase activity, and the protein in CORN+CGF appeared to be more ruminally degradable than that in CORN+SBM.

Key Words: Cattle, Antibiotic, Ruminal nitrogen metabolism


Thirty six Angus and Angus x Hereford heifers (314 kg initial BW) were used in a randomized complete block design to compare efficiency of limit-fed fibrous byproduct diets to a limit-fed corn diet or free choice hay for developing yearling beef heifers. Dietary treatments consisted
of: 1) free choice prairie hay (5% CP, DM basis) plus 9 kg soybean meal based supplement (CONT); 2) a whole shelled corn based diet fed at 1.22% of BW with .47% BW hay (CORN); 3) a wheat middlings / soybean hull-based diet fed at 1.42% BW with .47% BW hay (WMSSH); 4) a barley malt sprout-based diet fed at 1.43% BW with .47% BW hay (BMSH). All diets were formulated for .45 kg weight gain per day using 1989 and 1996 National Research Council feed energy values. Preplanned orthogonal contrasts were used to compare differences among treatments. Daily gain was greater (P<.05) for heifers fed concentrate diets (.63 kg) compared to CONT heifers (.51 kg). Daily gain among concentrate-fed groups was similar (.63, .63 and .62 kg/d for CORN, WMSSH and BMSH respectively). Body condition score did not differ among treatments. By design, feed DM intake differed (P<.05) among all groups at 9.19, 4.98, 5.59 and 6.24 kg for CONT, CORN, WMSSH and BMSH, respectively. Gain; feed for the CONT fed diet was lower compared to limit-fed diets (.055 vs .112, P<.01) and gain; feed for CORN (.126) was greater than WMSSH (.112, P=.03) and BMSH (.099, P<.01). Efficiency of WMSSH and BMSH was similar (P = .06). Limit-fed diet tabular net energy values were compared to values calculated from animal performance and DMI. Net energy for gain for CORN, WMSSH and BMSH was 24.7, 26.8 and 27.8% greater than tabular values and did not differ among treatments. We conclude that the improvement in efficiency of limit-fed fibrous by-product concentrate diets is similar to the improvement seen in energy value of corn-based limit-fed diets.

Key Words: Beef, Limit-fed, By-product


Two experiments were conducted to evaluate poultry manure as a crude protein and mineral supplement in high concentrate limit-fed diets to gestating and lactating beef cows. In Exp. 1, 67 gestating beef cows (640 ± 2.86 kg) were allotted by weight to six groups with two groups per treatment. Trial duration was 126 d and began when cows averaged 134 kg in gestation. Limit-fed cows were fed (on a DM basis) 5.3 kg/cow/d treatment. Trial duration was 126 d and began when cows averaged 134 kg in gestation and ended when cows averaged 42 d post-parturition. Cows were allotted by weight to four groups with two groups per treatment. By design, feed DM intake differed (P<.05) among all groups at 9.19, 4.98, 5.59 and 6.24 kg for CONT, CORN, WMSSH and BMSH, respectively. Gain; feed for the CONT fed diet was lower compared to limit-fed diets (.055 vs .112, P<.01) and gain; feed for CORN (.126) was greater than WMSSH (.112, P=.03) and BMSH (.099, P<.01). Efficiency of WMSSH and BMSH was similar (P = .06). Limit-fed diet tabular net energy values were compared to values calculated from animal performance and DMI. Net energy for gain for CORN, WMSSH and BMSH was 24.7, 26.8 and 27.8% greater than tabular values and did not differ among treatments. We conclude that the improvement in efficiency of limit-fed fibrous by-product concentrate diets is similar to the improvement seen in energy value of corn-based limit-fed diets.

Key Words: Beef, Limit-fed, By-product


A metabolism trial was conducted to determine the nutritive value of a food industry byproduct blend fed at two levels and in either unprocessed or extruded form (213 °F; Insta-Pro® model 2000R extruder). Byproduct blend was a recycled food industry waste consisting of 20% cereal waste, 20% candy waste, 20% chip waste, and 40% wheat middlings. Pre-extrusion values for byproduct were DM 94%; CP 11.7%; Lipid 17.2%; NDF 23.3%; and ADF 10.8%. Byproduct (unprocessed and extruded) was substituted for the control diet (C) at two inclusion levels. Twenty Dorset wethers (38.3 kg) were randomly allotted to five isonitrogenous (urea) treatments (DM basis): 7% alfalfa hay and 25% cracked corn (C); 66% unprocessed byproduct; 33% unprocessed byproduct; 66% extruded by-product, and a control diet (C). Preplanned orthogonal contrasts were: 1. C vs. byproduct; 2. unprocessed vs. extruded; and 3. 33% vs. 66% byproduct. Following a 17 d adaptation period, ad-libitum DMI was recorded for 9 d. During the subsequent 7 d total collection period, wethers were fed at 90% of their ad-libitum intake level. Least square means for the five respective diets (and significant*, p < .05) were: ad-libitum DMI (g/h/d), 837±, 997±, 1190±, 1055±, 1021± (1*); and ad-libitum digestible DMI (DDMI, g/h/d), 582±, 719±, 933±, 787±, 754± (1*). Respective digestion coefficients (%) were: DM, 67.7±, 72.0±, 77.8±, 74.6±, 73.1± (1*); CP, 74.6±, 69.4±, 80.1±, 73.0±, 75.6± (3*); lipid, 64.7±, 93.0±, 90.4±, 93.4±, 88.0± (1*); ADF, 47.4±, 32.3±, 58.8±, 43.9±, 49.7± (3*) and NDF, 53.1±, 50.9±, 64.8±, 57.4±, 55.2±. These data suggest that byproduct can substitute for corn in ruminant diets. Ad-libitum DMI and DDMI were 27% and 37% higher in byproduct vs the control diet. However, little benefit was noted for extrusion processing. Further the 66% vs 33% byproduct inclusion level did not result in increased DDMI and was related to depressed fiber digestibility.

Key Words: Byproduct, Digestibility, Extrusion

547 Feed intake of growing lambs fed diets containing oat hulls and soy hulls to provide indigestible neutral detergent fiber. M. L. Thoney* and D. E. Hogue, Cornell University, Ithaca, NY.

Sixty Suffolk-sired lambs out of Finn x Dorset ewes were used to evaluate the effect of high levels of dietary fiber on feed intake of lambs growing for 42 days. Three pens of 2 ewe lambs (initial weight 24 kg) and 2 pens of 2 ram lambs (initial weight 28 kg) were assigned to each of 6 diets. Oat hulls (OH) and soy hulls (SH) provided fiber to make up diets containing 14, 19, or 24% estimated indigestible neutral detergent fiber (INDF). The hypothesis derived from previous results was that, above 14% INDF, additional fiber from OH would increase intake and additional fiber from OH would decrease intake. The 24% INDF OH+SH diet contained the same proportion of OH as the 19% INDF oat hull diet but with SH replacing corn to increase the fiber content. Thus, lambs fed the 24% INDF OH+SH diets were expected to have higher intakes than lambs fed the 19% INDF OH diet. The 24% INDF SH+OH diet contained the same proportion of SH as the 19% INDF SH diet but with OH replacing corn to increase the fiber content. Thus, lambs fed the 24% INDF SH+OH diet were expected to have lower intakes than lambs fed the 19% INDF SH diet. The 2 (fiber source) x 3 (fiber level) factorial arrangement of treatments used pen as the experimental unit and included gender as a block effect. There was a fiber x level interaction (P<.04) for dry matter intake. Lambs fed OH diets consumed 4.0, 3.5, and 4.6% of body weight whereas lambs fed SH diets consumed 3.6. 4.2. and 4.3% of body weight for 14, 19, and 24% INDF, respectively (SE = .20). Average daily gain for ewe lambs was 313 g/day and for ram lambs was 367 g/day (SE = 13.6, P<.07). Neither source nor level of fiber significantly affected growth rate or feed efficiency. Surprisingly, the 4 ram lambs fed the 24% INDF SH+OH diet averaged 453 g of gain/day. This unexplained sex difference in rate of gain within diet contributed to a lack of statistical differences between fiber sources for growth rate. These results support the hypothesis that fiber from OH depresses feed intake compared to fiber from SH when INDF is greater than 14% of the diet.

Key Words: Sheep, Intake, Fiber

548 Ruminal degradable protein requirements of microbes in steers consuming concentrate-based diets. C. J. Fu*, E. E. D. Felton, and M. S. Kerley, University of Missouri-Columbia.

Four cannulated cross bred steers (260±20kg) were used in a 4 x 4 Latin square design to determine the effects of rumen-degradable protein (RDP) on microbial efficiency (MOEFF), nitrogen flow, and digestibility in the rumen. Treatments consisted of four levels of dietary RDP (6.5, 10.5, 14.5, and 18.5% on a DM basis). The basal diet consisted of cracked corn, soybean meal, and cottonseed hulls. Dietary rumen-fermented carbohydrate (RAC) was 66, 63, 58, and 57% on a dry matter basis. Soybean meal and urea was added as an RDP and ammonia

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source, respectively. Dry matter intake was 4.8 kg/d (1.8% of BW). RDP levels had no effect (P > .2) on total nitrogen flow, ruminal pH, particular passage rate (PPR), liquid passage rate (LPR), bacteria nitrogen flow, MOEFF, and ruminal true organic matter digestibility. As RDP level increased, ruminal dry matter digestibility (P < .01), organic matter digestibility (P < .01), ruminal true nitrogen digestibility (P < .03), total truc tary dry matter digestibility (P < .01), total truc tary nitrogen digestibility (P < .01), ammonia (P < .01), and peptide (P < .01) concentration increased linearly. From this study, we concluded that MOEFF was maximized and that the RDP requirement of ruminal bacteria was met at 6.5% on a DM basis. These results were in agreement with previous continuous culture study results (5.5-8.7% RDP at a 3.0%/h dilution rate). In this experiment, degradation rates of RDP and RAC were similar, a requirement when expressing a static RDP requirement. The only effect of increasing RDP was an increased DM digestibility in the rumen. Based upon MOEFF values, the predicted RDP requirement was approximately 7.0% on a DM basis, in agreement with experimental results.

Key Words: RDP, Microbes, Requirement

549 Effect of ruminal versus postruminal administration of degradable protein on utilization of low-quality forage by beef steers. C. A. Bandyk*, R. C. Cochran, T. A. Wickersham, E. C. Tigemeyer, and C. G. Farmer, Kansas State University, Manhattan, KS.

An experiment was designed to determine the effects of ruminal and postruminal infusions of degradable protein (casein) on intake and digestion of low-quality hay by beef steers. Twelve ruminally-fistulated British steers (BW = 563 kg) were assigned to one of 3 treatments: control (C; hay only), or hay plus ruminal (R) or postruminal (P) infusion of 400 g/d of casein. There were 5 periods: 1) 10-d adaptation to hay; 2) 7-d infusion of hay intake; 3) 10-d adaptation to treatments (h take measurements continued); 4) 7-d measurement of hay intake and digestibility; 5) 3-d ruminal sampling. Steers had ad libitum access to tallgrass-prairie hay (3.4% CP, 76.6% NDF). Casein was administered 1X/d before feeding, either directly into the rumen or via anchored infusion lines into the abomasum. Hay intake was increased by supplementation (P<.01). Ruminal infusion elicited a greater (P<.05) increase in hay intake than postruminal. Intake tended (P=.11) to be lower in period 4 than 2 for C animals, but was greater (P<.04) in period 4 than 2 for both R and P. The increase in intake between period 2 and 4 was greater for R than P steers (P<.03). Supplementation improved diet OMD (P=.04), but not NDFD (P=.18). There were no differences in either OMD (P=.42) or NDFD (P=.35) between the R and P treatments. Plasma urea nitrogen samples collected 0 and 3 h after feeding on the last day of the trial were lower (P=.05) for C than R and P, but no difference (P=.48) was evident between R and P. Ruminal ammonia N levels were also increased by supplementation (P<.01), with a much larger increase seen in R steers (P<.01). Total VFA concentrations were not affected by treatment (P=.21), but R steers exhibited lower proportions of isobutyrate, lower proportional size of isobutyrate, and lower proportional size of isobutyrate and isovalerate than P (P<.01). Ruminal infusion elicited a greater increase in hay intake than postruminal. The only effect of increasing RDP was an increased DM digestibility in the rumen. Based upon MOEFF values, the predicted RDP requirement was approximately 7.0% on a DM basis, in agreement with experimental results.

Key Words: RDP, Microbes, Requirement

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Key Words: RDP, Microbes, Requirement


Porcine meat and bone meal (pMBM) samples were obtained from different rendering plants and analyzed for DM, OM, CP, amino acids, hydroxyproline, collagen, fat, ash, Ca, and P in preliminary evaluation of its use as a protein supplement for ruminants. Mean and SD for DM were 92.8 vs 0.78, and 1.7 vs 0.03, respectively. Mean % DM for OM, CP, fat, and ash were 74.7, 59.6, 11.9, and 25.3, respectively; corresponding SD were 3.5, 3.8, 1.8, and 3.5. Collagen was estimated by determining hydroxyproline (% DM) and multiplying by 8. Collagen (% DM) ranged from 13.6 to 30.4 %, which represented a range from 22 to 51% of the average CP among pMBM sources. Mean value for collagen was 23.6 % and the SD was 3.91. In order to determine rate and extent of ruminal N disappearance, triplicate samples of each pMBM (200 g) were packed into polyester bags (8 X 14 cm; pore size 20 to 70 µm), placed in the rumen of 2 steers, and removed after 0, 3, 6, 9, 12, 18, 24, 36, and 48 h. of incubation. A non-linear model (Orskov and McDonald, 1979. J. Agric. Sci. 92:499) was used to calculate the total potentially digested fraction (T), fractional rate of degradation (kd), extent of degradation (ED), and escape crude protein (ECP). Fraction T ranged from 56.8 to 79.6 % of total CP with a mean value of 66.8 and a SD of 6.7. Fractional rate of degradation (%h), ED (% of total CP), and ECP (%DM) ranged from 3.4 to 13.1, 45.6 to 58.6, and 25.5 to 34.5, respectively with corresponding mean values of 7.8, 50.9, and 29.5; and SD of 2.9 , 3.4, and 2.4. These data demonstrates substantial variation in composition and ruminal digestion kinetics among different pMBM sources, which can affect the nutritive value of a given pMBM source for ruminants.

Key Words: Meat and bone meal, Composition, Digestion kinetics

552 Effect of substitution of chickpeas by soybean meal on total tract digestibility of finishing diets for sheep. R. Barajas, J. F. Obregón*, A. Estrada, and J. A. Felix, Universidad Autonoma de Sinaloa (Mexico).

This study was conducted to determine the effect of substituting ground chickpeas for soybean meal on the characteristics of total tract digestion in sheep fed finishing diets. Four male sheep (5/8 Pelibuey/3/8 Dorset blood; 30.4 kg BW) were used in a crossover design consisting of two treatments: 1) Diet 1, 20:80 roughage:concentrate (23.6% CP) containing 30% soybean meal (SBM); and 2) Diet 2, (17% CP) similar to number 1 but containing 30% chickpeas (CHP) substituted for all the SBM. The substitution of CHP for SBM increased (P<.03) total tract digestibility of dry matter (79.36 vs 81.26%), increased (P<.04) total tract organic matter digestibility 2.1% (80.64 vs 82.36%), and decreased (P<.03) total tract crude protein digestibility (81.33 vs 76.68%). The inclusion of CHP increased (P<.04) the DE content of the diet 2.4% (3.39 vs 3.47 Mcal/kg). Using the substitution method, the calculated true digestibility of CHP crude protein was 93.7% and its content of DE was calculated to be 3.91 Mcal/kg. It is concluded that chickpeas can be used as a substitute for soybean meal in diets for finishing sheep.

Key Words: Chickpeas, Digestibility, Sheep
The diet formulation programs for high producing dairy cows are continuously implemented with new parameters for a better balance of the diet being fed to animals. The rumen degradation rates of feeds are important parameters that need to be considered in diet formulation. To calculate synergic effects of feeds into the diet. The object of this work was to calculate predicting equations for the potentially degradable component of the protein fraction (b) based on the CNCPS analytical parameters. Alfalfa hay (n = 26), grass hay (n = 16), corn silage (n = 8) and concentrate (n = 25) samples were analyzed for CNCPS protein fractions (% of cp). The potentially degradable component = ACp, B2cp, B1cp, C2cp, C1cp. Samples (particles size: 5 mm forages ∼ 2 mm concentrate) were incubated (0, 4, 8, 24, 48 and 96 hours) with the nylon-bags technique (12 × 8 cm, 46 µm pore size) in three fistulated cows (513 ± 13 kg live weight) feeding on alfalfa hay (67% on a DM basis), corn silage (22% on a DM basis) and a 26% crude protein content concentrate (11% on a DM basis). Duplicate were observed for each incubation time. Bags were introduced in the rumen before the morning meal. Immediately after removal, bags were washed in tap water until eluate was clear, and placed in a forced-air oven at 65°C until constant weight was reached. Weight of bags with the dried residue was determined for estimating dry matter disappearance. Nitrogen was determined on incubated residues by Kjeldahl method and corrected for dry matter disappearance in each incubation time to estimate ruminal protein degradation. The degradation kinetic parameter b was calculated according to Orskov et al. and regressed on CNCPS parameters according to the stepwise procedure of SAS. The potentially degradable component of the protein fraction can be estimated with adequate accuracy in grass and alfalfa hay and concentrate by using the CNCPS protein and carbohydrates fractions. No equation was obtained for corn silage. Predicting equations can be estimated with adequate accuracy in grass and alfalfa hay. 

**Key Words:** Protein, Ruminants, Soybean meal

### 554 Metabolizable protein estimates of treated soybean meal products. R. A. Mass1, D. J. Jordan1, T. L. Scott, and T. J. Klopfenstein, 1University of Nebraska-Lincoln.

Three treated soybean meal products and commodity soybean meal were evaluated for ruminants. Metabolizable protein (% of CP; MP) of each product was calculated from estimates of undegraded intake protein by the in vitro ammonia release procedure (% of CP; UIP) and true nitrogen digestibility in lambs (% of CP; TND). Two lamb digestion trials consisting of three, 21-d periods each were conducted. For each trial, two bags (45 kg total) of each of the following products were sampled from commercially available lots: nonenzymatically browned soybean meal (SoyPass1, expeller soybean meal (SoyPlus2), a heated soybean meal; soy hull mixture (AminoPlus3), and solvent-extracted soybean meal (SBM). All lambs were fed individually (equal percentage of body weight, DM basis) a base diet which was formulated to be low in UIP but adequate in degradable intake protein: 72.6% cottonseed hulls, 15% dehydrated alfalfa pellets, 5% dry-rolled corn, 5% molasses, 1.5% urea, and .9% vitamins and minerals. Control lambs received only the base diet and treatment lambs received base diet plus an additional 3.75% of base diet DM added as units of N. Treatment contributed 27% of total N intake. The following CP (% of DM), UIP, TND (SE), and MP values were determined for each product in Trial I: SoyPass: 52.7, 80.2, 89.0 (3.1), 69.2; SoyPlus: 48.9, 57.9, 81.4 (3.1), 39.3; AminoPlus: 54.6, 71.4, 81.0 (3.4), 52.4; and SBM: 48.5, 31.2, 91.4 (3.8), 22.6. The same estimates were made for each product (different samples) in Trial II, except that two AminoPlus samples were analyzed because the preliminary UIP estimate of the first sample was low: SoyPass: 52.1, 71.6, 82.4 (3.4); SoyPlus: 52.1, 43.7, 47.0, 69.5 (3.3), 16.5; AminoPlus #1: 51.4, 55.8, 84.6 (3.1), 40.4; AminoPlus #2- 53.9, 67.1, 79.6 (3.4), 46.7; and SBM- 48.4, 29.6, 91.6 (3.4), 21.2. Differences in TND exist both within and among products and those differences may be due to temperature conditions of each process. Regular monitoring of the UIP content of treated soybean meal products is merited.

**Key Words:** Non-enzymatically Browned Soybean Meal, Beef Cattle, Growing


Seventy-two individually fed Angus x Hereford steers (292 kg) were used to evaluate the effects of supplementing limit-fed, growing diets with either soybean meal (SBM; 28% UIP) or non-enzymatically browned soybean meal (NEBSBM; 82% UIP) on steer performance. Steers were stratified by weight and randomly allotted, within strata, to one of nine treatments. Eight steers were allotted to a control diet composed of 40% high-moisture corn, 42% cottonseed hulls, 5% cane molasses, 2.25% urea and 1.75% vitamins and minerals on a DM basis. The remaining steers were allotted to each of four protein levels within each SBM source. Levels of SBM were 100 (6.5% CP), 80 (4.9% CP), 60 (3.2% CP) and 40% (1.6% CP) of supplemental N as SBM, with the balance of supplemental N provided as urea. Levels of NEBSBM were 60 (3.9% CP), 45 (2.9% CP), 30 (1.9% CP) and 15% (1% CP) of supplemental N as NEBSBM, with the balance of supplemental N as urea. All diets were formulated to contain 13.0% crude protein on a DM basis. Steers were fed once daily at 2.25% of BW for 80 d. Data were analyzed by regression using the level of supplemental protein from each source as a continuous variable, nested within supplement source (SBM or NEBSBM). Gain and efficiency did not differ between sources (ADGSBM = 0.878 + 0.047(%CP from SBM); ADGNEBSBM = 0.878 + 0.044(%CP from NEBSBM); gain to feedSBM = 0.140 + 0.006(% CP from SBM); gain to feedNEBSBM = 0.140 + 0.005(% CP from NEBSBM)). The growth response to SBM supplementation suggests that degradable intake protein may have been limited in the basal diet.

**Key Words:** Non-enzymatically Browned Soybean Meal, Beef Cattle, Growing

The objective was to correlate PUN levels to weight gain in response to different dietary protein regimens for steers. Angus steers (average initial weight, 302 kg) were assigned to five levels of dietary N (control plus supplemental N to provide from 100 to 400 g more crude protein daily). The highest level of supplemental N (soybean meal [SBM]) or a mixture of two parts corn gluten meal: one part blood meal (CGM:BM). There were 6 or 7 steers in each level X source. They were housed in groups of 12, and fed individually for 84 d. SBM or CGM:BM was combined with corn grain, vitamins, minerals and an ionophore to make a total of .89 kg supplement daily. Corn silage (55% DM, 6.52% CP) was fed at a restricted rate to minimizeorts. Jugular blood samples were collected at the end of the experiment. Break-point analysis of gain predicted that maximal ADG of steers fed SBM (1.0 kg) was reached with 173 g/d supplemental protein or 524 g/d total crude protein. Maximal ADG of steers fed CGM:BM (.91 kg) was reached with 133 g/d supplemental protein or 479 g/d total crude protein. Maximal ADG of steers fed SBM (1.0 kg) was reached with 173 g/d supplemental protein or 524 g/d total crude protein. DMI was lower (P <.05) for control (5.61 kg/d) than for steers fed SBM or CGM:BM (6.12 kg/d), and higher (P >.05) for SBM (6.42 kg/d) than CGM:BM (6.22 kg/d). PUN was 1.60 mg/dl for steers fed control. PUN increased linearly (P <.05) from 2.44 to 9.02 mg/dl for steers fed SBM, but increased quadratically (P <.08) from 2.74 to a maximum of 6.33 mg/dl for steers fed 300 g/d supplemental protein from CGM:BM. Increasing calculated ruminal escape protein from 36% (SBM) to 65% (CGM:BM) supported similar weight gain of growing steers, but decreased endogenous production of urea. Neither protein source improved ADG at CP levels that provided more than 9% CP in the diet.

Key Words: Protein, Urea, Growth


Seventy-seven crossbred steers with an initial weight of 238 kg (±13) were utilized in a completely randomized receiving study. Diets were formulated with the 1996 Beef NRC model to supply one of three amino acid:energy levels. A combination of bloodmeal and fishmeal was top-dressed for the adequate (A) and high (H) treatments at levels which synchronized the predicted amino acid and energy allowable daily gain or provided an amino acid allowable gain 25% above the energy allowable gain. Diets consisted of chopped hay, dry corn, whole soybeans and a corn based supplement. Hay was replaced with 10% dry corn weekly to achieve 20% hay in the diet during the last week. The low (L) treatment contained 20% whole soybeans with an amino acid allowable gain less than the energy allowable gain. Calves were weighed weekly and bunk samples were taken twice weekly. Diets averaged 19.4%, 16.5%, 17.2%, 16.5%, 15.9%, 16.8%, 19.0%, 18.2%, and 20.4% crude protein for L, A, and H, respectively by week. There were no differences (P >.17) for BW or ADG during the last week. The low (L) treatment contained 20% whole soybeans with an amino acid allowable gain less than the energy allowable gain. The high (H) treatment contained 40% whole soybeans with an amino acid allowable gain greater than the energy allowable gain. There were no differences (P >.05) for control (5.61 kg/d) than for steers fed SBM or CGM:BM supported similar weight gain of growing steers, but decreased endogenous production of urea. Neither protein source improved ADG at CP levels that provided more than 9% CP in the diet.

Key Words: Protein, Urea, Growth

559  Ciliate protozoal populations in the rumen of cattle fed high concentrate, barley-based diets. A. N. Hristov*, M. Ivan, L. M. Rode, and T. A. McAllister, Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB.

Fermentation characteristics and the concentration and genera distribution of ciliate protozoa in the rumen were measured in 10 ruminally cannulated steers fed barley-based backgrounds and finishing diets. The steers (451±11.1 kg) were gradually adapted to a diet consisting (ad libitum) of 59% sorghum and 41% barley silage in two treatments (diets 1 and 2). After 30 d on diet 1, they were adapted to a diet of 85% rolled barley, 10% barley silage and 5% soybean meal (diet 2). Samples of ruminal contents were collected at 5-d intervals over the 30-d immediately following adaptation to each diet. Rumen pH and ammonia concentration were lower (P <.001) with diet 2 than with diet 1. Soluble protein concentration was higher (P <.001) and concentrations of reducing sugars and total free amino acids tended to be higher (P < 0.1 and P = 0.102, respectively) with diet 2 than with diet 1. Total protozoal counts were 42% lower (P <.01) with diet 2, and varied significantly with animal and sampling day. On diets 1 and 2, respectively, Entodinium spp. made up 79.9 and 81.1% of the ciliate protozoal populations. Increasing concentrate in the diet from 60 to 90% decreased (P <.05) the number of protozoa in all genera (except Epidinium, numerically lower). With diet 1, relative proportions of Dasystricha, Ophryoscolex, Ostrocodinium, Diplodinium and Metadinum spp. in the total ciliate population were 4.5, 0.4, 0.5, 0.7, and 0.3%, respectively. When diet 2 was fed, these genera were not detected. Over the course of the experiment only two ruminal samples (one on diet 1, day 5 and one on diet 2, day 15) were free of protozoa, but the effect was transient. As the concentrate level increased from 60 to 90%, protozoa were present in all 10 samples; eight of the 10 contained >10^7 per cm^3. These data demonstrate that large, diverse protozoal populations can persist in the rumen of cattle fed diets high in barley grain. Thus, the role of ciliate protozoa in ruminal metabolism of nutrients under these dietary conditions warrants reevaluation.

Key Words: Rumen ciliates, Finishing cattle, Barley

560  Effect of dietary concentrate level on polysaccharide-degrading enzyme activities and bacterial distribution in the solid and liquor fractions of in vitro ruminal digesta. Q. Meng*, X. Xiao1, Z. Xia1, L. Lu1, and W. Gao1, 1 College of Animal Science & Technology, China Agricultural University.

A dual-flow continuous culture system with 12 fermenters was used to study the effect of dietary concentrate level on the activity of polysaccharide-degrading enzymes and the distribution of bacterial populations in the solid and liquor fractions of in vitro ruminal digesta. Solid and liquid dilution rates were 0.04 and 0.08 of fermenter volume per hour, respectively. Six diets with concentrate levels of 0, 20, 40, 60, 80, and 100% were formulated with rice straw, ground corn, alfalfa and cotton-seed meal as primary ingredients. In vitro ruminal digesta was sampled when a steady-state of incubation was achieved after 7-day's adaptation. Liquid fractional bacteria were collected by passing through 8 layers of cheesecloth. Solid-associated bacteria were obtained by filtration prior to homogenizing squeezed solids in a pre-cooled (4°C) anaerobic salts solution. Xylanase, carboxymethylcellulase (CMCase) and amylase activities were measured. Viable bacteria including cellulolytic, amylolytic and whole populations associated with digesta solids and liquor fractions were anaerobically counted. As the concentrate level increased, there was an increase in the activity of xylanase (quadratic, P <.03), CMCase (quadratic, P <.01) and amylase (linear, P <.03) in the digesta solids, whereas no significant (P >.10) change in the activity occurred in liquor fractions. At all concentrate levels, polysaccharide-degrading enzymes were more active in the solid fraction than those in the liquor fraction. Assessment of the numbers of viable bacteria indicated that the cellulolytic, amylolytic and whole bacterial populations from both digesta solids and liquor fractions increased (P <.01) with increasing dietary concentrate levels. The numbers of cellulolytic, amylolytic, and whole bacteria collected from digesta solids averaged 37.4% (ranged from 6.9 to 62.3%), 26.1% (ranged from 11.6 to 46.3%) and 18.4% (ranged from 6.1 to 38.4%), respectively. The number of bacteria distributed in the digesta solids varied with the dietary concentrate. The numbers of bacteria were linearly correlated with reducing sugars and total free amino acids (R^2 =.79, P <.0177), CMCase activities and cellulolytic bacterial counts (R^2 =.77, P <.0218), and amylase activities

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and amylolytic bacterial counts (R^2=0.55, P<0.024) in digesta solids, respectively.

**Key Words:** concentrate level, polysaccharide-degrading enzyme, ruminal bacteria


*Escherichia coli* O157:H7 (EC) and *Salmonella* Typhimurium DT104 (ST) are important food borne pathogens affecting the beef industry and strategies are sought to rid these from slaughter cattle. As members of the family *Enterobacteriaceae*, both pathogens possess respiratory nitrate reductase. Since most ruminal anaerobes lack nitrate reductase, and since most known respiratory nitrate reductases also reduce chlorate to cytotoxic chlorite, we hypothesized that chlorate may selectively inhibit EC and ST. To test this, ruminal fluid, collected from a cannulated cow maintained on pasture (predominantly rye grass), was mixed 1:1 with phosphate buffer (pH 6.8) containing cellobiose, glucose, soluble starch, and xylose (1% wt/vol each). The buffered ruminal fluid was incubated anaerobically (39°C) in duplicate with or without 5 mM sodium chlorate and either 5.9 ± 0.06 log_10 colony forming units/ml (cfu/ml) of a novobiocin (NO) and nalidixic acid (NA) resistant EC or 5.4 ± 0.08 log_10 cfu/ml of ST. Colony counts for EC were determined via direct plating on MacConkey agar containing 25 µg NO/ml and 20 µg NA/ml and for ST via plating on Brilliant Green agar containing NO and chloramphenicol (25 µg/ml each). Concentrations of EC declined slightly to 5.1 ± 0.01 log_10 cfu/ml following 24 h incubation in ruminal fluid without added chlorate but declined rapidly to below our level of detection (<1 log_10 cfu/ml) by 6 h when incubated with added chlorate. Concentrations of ST declined to 1.7 ± 0.04 - 4.1 ± 0.07 log_10 cfu/ml when incubated 24 h with or without added chlorate, respectively. Sodium nitrate (2.5 mM), when added to ruminal fluid containing chlorate, caused ST concentrations to decline to ≤1 log_10 cfu/ml following 24 h incubation, presumably by inducing expression of nitrate reductase. As expected, chlorate addition had little effect on the most probable number of culturable anaerobes (ranging from 9.9 ± 0.72 to 10.7 ± 0.01 log_10 cells/ml).

**Key Words:** *Escherichia coli* O157:H7, *Salmonella* Typhimurium DT104

562 Isolation and characterization of a succinate-degrading bacterium from the rumen. T. L. Weddington*, D. M. Hopkins, H. J. Strobel, and K. A. Dawson, University of Kentucky, Lexington, KY.

Succinate-containing enrichment media were used to selectively enrich and isolate gram-negative, rod-shaped, anaerobic bacteria from the rumen of a heifer fed a fescue hay-based diet. Most probable number enumeration procedures indicated that succinate degrading organisms were present at concentrations of at least 100 million organisms/ml. A representative isolate (TL7) stoichiometrically decarboxylated one mole of succinate to one mole of propionate. Succinate was the only substrate that sustained growth of this isolate. Evaluation of the gene sequence encoding for the 16S ribosomal RNA subunit suggests that this isolate represents a previously undescribed species of ruminal bacteria. Yeast extract was a required constituent in a semi-defined minimal medium and a mixture of 2-methylbutyrate, iso-butyrate and iso-valerate enhanced but were not a requirement for growth. Studies indicate that TL7 was resistant to monensin at concentrations of 2.5 mg/ml. The ability of TL7 to decarboxylate radiolabeled succinate was compared with that of *Stenomonas ruminantium* strain HD4 and the succinate-degrading organism, *Schwartzia succinovarans* strain 10052. The affinity (Km) for succinate was similar in TL7, HD4 and 10052 (mean of 4.18 ± 2.31 mM). However, the theoretical maximum decarboxylation rate was greater for TL7 and 10052 as compared to HD4 (114.07 and 221.23 vs. 6.17 µmoles/mg protein/h, respectively). After 72 h, the rate of end product formation from filter paper cellulose in cultures of *Fibrobacter succinogenes* strain S85 was 4-fold greater when strain TL7 was included (9.40 vs. 35.75 mM). Propionate was the major end-product in cultures containing both S85 and TL7 and succinate were the predominant end-products measured in cultures containing S85 alone. The data from these studies suggest that this newly recognized group of succinate-decarboxylating organisms may play an important role in propionate formation in the rumen.

**Key Words:** Propionate, Ruminal bacteria, Succinate

563 Effects of defined xylanase and cellulase enzyme preparations on digestive processes of ruminal microbial cultures. J. M. Tricárico and K. A. Dawson, University of Kentucky, Lexington KY.

The use of supplemental exogenous enzyme preparations in ruminants has yielded variable results. We performed a series of studies to examine the effects of defined xylanase and cellulase enzyme preparations on digestion of fescue hay by ruminal microorganisms. In vitro batch cultures were established with rumen fluid from a heifer fed a 50% fescue hay: 50% concentrate diet. Cultures were supplemented with enzyme and incubated at 39°C for 12 h under anaerobic conditions. Addition of xylanase at 135 IU/mL rumen fluid enhanced total volatile fatty acid (VFA) production (44.3 vs. 57.2 mM; P<0.05) and estimated hexose utilization rate (1.95 vs. 2.52 mmol/h; P<0.05). This level of xylanase addition enhanced acetate (27.2 vs. 34.4 mM; P<0.05), propionate (7.5 vs. 9.9 mM; P<0.05) and butyrate (5.3 vs. 7.2 mM; P<0.05) productions. Lower levels of xylanase addition (1.35 and 13.5 IU/mL rumen fluid) had no effects on VFA production or hexose utilization rates. On average, addition of cellulase (2, 3, 4 and 5 CMC U/mL rumen fluid) enhanced total VFA (36%) and estimated hexose utilization rates (40%). The lowest level of cellulase addition resulted in higher acetate (19.2 vs. 24.8 mM; P<0.05), propionate (5.2 vs. 7.0; P<0.05) and butyrate (26.2 vs. 4.1; P<0.05) concentrations without affecting the acetate:propionate ratio (A:P ratio). As the level of cellulase supplementation increased (3, 4 and 5 CMC U/mL rumen fluid) the A:P ratio decreased (3.7 vs. 2.7, 2.2 and 1.8; P<0.05, respectively). The combined addition of xylanase (135 IU/mL) and cellulase (5 CMC U/mL) resulted in higher total VFA production (40.9 vs. 61.5 mmoles/h; P<0.05) and estimated hexose utilization rates (1.88 vs. 3.08 mmol/h; P<0.05). Although acetate production increased when both enzymes were added (26.5 vs. 28.0 mmoles; P<0.05), the A:P ratio decreased markedly (3.4 vs. 1.5; P<0.05). These observations indicate that defined exogenous enzyme preparations differ in their abilities to affect fermentation of fescue hay by ruminal microbial cultures.

**Key Words:** Ruminants, Digestion, Enzyme supplements

564 In vitro effects of steroidal saponins from *Yucca schidigera* extract on rumen microbial protein synthesis and ruminal fermentation. Y. Wang¹, L. J. Yanke¹, Z. Xu¹, P. R. Cheeke², and T. A. McAllister¹, ²Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB, ²Desert King International, Chula Vista, CA.

A crude butanol extract prepared from *Yucca schidigera* powder was added to *in vitro* incubations of ground barley grain in ruminal fluid to determine the effects of steroidal saponins (SAP) on rumen microbial protein synthesis and ruminal fermentation. Prior to incubation, ruminal fluid was centrifuged (1,000 x g) to remove protozoa and small feed particles. Extract was included to provide 0 (control), 15, 75 or 225 µg/mL SAP (as smlagenin equivalents). Incorporation of [15N](NH_4)_2SO_4 into microbial protein was increased (P<0.05) by 15 µg/mL SAP, but was decreased (P<0.05) by 225 µg/mL SAP. Gas production, VFA production and microbial protein synthesis were quadratically (P<0.05) related to SAP concentration. Gas and VFA production peaked at 75 µg/mL SAP, and were elevated (P<0.05), relative to the controls, at this concentration of SAP. Acetate:propionate ratios in the incubation fluid were linearly reduced (P<0.01) by SAP from 8 to 24 h of incubation. Throughout the incubation (2 to 24 h), SAP at 75 and 225 µg/mL increased (P<0.05) reducing sugar concentrations, but SAP at 15 µg/mL did not affect them. Over 2, 4 and 8 h of incubation, β-glucanase activity (measured as release of reducing sugars) was linearly increased (P<0.05) by SAP, but it was reduced (P<0.05) at 12 and 24 h by SAP at 225 µg/mL. A quadratic relationship between the concentration of SAP and their effects on microbial synthesis and fermentation of barley in vitro was clearly demonstrated. This relationship, and the alterations to fermentation that were observed in the present study are recorded important potential effects on fermentation of barley-based feedlot diets. Thus, SAP from *Yucca schidigera* could be effective for increasing propionate production and
rumen microbial protein synthesis in ruminants fed high barley diets, but optimum application rates remain to be defined.

**Key Words:** Steroidal saponins, In vitro ruminal fermentation, Microbial N

**565 Demonstration of endosymbiotic methanogens and hydrogenosomes in ruminal protozoa from sheep.** R. J. Wedam*, M. L. Nelson, and V. R. Franceschi, .

Fluorescence microscopy (using autofluorescence of F4 280, a reduction enzyme from the methylene pathway) and transmission microscopy were used to study endosymbions and hydrogenosomes in entodinomorph protozoa from the rumen of a sheep fed an alfalfa diet. Fluorescence microscopy was used to demonstrate the presence of endosymbiotic methanogenic bacteria. Surface area was measured and methanogenic endosymbions counted in randomly selected protozoa stained for 0, 6.5, and 18h. Data were analyzed as a completely randomized design. Transmission electron microscopy was used to visualize hydrogenosomes, endosymbions and their physical relationship. Protozoal surface area (190.3 ± 33.10 µm²) and number of methanogenic endosymbions/protozoa area, µm² (2 ± 0.4) did not differ (P > 0.10) across duration of culture starvation. Results show these methanogens were symbions and not ingested bacteria being degraded in digestive vacuoles. With these imagery techniques, it was noted that the methanogens tended to congregate into one area of the protozoal endoplasm, which was presumably most metabolically active. Additionally, the close physical proximity between hydrogenosomes and endosymbions, but not direct physical contact, was shown.

**Key Words:** Rumen Protozoa, Methanogenic Bacteria, Microscopy

**566 Inoculation with Lactobacillus buchneri increases the acetate and propionate content of barley silage resulting in improved aerobic stability.** N. K. Ranjit, L. Kung, Jr.*,1, J. M. Robinson1, and K. K. Kreikemeier2, 1University of Delaware, Newark, 2Biotial, Eden Prairie, Minnesota

*Lactobacillus buchneri* (LB) at 3 different levels as silage inoculant was compared with one biological and one chemical additive. Barley (36.7% DM) was ensiled in triplicate 20-L laboratory silos after the following treatments: 1) Untreated; 2) LB, 1 x 10^6 cfu/g of fresh forage; 3) LB, 5 x 10^5 cfu/g; 4) LB, 1 x 10^6 cfu/g; 5) Biotal Plus (*Lactobacillus plantarum, Pediococcus pentosaceus* and *Propionibacterium freudenreichii*), 1 x 10^6 cfu/g; and 6) TMR-Mate®TM4 (a buffered propionic acid based product), 2 g/kg. After 120 d of ensiling, acetate contents were resulting in improved aerobic stability. Yeast counts of silages were low (< 1000 cfu/g). Aerobic stability of silage or TMR was determined as the number of erythrocytes. Concentrations of Se plateau in serum within a couple of weeks after a Se intake whereas Se levels in whole blood and albumin and glutathione peroxidase increase for months. Concentrations of Zn and Cu in plasma remain within normal ranges even though intakes of Zn and Cu can vary several-fold. Diets severely deficient in Zn will cause plasma Zn to drop within days. Plasma Cu values are not reduced substantially until liver reserves of Cu are depleted to < 40 µg Cu/g of liver DM. Infection, stress, pregnancy, and hemolysis influence plasma concentrations of Zn, Cu and Se; concentrations of Cu are lower in serum than plasma. Concentrations of Mn in plasma are low and poorly correlated with Mn intakes. Serum Co is a poor measure of B12 status and either measurement of liver B12 or metabolite accumulation is needed for assessment. The trace mineral status of animals is better described by analyses of liver than blood. Improvements in sensitivity of blood measures to assess trace mineral status await determination of the most critical metallo-activity. At present, metallo-enzyme activities are seldom more useful than concentrations of minerals in plasma and often are impractical because of loss of activity in shipment to the laboratory. Perhaps the ultimate assessment is response of animals to supplementation.

**Key Words:** Dyes, Microbes, Rumen Fluid

**567 Use of the reducible dyes resazurin, 2',6'-dichlorindophenol and methylene green to estimate rumen microbial numbers.** R. E. Dodson*, S. A. Ericsson1, K. L. Sternes1, T. W. Downing2, and P. H. Purdy1, 1Sul Ross State University, Alpine, Texas, 2Oregon State University, Corvallis, Oregon

The objective of this study was to determine if reduction of the dyes resazurin (blue) to pink or colorless, 2',6'-dichlorindophenol (DCIP) (blue to colorless) and methylene green (green to colorless) could be used to assess the number of rumen microbes. Rumen samples were collected with a stomach tube and rumen fluid from Holstein dairy cows (n=79) and the number of bacteria and protozoa were determined using 400x phase contrast microscopy. Rumen samples were identified as having below the average number of microbes (< 10^{10} bacteria and < 10^7 protozoa/ml), or containing at least the average number of rumen microbes (≥ 10^{10} bacteria and ≥ 10^7 protozoa/ml). A 50 µl drop of resazurin (0.338 mM), DCIP (1.034 mM), or methylene green (0.045 µM) was added to separate 1 ml aliquots from each sample and observed to determine the amount of time required for a visual change in the color of the dye. Predictive value theory statistics were used to analyze the data. Specificity is the ability of a test within a set time, to detect a change in dye color in a rumen sample known to contain at least the average number of microbes. The negative predictive value (NPV) is the probability that an unknown rumen sample will have at least the average number of microbes if the dye changed color within a set time limit. All the dye tests had a NPV of 100% at varying times, resazurin to pink (0.5-1 min) or colorless (1.5 min), DCIP (0.25-0.5 min) and methylene green (0.5-1 min) showing that these dyes can be used to determine if unknown samples contain at least the average number of rumen microbes. Sensitivity and positive predictive value (PPV) is the ability of a test to detect an absence of change in dye color in a rumen sample containing less than the average number of microbes in known and unknown samples, respectively. All of the dye test sensitivities and PPVs were 0%. These results suggest that the dye tests are accurate for predicting if samples contain at least the average number of microbes.

**Key Words:** Cattle, Sheep, Minerals

**568 Assessment of trace mineral status of ruminants.** R. L. Kincaid*,1 Washington State University, Department of Animal Sciences

Assessment of trace mineral status of ruminants requires that the objective be clear; i.e., to determine the prevalence of a deficiency within a population, the mean of a population, or to detect differences due to treatments. The number of needed samples depends upon herd size, expected prevalence, and estimated standard deviation. Diet analysis provides very useful supporting data if all dietary components are sampled and intakes known. The bioavailability of minerals is affected by forage species and processing, relative ratio of forage to concentrate, and interactions with other minerals. Concentrations of Cu and Se in whole blood change slowly with shifts in intake because of the 120-day lifespan of erythrocytes. Concentrations of Se plateau in serum within a couple weeks of an increase in Se intake whereas Se levels in whole blood and albumin and glutathione peroxidase increase for months. Concentrations of Zn and Cu in plasma remain within normal ranges even though intakes of Zn and Cu can vary several-fold. Diets severely deficient in Zn will cause plasma Zn to drop within days. Plasma Cu values are not reduced substantially until liver reserves of Cu are depleted to < 40 µg Cu/g of liver DM. Infection, stress, pregnancy, and hemolysis influence plasma concentrations of Zn, Cu and Se; concentrations of Cu are lower in serum than plasma. Concentrations of Mn in plasma are low and poorly correlated with Mn intakes. Serum Co is a poor measure of B12 status and either measurement of liver B12 or metabolite accumulation is needed for assessment. The trace mineral status of animals is better described by analyses of liver than blood. Improvements in sensitivity of blood measures to assess trace mineral status await determination of the most critical metallo-activity. At present, metallo-enzyme activities are seldom more useful than concentrations of minerals in plasma and often are impractical because of loss of activity in shipment to the laboratory. Perhaps the ultimate assessment is response of animals to supplementation.

**Key Words:** Cattle, Sheep, Minerals

**569 Performance and lipid and cholesterol metabolism in finishing steers fed varying concentrations of copper.** T. E. Engle* and J. W. Spears, North Carolina State University, Raleigh, NC.

Forty-eight Angus and Hereford-Angus crossbred steers (average initial BW 329 kg ± 4.1) were utilized to determine the effects of copper (Cu)
on performance and lipid and cholesterol metabolism. Steers were stratified by weight within breed and randomly assigned to treatments. Treatments consisted of 0 (control, no supplemental Cu), 10, and 40 mg of supplemental Cu (as trisbacic Cu chloride)/kg diet DM. The growing diet was a corn silage-soybean meal based diet that analyzed 10 mg of Cu/kg diet DM. The growing diet was fed for 42 d. Animals were then switched to a high concentrate finishing diet that analyzed 5.0 mg of Cu/kg diet DM. Steers remained on the same dietary treatment during both the growing and finishing phases. Steers were housed in pens equipped with individual electronic Calan gate feeders. Equal numbers of steers per treatment were slaughtered after receiving the finishing diets for either 112 or 124 d. Average daily gain over the finishing period was higher (P <.06) and final body weights were higher (P <.09) in the steers receiving supplemental Cu. Liver Cu concentrations were higher (P <.05) in steers receiving supplemental Cu at the end of the experiment. Steers supplemented with 40 mg of Cu/kg diet DM had higher (P <.05) liver Cu concentrations than those supplemented with 10 mg of Cu/kg diet DM. Serum total cholesterol concentrations were reduced (P <.05) by 84 d and at subsequent sampling dates in steers supplemented with Cu. Serum nonesterified fatty acid concentrations tended to be higher (P <.11) on d 70 and plasma reduced glutathione was reduced (P <.09) on d 84 in animals receiving supplemental Cu. Backfat depth was lower (P <.10) in steers receiving supplemental Cu, but marbling scores were similar across treatments. These results indicate that Cu addition to a finishing diet containing 5 mg of Cu/kg diet DM alters lipid and cholesterol metabolism in steers.

Key Words: Cattle, Copper, Cholesterol

570 Effect of dietary copper level and high sulfate water on copper metabolism and growth in cattle, C. L. Wright*, J. W. Spears, T. E. Engle, and T. A. Armstrong, North Carolina State University, Raleigh, NC.

This experiment was designed to determine the effects of supplemental Cu and high SO₄ water on Cu metabolism and growth of cattle. The experiment was divided into an 84-d depletion phase and 70-d repletion phase. In the depletion phase, twenty-nine Angus and Angus x Hereford heifers were blocked by weight and randomly assigned to one of two treatment groups. One treatment received ad libitum access to water containing 1500 mg SO₄/L added as MgSO₄, the remaining treatment received control water. In the depletion phase, all heifers were individually fed a corn silage-soybean meal based diet that contained 6 mg Cu/kg dm and 1 mg Mo/kg dm. Rumen soluble Cu decreased (P <.01) in calves receiving high SO₄ water. High SO₄ water reduced (P <.01) liver Cu on d 42 and d 84. In the repletion phase, heifers continued to receive their appropriate water treatment and were assigned to one of three dietary treatments. Dietary treatments included: 1) basal diet (CON), 2) basal diet + 10 mg Cu/kg as CuSO₄ (10Cu), 3) basal diet + 100 mg Cu/kg as CuSO₄ (100Cu). The basal diet from d 0 through d 36 was a corn silage-soybean meal based diet that contained 6 mg Cu/kg DM. On d 37 the basal diet was changed to a corn-cottonseed hull based diet which contained 5 mg Cu/kg DM. Cattle given high SO₄ water continued to have reduced (P <.01) liver Cu during the repletion phase. Liver Cu was increased (P <.01) in the 100Cu diet relative to the 10Cu and CON treatments, and tended to be greater (P <.07) in the 100Cu treatment relative to the CON treatment. Rumen soluble Cu was increased (P <.01) in the 100Cu treatment relative to 10Cu and CON treatments. Copper supplementation decreased (P <.03) ADFI. Feed intake from d 37 to d 70 was depressed (P <.04) in the 100Cu diet relative to 10Cu. Neither Cu supplementation nor high SO₄ water affected plasma ceruloplasmin, bilirubin, Cu, feed efficiency, or hepatic copper. High SO₄ water decreases liver Cu and rumen soluble Cu. High levels of supplemental inorganic Cu depress intake and increase hepatic Cu stores in the presence of high SO₄ water.


A laboratory procedure was conducted to determine the trace mineral solubility in a free-choice mineral supplement (ProPhos 10 E-EXTRA, Farmland Industries, Kansas City, MO) treated with or without petrolatum (PET). Petrolatum has recently been used to prevent moisture penetration into free-choice mineral supplements to enhance the weathering ability. Petrolatum was heated to its’ melting point and 3% blended into the mineral supplement for 3 min with a paddle mixer speed of 58 rpm. Zero, 1, 2, 4, 8 and 10 g of treated and untreated mineral supplement was placed into 125 ml erlenmeyer flask. Ruminal fluid from 4 ruminally cannulated cows fed either a high roughage diet (n=2; 50% cottonseed hulls; CSH; 40% steam-rolled corn, SRC; 10% protein-mineral-vitamin supplement; PMV) or a high concentrate diet (n=2; 10% CSH, 80% SRC and 10% PMV) was collected, composited by diet type and 100 ml added to each erlenmeyer flask. Flasks were incubated in a 39°C water bath for 30 min. Each treatment combination was replicated 3 times. After incubation, flask contents were filtered. Supernatant was diluted and analyzed for Zn, Cu, Mn and Fe via inductively coupled plasma argon spectrophotometry. Source of ruminal fluid or addition of PET did not affect the solubility of Zn, Mn or Fe in any of the incubations (P >.10). As level of mineral supplement increased, the amount of soluble Zn and Mn in the incubation vessel increased (P <.0001). Copper solubility was 46% less (P <.0082) when PET was included in the supplement compared to the non-treated control. As level of mineral supplement increased the amount of soluble Cu increased (P <.0001). These data indicate that including PET into this mineral supplement did not affect the solubility of Zn, Mn and Fe, but, reduced Cu solubility by 46%. These differences could be related to characteristics of specific mineral salts added to the supplement. In this study, sulphate was used to provide added Cu and oxide was the predominant source of added Zn, Mn and Fe.

Key Words: Mineral, Solubility, Supplement

572 Effect of decreasing dietary phosphorus on nutrient balance in beef feedlots. G. E. Erickson*, C. T. Milton, and T. J. Klopfenstein, University of Nebraska, Lincoln, NE.

The effect of decreasing dietary P on mass balance in the feedlot was evaluated in two experiments with calves from November to May (183 d) and two experiments with yearlings from May to October (137 d). The conventional diet (CON) consisted of dry-rolled corn and 7.5% alfalfa average 40% P for all four experiments. A lower phosphorus diet (LOWP) was formulated to not exceed the NRC-predicted requirements, averaging 22% P for yearling and 30 to 22% P for calf experiments. LOWP was changed every 14 d for calves and 28 d for yearlings to minimize overfeeding. P balance was evaluated by measuring P intake, manure removed, soil on the pen surface, and runoff. P retention in the animal was similar (P >.20) for both diets due to similar (P >.15) ADG, resulting in .88 and 1.11 kg/steer retained for yearlings and calves, respectively. Efficiency of dietary P use was increased by feeding LOWP because 26.7 and 24.7% of dietary P was retained in steers fed LOWP, whereas only 14.9 and 16.3% was retained in steers fed CON for yearlings and calves, respectively. P excretion was decreased (P <.01) by feeding LOWP. However, P removed in manure was not different (P >.15) between treatments. P in runoff ranged from 1 to 4.7% of P fed for both diets. More soil P from the pen surface was removed from LOWP (P <.10) which explains the similarity of P in manure between treatments. Correcting manure for soil P results in 1.08 and 2.62 kg of P/steer with yearlings and 3.03 and 4.68 kg of P/steer with calves for LOWP and CON, respectively. Mass balance did not account for all the P excreted, suggesting that 47% of the P from yearlings and 12% from calves is either being lost or was not accounted for in soil, manure or runoff. No differences were observed between treatments for amount of P lost in three of the four experiments suggesting that the influence is on absolute amount of P. These results suggest that decreasing dietary P will improve efficiency of P use and decrease P excretion into the environment without adverse effects on ADG.

Key Words: Phosphorus, Nutrient management, Requirement

573 In Situ Rumen Degradability of Processed Kitchen Wastes. J. J. Lechner*, B. A. Altizio, and M. L. Westendorf, 

Productive ruminants require a source of dietary rumen escape or undegradable protein (UIP), which are often quite expensive. We performed a study to determine if a less expensive product, dry, processed food waste, could serve as an UIP source. We compared in situ degradability of soybean meal (SBM), pelleted food waste plus wheat middlings (FWW) and pelleted food waste plus corn (FWC). Both food waste (FW) samples were acquired from Nutrafeed Corp. (Clermont, FL), and contained approximately 35% food waste and 65% wheat middlings or corn. Samples (10g) were placed in dacron bags (Ankom Tech.)
having a pore size of 50 ± 15 microns, heat-sealed and pre-washed. Bags were placed in the rumen of a cannulated Holstein heifer and incubated for 0, 4, 8, 12, 16, 24 and 48 h, with 4 replicates per treatment and time. Residues were analyzed for DM, CP and ADF disappearance with results reported as percent disappearance (mean ± SEM). Data were analyzed by a two-way ANOVA, with time and treatment as main effects. DM, CP and ADF disappearance for all main effect comparisons were significantly different at \( p < 0.05 \). DM disappearance at 12 and 24 h for SBM were 76.3 ± .3 and 85.9 ± 9.0%, for FW 52.4 ± 2.8 and 61.5 ± 1.6%, and for WC 63.9 ± 3.9 and 74.6 ± 9.9%. ADF disappearance for SBM at 12 and 24 h were 54.1 ± 4.8 and 79.9 ± 14.5%, for FW 27.4 ± 1.1 and 33.7 ± .6%, and for WC 37.8 ± 1.9 and 40.4 ± .8%. CP disappearance at 12 and 24 h for SBM were 78.4 ± 1.0 and 81.6 ± 8.4%, for FW 62.1 ± 5.3 and 72.8 ± 5.2%, and for WC 47.5 ± 8.4 and 62.1 ± 3.7%. Percent DM and ADF disappearance were greatest for SBM. Between the FW Treatments, percent DM disappearance was greater for FW than FW 2WW, possibly due to the higher fiber content of wheat middlings. This can also be explained by FW having a lower percent ADF disappearance than FW 2WW. These differences in ADF disappearance between the two FW diets may be due to the different sources of fiber present. Percent CP disappearance was greatest for SBM, meaning that the two FW diets contained a greater percentage of UIP than did the SBM. Between the two FW diets, FW had less UIP than FW 2WW. These data suggest that the protein within food waste has both rumen degradable and undegradable components and may provide an economical source of UIP in the ruminant diet.

**Key Words:** Undegradable Intake Protein, Food Waste, Rumen Degradability

### 574 Evaluation of Corn Steep Liquor as a Rumen degradable protein source for starch and cellulose digestion by rumen microorganisms in vitro

C. C. Ribeiro-Filho* and A. Trenkle, *Iowa State University, Ames.

Corn steep liquor, a byproduct from the corn wet milling industry, was evaluated as a source of nitrogen for rumen microorganisms. The experiment consisted of measuring in vitro rate of NH3-N accumulation and the rate of in vitro dry matter digestibility by batch cultures of rumen microorganisms using cellulose or starch as substrate. In the digestibility trial the fermentation periods were 12, 24, 36, or 48 h with cellulose, and 8, 12, 20, or 32 h with starch. In the NH3-N accumulation trials the fermentation periods were 4, 8, 12, or 24 h for both substrates. The experimental units (\( n=12 \)) consisted of incubating 100 mg of purified cellulose or purified insoluble starch as substrate, 20 ml of buffer-nutrient solution, 1 ml of strained rumen fluid, and a nitrogen source (0 mg N in the control or 4 mg N in the other treatments). The nitrogen sources used were steep liquor, urea, soybean meal (SBM), casein plus starch, or ammonium sulfate plus sucrose with cellulose as substrate, and steep liquor, urea, or SBM with starch. The use of steep liquor as nitrogen source increased \( P<0.01 \) starch digestibility when compared with the control, urea, or SBM at 8, 12, and 20 h fermentation. However, the use of steep liquor decreased \( P<0.01 \) cellulose digestion when compared with urea, SBM, casein, and ammonium sulfate plus sucrose. The use of steep liquor decreased \( P<0.01 \) NH3-N accumulation when compared with urea and ammonium sulfate plus sucrose with both starch and cellulose. Accumulation of NH3-N with steep liquor was similar to SBM, except at 4 h fermentation when the steep liquor was higher \( P<0.01 \). The addition of corn steep liquor resulted in better starch digestion and an inhibition of cellulose digestion when compared with other nitrogen sources. Corn steep liquor had a slow rate of NH3-N accumulation when compared with sources of nonprotein nitrogen.

**Key Words:** Byproducts, Cattle, Steep liquor

### 575 Evaluation of a modified condensed molasses solubles (CMS) as a nitrogen source for rumen microbes in vitro

C. C. Ribeiro-Filho* and A. Trenkle, *Iowa State University, Ames.

The objective of this study was to evaluate a modified condensed molasses solubles (CMS), a high protein byproduct from the production of lysine, as a nitrogen source for rumen microorganisms by measuring the rate of in vitro dry matter digestibility and NH3-N accumulation. The study consisted of a series of in vitro trials using two different substrates, starch or cellulose, in four different fermentation periods. They were 12, 24, 36, or 48 h with cellulose and 8, 12, 20, or 32 h with starch to evaluate digestion, and were 4, 8, 12, or 24 h for NH3-N accumulation with both substrates. Each experimental unit \( (n=12) \) was the incubation of 100 mg of substrate, 20 ml of buffer-nutrient solution, 1 ml of strained rumen fluid, and 0 mg (control) or 4 mg of nitrogen (treatments). The nitrogen sources used were modified CMS (different bacteria used to produce lysine), urea, soybean meal (SBM), unmodified CMS, ammonium sulfate, urea plus ashed CMS, or casein with the cellulose substrate, and urea, unmodified CMS, or SBM with the starch substrate. The utilization of modified CMS as nitrogen source increased \( P<0.01 \) cellulose digestion at 12, 24, and 36 h fermentation when compared with the SBM \( (P<0.0002) \) at 12 and 24 h when compared with control, ammonium sulfate, urea, and urea-ashed CMS. The addition of modified CMS as nitrogen source increased \( P<0.005 \) starchy digestion at 8, 12, and 20 h when compared with control, urea, and SBM. The utilization of modified CMS as nitrogen source increased \( P<0.005 \) the accumulation of NH3-N when compared with control, soybean meal, and casein at all fermentation periods. When compared with urea, CMS increased \( P<0.0002 \) NH3-N accumulation at 4 and 8 h fermentation with cellulose and at 4 h with starch. The results of this study indicate that utilization of modified (CMS) as a nitrogen source for rumen microorganisms resulted in greater and faster cellulose and starch digestion, and a more rapid NH3-N accumulation.

**Key Words:** Byproducts, Cattle, CMS

### 576 Comparative nutritional value of steam-flaked white corn and moisture-heat damaged cottonseed in diets for beef cattle

R. Barajas, A. Felix, and A. Estrada*, *Universidad Autonoma de Sinaloa (Mexico).

To determine the comparative nutritional value of steam-flaked corn and moisture-heat damaged cottonseed on growth performance of beef cattle, sixty four brahman (262 kg) bull-calves were used in a 55-d feedlot trial. In agreement with a randomized block design, four groups of 16 calves (four calves per pen), were designated to be fed with one of the four diets: 1) Diet 1 (12% CP, 1.72 Mcal/kg NEm) containing 18% of straw, 45% moisture-damaged cottonseed; 2) Diet 2, similar to diet 1, but substituting steam-flaked white corn (SWC); 3) Diet 3, similar to diet 2, but 20% whole cottonseed (WCS) was substituted for SWC; and 4) Diet 4, similar to diet 3, but moisture-heat damaged cottonseed was substituted for the WCS. Steam flake processing of white corn increased \( P=0.05 \) average daily gain 15.3% (1.560 vs 1.799 kg/d), improved \( P=0.02 \) feed efficiency 17% (DM intake/ADG: 7.244 vs 6.011), and increased \( P<0.01 \) NEm of the diet (1.996 vs 2.287 Mcal/kg). The calculated NEm-content of SWC was 2.8 Mkal/kg, the substitution of WCS for SWC had no effect \( P>0.10 \) on ADG (1.799 vs 1.642 kg/d), or feed efficiency (6.011 vs 6.332). The substitution of moisture-heat damaged cottonseed for WCS increased \( P<0.01 \) NEm, and had no effect on diet NEm content (2.21 vs 2.31 Mkal/kg). The calculated NEm of WCS was 2.4 Mkal/kg. It is concluded that steam-flake processing of white corn increase its NE content more than 20%, and that moisture-heat damaged cottonseed can be used as a substitute for whole cottonseed in diets of growing beef cattle.

**Key Words:** Corn, Cottonseed, Cattle

### 577 Effect of moisture-damaged cottonseed on total tract digestion characteristics of finishing diets for sheep


In the northwest of Mexico it is usual that the rainy season starts together with the cotton harvest. Consequently, some of the cotton harvested is rained on, and the cottonseed suffers some damage due to microbial activity. This is detected by increased temperature and softening of the cottonseed. There is a lack of information about the effects of this moisture-heat damaged cottonseed on digestion characteristics in ruminants. This study was conducted to determine the effect of the substitution of moisture-heat damaged cottonseed for whole cottonseed on total tract digestibility of diets for sheep. Eight sheep (22 kg; male; Pelibuey 5/8; Dorset 3/8 blood) were used in a crossover design. The diets that made up the treatments were: 1) a diet with 12% roughage:88% concentrate (19%CP), containing 20% of whole cottonseed (WCS) included as part of the concentrate; and 2) a diet similar...
to treatment 1; but with moisture-heat damaged cottonseed (MHDCS) substituted for the WCS. The substitution of MHDCS for WCS had no effect (P = 0.28) on total tract digestibility of dry matter (70.17 vs 68.4%), organic matter (72.25 vs 70.51%) or nitrogen (70.00 vs 68.87%, for WCS and MHDCS, respectively). The digestible energy content of diets was similar (P = 0.30) with values of 2.98 and 2.89 Mcal/kg for WCS and MHDCS, respectively. From this data, and using the substitution method, the DE content of MHDCS was 3.9 Mcal/kg.

It is concluded that moisture-damaged cottonseed can be used up to 20% of finishing diets for sheep, without adverse effect on digestibility and energy value of the diets.

Key Words: Cottonseed, Digestion, Sheep

578 Ruminal Fermentation and Microbial Protein Synthesis of Korean Cattle Fed Alcohol-Fermented Feedstuffs. B. W. Kim1, C. G. Yang2, J. S. Shin1, and B. J. Hong1, 1 Kangwon National University, Korea, 2 Yeon-Byeon Agriculture University, China.

Generally, alcohol has been known to increase the efficiency of diet utilization when it is fed to animals. However, no information is presently available about the effect of feedstuffs fermented with yeast on ruminal fermentation and microbial protein synthesis. The objective of this study is to investigate the effects of the alcohol-fermented feedstuff (AFF) on ruminal pH, ammonia N, volatile fatty acids (VFA) and amino acids (AA) productions of growing Korean cattle. The diet consisted of 80% corn and 20% oat, added with 50% water, 10% molasses, and 5% yeast and fermentation at 32°C. Twenty-six Korean cattle averaging 230 kg were randomly assigned into two dietary treatments (AFF; AFF + rice straw and Control; non-fermented corn and oat + rice straw).

Ruminal pH ranged from 5.9 to 6.6 for both control and AFF, and pH was always slower (P < 0.05) in AFF after feeding. Ammonia N in the rumen was highest at 2 h after feeding in both control (19.14 mg/100 ml) and AFF (23.18 mg/100 ml). The ammonium N in the rumen was lower in AFF (19.47 mg/100 ml) with lower pH and higher VFA concentration was resulted in AFF. The total AA productions of growing Korean cattle. The diet consisted of 230 kg were randomly assigned into two dietary treatments (AFF; AFF + rice straw and Control; non-fermented corn and oat + rice straw).

230kg were randomly assigned into two dietary treatments (AFF; AFF + rice straw and Control; non-fermented corn and oat + rice straw). The total AA productions of growing Korean cattle. The diet consisted of

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580 In vitro evaluation of sunflower heads with varying levels of nonstructural carbohydrate and degradable intake protein. J. W. Lehmkhuler, D. A. Schmidt, M. D. Howard1, and M. S. Kerley, University of Missouri, Columbia, MO.

Sunflower heads (seeds removed) were evaluated as a feed source for ruminants using a continuous culture system. The objective was to evaluate the digestibility profile and microbial N synthesis capacity of sunflower heads in response to varying levels of degradable intake protein (DIP) and nonstructural carbohydrate (NSC). Sunflower meal supplied DIP and corn was the source of NSC. The continuous culture system was a single effluent type. A dilution of 0.03/h was used.

Using regression equations that predict maximum bacterial efficiency for three functional classes of bacteria, diets were formulated to provide degradable intake protein and fermentable carbohydrate needed to support maximum bacterial growth. The experiment consisted of 6 treatments: 0, 30 and 60% added NSC, with each level of NSC formulated for either 1 or 1.5 x the DIP requirement (0/1, 0/1.5 30/1, 30/1.5, 60/1, 60/1.5). True DMD and OMD were increased linearly (P = .0001) with addition of NSC: an interaction (P = .03) of NSC x DIP existed for true OMD. True DMD ranged from 72% (0/1) to 79.8% (60/1.5). True OMD ranged from 71% (0/1) to 80.2% (60/1.5). Digestibility of DIP was linearly and quadratically (P = .0001) affected by NSC and linearly (P = .005) affected by DIP: an interaction of NSC x DIP existed (P = .05). Digestibility of DIP ranged from 37.4% (60/1.5) to 63.7% (0/1.5). Bacterial efficiency (g bacterial N/kg of truly digested organic matter) was linearly (P = .0004) affected by increasing DIP: an interaction (P = .01) of NSC x DIP existed. Efficiency ranged from 5.91 (60/1.5) to 9.38 (60/1.5). Actuarial T. Bacterial DM synthesized was linearly affected by increasing NSC (P = .02) and DIP (P = .01): an interaction of NSC x DIP existed (P = .02). Bac terial DM synthesized ranged from 3.26 (30/1) to 4.8 (60/1.5). Based on digestibility values, sunflower heads appear to be a useful feed for ruminants; however, it would require supplemen tal NSC and DIP in order to maximize microbial N synthesis.

Key Words: Sunflower Heads, Nonstructural Carbohydrate, Degradable Intake Protein

581 The effects of high levels of mosalled sugar beet pulp or barley inclusion and floor type on performance and liver copper accumulation in early weaned lambs. T. F. Crosby1, P. J. Quinn, J. J. Callan, B. Flynn, and P. J. Malone, University College Dublin, Dublin, Ireland.

One hundred and twenty three early weaned (weaned at 35 days old), Texel sired lambs from mainly Suffolk cross ewes were intensively reared on two concentrate types (barley based and molassed beet pulp (MSBP) based), and housed on one of two floor types (straw bedding and expanded metal flooring), in a 2 x 2 factorial experiment in order to evaluate lamb performance and copper accumulation in the liver. The background copper content was higher in the MSBP based concentrate (12.52 vs 8.2 mg/kg DM ). The lambs were drafted for slaughter once they reached 36 kg live weight. Lambs reared on the straw bedding had a lower liver copper level than the lambs reared on the expanded metal flooring (301.5 vs 482.3 mg/kg DM; S.E.M. 43.6; P < 0.005). Lamb on the MSBP based diet accumulated more copper than on the barley based diet (482.6 vs 301.2 mg/kg DM; S.E.M. 43.59; P < 0.005). While liver copper values on the straw bedded treatments were lower, the lambs on these treatments also had a lower growth rate to slaughter (304 vs 346 g/d/1 day; S.E.M. 5.6; P < 0.05) and had a higher kill out proportion (0.478 vs 0.487; S.E.M. 0.002; P < 0.0001) than lambs reared on the barley based concentrate. Female lambs had better conformed carcasses (P < 0.05), but were fatter (P < 0.005) and had a higher kill out proportion (P < 0.0001) than male lambs. The data indicate significant differences in performance due to concentrate type and that floor type in addition to dietary treatment can affect liver copper values in intensively fed lambs.

Key Words: Lambs, Concentrate, Copper

Key Words: Whole Cottonseed, Reproductive Parameters, Goats

579 The effects of feeding whole cottonseed on reproductive parameters in crossbred Nubian bucks. Q. McCrady1, S. Solaiman, H. Goyal, and E. Coleman, Tuskegee University.

This study was conducted to determine the effect of feeding moderate level (15%) and high level (30%) of whole cottonseed (WCS) containing 1083 ppm and 2166 ppm gossypol, respectively, on gossypol level in plasma and reproductive parameters in growing crossbred Nubian bucks. Feed levels were stratified by weight and were assigned to three experimental treatments. Treatment 1 contained 50% bermudagrass (BG) hay + 50% concentrate mix containing 0% WCS (control), treatment 2 contained 50% BG + 50% concentrate mix containing 30% WCS and treatment 3 contained 50% BG + 50% concentrate mix containing 60% WCS. Feed was offered ad libitum. All animals were fed control diet for four weeks (pre-treatment period) to establish the baseline data and were switched to respective treatment there after. Body weight data, scrotal circumference, semen and blood samples were collected every four weeks. Plasma samples were collected to monitor gossypol in blood via jugular vein puncture. Serum samples were collected every hour for 6 hours to monitor testosterone level in blood through catheterization of jugular vein. Semen parameters and sperm abnormalities were evaluated for each collection. Body weights were increased (P < 0.05) from August through January with no difference (P > 0.10) observed among treatments. Scrotal circumferences were similar for animals receiving 0% and 15% WCS diets and were reduced (P < 0.05) for animals receiving 30% WCS diet. Semen volume, semen concentration and gross motility did not differ (P > 0.10) among diets, however sperm progressive motility was reduced (P < 0.05) for animals receiving 30% WCS diet. Percent normal sperm, head abnormality and tail abnormality tended to be higher (P < 0.10) for animals receiving 30% WCS diet. Plasma gossypol was increased (P < 0.05) for animals fed 15% and 30% WCS. Serum testosterone levels were not affected (P > 0.10) by feeding WCS. Feeding WCS at levels higher than 15% can adversely affect semen quality in male goats.

Key Words: Whole Cottonseed, Reproductive Parameters, Goats

Key Words: Whole Cottonseed, Reproductive Parameters, Goats
Effects of grain sorghum planting density and processing method on in vitro ruminal pH and dry matter digestibility, P. J. Defoor1, M. L. Galway2, and N. A. Cole1.

A 4 x 4 Latin square experiment utilizing four ruminally cannulated beef cows (BW = 616 kg) was conducted to examine digestibility characteristics of hulless barley. The experiment had a 2 x 2 factorial arrangement of treatments to test the main effects and interactions of barley type (covered and hulless) and processing method (dry rolled and tempered). The covered barley contained 63.5% starch compared with 67.3% starch in the hulless barley. The tempering process involved applying water to the barley to a final moisture content of 19% for at least 12 h prior to rolling. The roller spacing was adjusted for each of the four barley treatments such that each kernel was fractured at least once. Cows were fed diets consisting of 60% barley and 40% forage (DM basis) which was a 60:40 mixture of alfalfa silage and chopped grass hay. Ruminal pH was lower (P < .10) from 8 h through 16 h after feeding for cows fed dry rolled compared with tempered rolled barley. A processing x barley type interaction (P < .10) was observed for in situ DM disappearance (ISDM) of grain at each incubation time (2 through 48 h). The nature of the interaction was that tempering reduced ISDM of covered barley but improved ISDM of hulless barley. This same interaction (P < .05) was observed for total tract DM digestibility. Twenty-four and 48 h ISDM of barley and total tract DM digestibility were greater (P < .01) for hulless than covered barley treatments. In situ DM disappearance was not affected neither by forage quality nor by grain processing method (mean = 30.9 kg, SEM = 0.73). Carcass traits were not affected by treatments applied during the growing phase. Cattle fed DRGS tended to gain faster during the finishing period, partially compensating for poorer performance in the growing phase. In Trial 2, DRGS was used as the primary ingredient in limit-fed growing diets (88% concentrate) fed to 72 heifers for 100 d. Heifers were stratified by weight and allotted, within strata, to 12 pens (6 head each). Treatments consisted of four levels of nonenzymatically-browned soybean meal (Soypass®; 0, 6.7, 13.3, and 20% of DM). Diets were formulated to provide .73% Ca, .45% P, 33 mg/kg monensin, and 11 mg/kg tylosin, and fed once daily at 2% of BW. Feed intakes were programmed on d 1 and increased weekly, assuming a gain of .9 kg/d. Treatments were 70% steam-flaked grain sorghum (SFGS), 70% dry-rolled corn (DRC), 70% dry-rolled grain sorghum (DRGS), 35% SFGS+35% DRGS, 35% SFGS+35% DRC, and 35% DRGS+35% DRC. Diets were fed for 95 d followed by 5 d on a common diet. At the end of the growing trial steers were placed on finishing diets for 142 d and then slaughtered. There were no significant associative effects for grain combinations. Gain and efficiency were similar for SFGS and DRC, but DRGS resulted in lower gains and poorer efficiencies (P < .03). Carcass traits were not affected by treatments applied during the growing phase. Cattle fed DRGS tended to gain faster during the finishing period, partially compensating for poorer performance in the growing phase. Four ruminally cannulated Holstein cows were used in a double 2 x 2 Latin square design over a period of 13 d each to study the effects of feeding concentrate computerised individually over 24 h (A), in 2 meals/d (B) and in a TMR (C) on ruminal fermentation and chewing activity. In each group cows received daily a total of 17 kg DM with a concentrate share of 49% of total DM. The basal ration consisted of 38% corn silage, 29% grass silage, 27% hay, 3% soybean meal and 3% of a mineral mixture (% of DM). The concentrate consisted of 45% corn, 24% soybean meal, 21% wheat, 9% sunflower seeds, 0.5% soyoil and 3.5% of a mineral mixture. Basal ration and concentrate were identical for each feeding
Two experiments were conducted to study the effects of dietary acetate (A) on ruminal VFA levels and performance of beef steers. All-concentrate (C) diets (11.1% CP, 8.3% NDF, and 3.0% ash, DM basis) based on corn were fed with rice hulls (968 g) and (or) sodium acetate, and fed for 112 d in both experiments. The five diets fed in Exp. 1 were: C, C + 1.65% A, 20% RH, 20% RH + 1.32% A, and 20% RS. The six diets fed in Exp. 2 were: C, C + 5.5% A, 20% RH, 20% RH + 4.4% A, 20% RS, and 20% RS + 4.4% A. Hereford steers, 40 in Exp. 1 (BW = 270 kg), and 48 in Exp. 2 (BW = 297 kg), were randomly assigned to diets in pens of two. In Exp. 1, concentrate intake, acetate, A concentration, rumination periods, and fat thickness were observed. In Exp. 2, all the measurements were followed by a change in rumination pattern and a change in ruminal fluid pH. The results indicate that feeding whole high-oil corn grain at a level above 70% of diet DM in steer finishing diets decreases TT DM, OM, and N digestion when compared to isonitrogenous diets containing an equal amount of control corn grain. 

**Key Words:** Cattle, High-oil corn, Digestion

589 Influence of ruminal pH and NDF source on in situ fiber disappearance. M. Basalan*, E. Polat², and F. N. Owens¹, ¹Oklahoma State University, Stillwater, OK, ²Agriculture Ministry, Turkey, ³Optimum Quality Grains, Des Moines, IA

In vitro disappearance of NDF decreases as pH declines. Yet, to maintain ruminal function, forage fiber generally is included in grain-rich feedlot diets where ruminal pH is low, often below 5.5. Reductions in fiber digestibility have been attributed to reduced activity or retarded attachment of cellulosic microbes or interference by other nutrients and toxins in the rumen environment. Although most studies with NDF disappearance have examined cellulose, hemicellulose has been largely ignored. The objectives of this study were to measure the impact of ruminal pH on in situ disappearance of hemicellulose (NDF minus ADF) and of ADF. To obtain different and relatively constant ruminal pH values, we supplemented ruminally cannulated steers (387.5 kg BW) in a randomized complete square experiment were fed a 90% concentrate diet (based on ground corn grain) at three levels of feed intake (1% and 1.5% of body weight daily or free choice) at three times each day. Three different fiber sources (alfalfa hay, prairie hay and wheat straw) were placed in dacron bags and extracted with neutral detergent devoid of EDTA to obtain NDF. These were incubated in situ for 24, 12, 24, or 96 h, and again extracted with neutral detergent and with acid detergent. After 96 h of incubation, NDF disappearance ranged from 14 to 33%, being greater (P < .05) with wheat straw than with alfalfa hay. Rate of disappearance of hemicellulose and ADF as a fraction of that disappearing at 96 h were quadratically related to pH with minimums of 5.9 and 5.4 respectively. Stepwise regression indicated that below a pH of 5.2 to 5.6, depending on the source of fiber, pH had no impact on disappearance of hemicellulose or ADF and that above this pH, disappearance increased quadratically with pH. Results indicate that rate and extent of fermentation differ with fiber source and that low ruminal pH inhibits disappearance of both hemicellulose and ADF in a curvilinear fashion rather than abruptly at a pH of 6.0.

**Key Words:** NDF, Hemicellulose, fermentation


Overconsumption by starting cattle and the related potential for subacute acidosis the remainder of the feeding period prompted four trials (T1, T2, T3, T4) to evaluate a thermochemical combination of tertiary calcium phosphate and calcium pyrophosphate as an intake limiting component (ILC). Crossbred calves (259 kg BW initially; n = 34, 151, 184 and 148) were fed: 1) silica (CTRL), or 2) ILC, at 92, 106, 91 and 90 g/d in T1 through T4, respectively. Complete starting diets were fed ad libitum for 28 d in T1 and T2. In T1, CTRL and ILC were fed continuously to three pens each. In T2, CTRL was fed continuously to three pens; three remaining pens were fed ILC on d 1, 3-7 and 15-28, but fed CTRL on d 2 and 8-14. Intake of the ILC diet in T1 was 91% (P<.05) of that for CTRL. However, continuous feeding of ILC did not reduce variation; SEM for CTRL intake curves were 90 and .89. Venous glucose (1000 h, d 28) was higher (P<.10) for ILC. Eating behavior suggested less time eating, and avoidance of agonistic feeding situations, by calves fed ILC. In T2, intake by calves fed ILC intermittently was 93% (P<.05) of that for CTRL fed continuously. Variation in intake was reduced with the ILC feeding scheme; SEM for the CTRL and ILC intake curves were 90 and .89. Venous glucose (1000 h, d 28) was higher (P<.10) for ILC; no differences were found for venous glucose, PCV or pH. ILC numerically improved feed:gain in both T1 and T2. T3 and T4 were conducted to determine whether the higher blood glucose for ILC in T1 and T2 was due to a difference in hydration related to feed intake. In T3, three pens per treatment were limited fed concentrate (respectively) CTRL or ILC at 0630 h and hay at 1830 h for 28 d in an attempt to assure similar hydration between treatments. Venous glucose (0830 h, d 24) was higher (P<.05) in calves fed ILC. T4

**Key Words:** Feeding Frequency, Rumen, Dairy Cow

587 Effect of acetate and roughage on ruminal VFA levels and performance of steers. T. W. White* and D. C. Blouin, Louisiana State University Agricultural Center, Baton Rouge.

The objectives of this experiment were to determine the differences in the site and extent of digestion of finishing steer diets containing high-oil corn, isogenetic control corn, or isogenetic control corn supplemented with animal/vegetable fat. Two 3 x 3 Latin Squares were utilized in an 84 d digestion trial using three ruminally fistulated mature beef steers with canulas located in the proximal duodenum. Each square consisted of three, 14 d periods, with the first 8 d of each period being for diet acclimation, followed by the last 6 d for sampling. Diets consisted of 70% whole corn grain, 12.3% corn silage and 2.0% N, with the treatment differences being high-oil corn (HOC) grain, control corn (CC) grain, or control corn grain supplemented with animal/vegetable fat (CC+F). The CC+F diet was formulated to provide the same ether extract content as the HOC diet. Diets were fed every 12 h at 90% ad libitum. A, NDF, and rumination periods over urinary rib increased (P < .05) from an average for C and RH diets of 6.0 kg, .89 kg, 226 kg, and 7 mm, respectively, to 7.3 kg, 1.2 kg, 240 kg, and 10 mm when A was added to these diets. Intake and performance was similar when diets contained A or RS. Acetate added to C and RH diets increased (P < .05) ruminal pH and decreased (P < .05) butyrate and valerate. In Exp. 2, A increased (P < .05) concentrate intake, ADG, and carcass weight when added to the RH diet but had no effect when added to the RS diet. Acetate had little effect on ruminal fluid characteristics at the level fed in Exp. 2. Levels of A in excess of .55% appear necessary to improve DMI and ADG of finishing steers.

**Key Words:** Roughtage, VFA, Beef Steers

588 Effect of feeding high-oil corn, and control corn with added fat on ruminal and total tract digestion of finishing steers. C. Belknap* and A. Trenkle, Iowa State University.

The objectives of this experiment were to determine the differences in the site and extent of digestion of finishing steer diets containing high-oil corn, isogenetic control corn, or isogenetic control corn supplemented with animal/vegetable fat. Two 3 x 3 Latin Squares were utilized in an 84 d digestion trial using three rumingly fistulated mature beef steers with canulas located in the proximal duodenum. Each square consisted of three, 14 d periods, with the first 8 d of each period being for diet acclimation, followed by the last 6 d for sampling. Diets consisted of 70% whole corn grain, 12.3% corn silage and 2.0% N, with the treatment differences being high-oil corn (HOC) grain, control corn (CC) grain, or control corn grain supplemented with animal/vegetable fat (CC+F). The CC+F diet was formulated to provide the same ether extract content as the HOC diet. Diets were fed every 12 h at 90% ad libitum. A, NDF, and rumination periods over urinary rib increased (P < .05) for each treatment using chromic oxide as a marker. Rumen pH and NH3-N were measured over time. TT DM and OM digestibilities were greater (P<.04; 73.3 and 74.7% vs. 64.3 and 65.7% respectively), as was apparent N digestion (P<.03; 71.3% vs. 63.7% respectively) for CC than HOC. TT DM and OM digestion tended to be greater (P=.06; 72.1 and 73.5% vs. 64.3 and 65.7% respectively) for CC+F than HOC, but was not different (P>.10) for N digestion. There were no differences (P>.10) in DM, OM, or TT digestion between CC and CC+F. No differences were observed (P>.10) in R DM or OM digestion among treatments. Rumen ph and NH3-N were also not different (P>.10) among treatments. These data suggest that feeding whole high-oil corn grain at a level above 70% of diet DM in steer finishing diets decreases TT DM, OM, and N digestion when compared to isonitrogenous diets containing an equal amount of control corn grain.

**Key Words:** Cattle, High-oil corn, Digestion

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had three pens per treatment limit fed concentrate (containing CTRL or ILC) at 0700 h and hay at 1600 h for 21 d. Arterial and venous glucose (1100 h, d 21) were higher (P < 0.05) for ILC; no differences were found for PCV or pH. These data indicate that variation in intake can be reduced by intermittent feeding of the ILC.

**Key Words:** Beef Cattle, Starting Diets, Limit Feeding

591 Practical aspects of urea and ammonia metabolism in ruminants. G. B. Huntington and S. L. Archibeque,
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Nitrogen was recognized over 200 years ago as an element essential for normal function of farm animals. During the first half of the last century, the roles of proteins and urea in nitrogen metabolism were discovered. By the middle of the 20th century, the substrates, products, and enzymes of the urea cycle were elucidated. Work since then quantifies dietary crude protein requirements for specific production goals, protein synthesis and breakdown, ruminal ammonia production, endogenous urea synthesis, and urea recycling. In ruminants fed conventional diets, nitrogen absorbed as ammonia can be several times the amount of nitrogen absorbed in the form of amino acids or peptides. Nitrogen recycled to the digestive tract as urea in saliva or urea transported from blood ranges from 10 to 40% of nitrogen consumed in feed. Under production conditions, from zero to 20% of nitrogen consumed by ruminants is retained as tissue nitrogen or excreted as milk protein. This review will discuss the quantitative aspects of urea and ammonia metabolism in ruminants, then relate the metabolic or economic effects on HCW, REA, marbling, kidney, pelvic, heart, fat depot percentage, yield grade or quality grade. Incidence of liver abscesses in steers fed 100% ALM was numerically lower than in those fed the other treatments (P < 0.10; 21, 23.3, 27.3, 9.8% for control, 33%, 66% and 100% ALM, respectively). Thus, ALM is a suitable replacement for soybean meal as a protein source in finishing diets. Feeding ALM as the sole protein source may have added benefits including decreased incidence of liver abscesses.

**Key Words:** Alfalfa, Steers, Diets


Thirty-four crossbred steers and heifers (264.2 ± 29.5 kg BW) fed in Calan gates were used to evaluate expeller cramble meal (ECM) as a protein source in comparison to soybean meal (SBM). Calves were blocked by sex, stratified by weight, and allotted randomly to one of six supplemental treatments containing graded amounts of ECM (0%, 25%, 50%, 75%, and 100%), replacing SBM and beet pulp; and a urea control. Diets were formulated to contain 11.5% CP. Supplements were formulated to provide 60% of total dietary CP, SBM and ECM make up .33% and .41% of total dietary CP, respectively. Diets consisted of 37.3% sorghum silage, 37.3% corn cobs, 7.4% alfalfa hay, and 18% supplement on a DM basis. Calves were fed at 1.95% of BW on a DM basis with 14-day weigh intervals. Weekly samples of feed ingredients were taken. Weekly orts were collected, weighed and sub-sampled. Initial weights and final weights were the average of three consecutive days, with the trial being 85 days. There were no statistical differences (P > .21) in performance with orthogonal contrast used (urea vs. protein, linear and quadratic ECM effects, SBM vs. ECM). Metabolizable protein may not have been limiting gains or replication may have been too small.

**Key Words:** Crambe, Meal, Protein

595 Effect of a Revalor™ implant on the growth response to an animal by-product protein mixture in high energy feedlot diets. P. J. Guiroy*, D. H. Beermann1, D. G. Fox1, and D. J. Ketchen1, Cornell University.

A mixture of four animal by-product protein sources (pork meal, fishmeal, blood meal and hydrolyzed feather meal) was formulated based on the NRC 1996 to contain an ideal amino acid (AA) pattern. The 1996 NRC model level 2 was used to develop three high energy diets that met ruminal N requirements, and met or exceeded MP requirement, with addition of 0, 3, or 6% of this UIP mix in the ration DM (diets contained 13.4, 14.3, and 15.6% CP, respectively). Ninety-six crossbred beef steers with an average weight of 350 kg, half implanted (I) with Revalor™ and half not (nol), were blocked by weight in pens of 8 and fed ad libitum...
one of the diets. Daily feed intake was recorded and live weight was measured every 28 days. Plasma urea nitrogen (PUN) concentrations were determined on days 56 and 112. Initial weight of the cattle was used as a covariant for statistical analysis. The cattle were commercially slaughtered after 134 days on feed, weighing an average of 576 and 540 kg for I and noI (P < .01), respectively. Eighty-four percent exhibited a small degree of marbling (Choice Quality Grade) or higher. Carcass composition of 48 steers was determined by Hankins and Howe rib dissection. Across treatments ADG and feed efficiency were 1.7 and 1.4 kg/d, and 6.6 and 7.3 DM/kg gain for I and noI (P < .01), respectively. Neither were affected by UIP level (P = .63 and P = .16). PUN was lower for I vs. noI (P < .001), 10.3 and 12.4 mg/dL, and was increased (P < .001) with UIP addition. The implants decreased PUN at 56d, but not at 112d. Rib eye area and longissimus dorsi weight in the primal rib was higher for I vs. noI (P = .076 and P = .03). 80 vs. 77 cm2, and 2.39 vs. 2.17 kg, but they were not affected by UIP level. Carcass composition at slaughter was not affected by treatments, because I and noI were fed to the same body fat composition endpoint. However, implanted animals deposited 126 and 39 g/d more moisture and protein, respectively. The NRC 1996 model level 2 accurately predicted rumen microbial N and animal AA requirements.

Key Words: Feedlot, Undegradable intake protein, Implant

598 Effects of feeding an animal by-product protein mixture in high energy feedlot diets on growth performance and composition of gain in Revalor™-implanted beef steers. P. J. Guiroy†1, D. H. Beermann1, D. G. Fox1, and D. J. Ketchen1, Cornell University.

A mixture of four animal-byproduct protein sources (pork meal, fish meal, blood meal and hydrolyzed feather meal) was formulated based on the NRC 1996 to contain an ideal AA pattern. The 1996 NRC level 2 was used to develop four high energy diets that met ruminal N requirements, and met or exceeded MP requirement, with addition of 0, 3, 6, or 9% of this UIP diet in the ration DM (diets contained 13.4, 13.1, 15.6, and 16.6 % CP, respectively). Forty yearling Revalor™-implanted crossbred steers with an average weight of 302 kg were randomly assigned to individual pens with 10 steers each being fed ad libitum one of the diets for 119 days. Individual daily feed intake was recorded and live weight was measured every 28 days. Plasma urea nitrogen (PUN) was determined on days 0, 56, and 112. The cattle were commercially slaughtered after averaging an average of 528 kg with 78% reaching a small degree of marbling (Choice Quality Grade) or higher. Carcass composition was determined by Hankins and Howe rib dissection. Across all four treatments, ADG and feed efficiency were 2.02 kg/d and 5.76 kg DM/kg gain, respectively, and were not affected by treatment (P = .71 and P = .28). PUN increased linearly with protein level and time (P = .022 and P < .001). Values ranged from 8.0 to 11.2 mg/dL for 0 and 9% UIP, and from 4.9 to 10.4 mg/dL at days 0 and 112, respectively. Yield grade increased (P = .045) from 3.2 to 3.9 as level of UIP supplementation increased. Longissimus dorsi (ld) weight in the primal rib was not affected by treatment. Percentage of carcass lipid and lipid accretion rate were not affected by diet. Percentage of carcass lipid and lipid accretion rate were not affected by diet (both P = .17) but a trend for both increasing linearly with increasing UIP level was observed, averaging 29.9 and 33.47%, and .61 and .73% for 0 and 9% UIP, respectively. Percentage of carcass protein and protein accretion rate were not affected by diet (P = .32 and P = .44). In this study, performance (ADG and efficiency of gain), carcass traits, ld weight, carcass composition, and composition of gain were not improved by UIP supplementation. The NRC 1996 model level 2 accurately predicted AA and rumen microbial N requirements of these fast growing steers.

Key Words: Cattle, Undegradable intake protein, Protein requirements

599 Degradable intake protein requirement of finishing steers fed a high moisture corn-based diet. R. J. Cooper*, C. T. Milton, T. J. Klopfenstein, and D. J. Jordan, University of Nebraska, Lincoln, NE.

A finishing trial was conducted to determine the degradable intake protein (DIP) requirement of yearling steers fed a high moisture corn-based diet. Two hundred and fifty-two crossbred yearling steers (average initial weight = 379 kg) were used in a randomized complete block design. Within three initial weight blocks, steers were stratified to one of four pens (12 pens, 21 steers per pen). Pens were randomly assigned to one of four treatments. Treatments consisted of graded levels of supplemental urea (0, .4, .8, and 1.2% of diet DM). Dietary DIP levels were 6.6, 7.8, 8.9, and 10.0% of DM, respectively. The final diet consisted of 82.5% high moisture corn, 5% alfalfa hay, 5% extruded feeds, 2.5% minerals, and 5% supplement (DM basis). High moisture corn was 26% moisture, 9.6% CP (DM basis), and 66% DIP (% of CP). Steers were adapted to
the final diet in 21 d with 50, 40, 30, and 20% alfalfa (DM basis) replacing high moisture corn for 3, 4, 7, and 7 d, respectively. Steers were implanted with Synovex Plus on day 1, and fed for 108 d. Treatment means were separated with linear, quadratic, and cubic contrasts. Dry matter intake was not affected by treatment and averaged 12.2 kg/d. Daily DMI was linearly related to BET (P = .01) for both levels of BET (level 1: 1.71 ± .82 and 1.85 kg/d, respectively). Gain/feed increased linearly (P = .03) with DIP level (.139, .141, .151, and .153, respectively). Twelfth rib fat depth increased linearly (P = .06) with DIP level (.89, .99, 1.0, and 1.07 cm, respectively). As dietary DIP level increased, steers gained faster and more efficiently, with greater fat depth. Based on level one of the 1996 NRC model, all diets exceeded MP requirements of steers by at least 76 g/d. The DIP balances were -63, 74, 211, and 347 g/d, respectively. The NRC (1996) model predicts a requirement of 7.2% DIP (.2% urea). Because gain and efficiency were linear, a DIP requirement cannot be estimated, but appears to be greater than predicted by NRC for highly fermentable corn-based finishing diets.

Key Words: Cattle, High moisture corn, Protein

600 Urinary allantoin excretion as a bacterial crude protein marker for beef cattle. R. A. Mass 1, D. J. Jordon 1, T. L. Scott 2, D. L. Harmon 2, C. T. Milton 3, and T. J. Klopfenstein 3, 1University of Nebraska, Lincoln, NE, 2University of Kentucky, Lexington, KY.

Two metabolism trials investigated urinary allantoin excretion (ALLAN) as a marker of bacterial CP synthesis for beef cattle. Both trials utilized the same diet system and predominantly cannulated steers (360 kg). The objective of Trial I was to measure the relationship between the duodenal purine flow and ALLAN. Steers were utilized in a replicated 3 x 3 Latin square design (21-d periods) with steer as experimental unit and three separate levels of alfalfa hay DMI (24.4% CP, 22.4% CP and 20.4% CP for highly fermentable corn-based finishing diets.

602 Effects of dietary protein and ruminally protected betaine or choline on productivity of Angora doelings. R. Puchala*, V. Banskalieva, A. L. Goetsch, I. Prieto, and T. Sahlu, E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK.

Thirty Angora doelings (22 ± 2 kg initial BW, 6 mos) were used in an experiment with a 2 x 3 factorial arrangement of treatments to investigate the effects of dietary protein level (9 and 15% CP, 2.4 Mcal/kg ME) and methionine with ruminally protected choline (6 g/d) or ruminally protected betaine (6 g/d) or control (no supplementation) on ADG and mohair growth. Goats were housed in pens (seven or eight per pen) and were given ad libitum access to the diet using electronic feeders for 120 d. There was a dietary protein x supplement interaction (P < .05) in ADG. Animals fed 9% CP - control and 9% CP - choline diets had lower (P < .001) ADG (46.7 and 52.1 g/d) than ones consuming the 9% CP - betaine diet (78.8 g/d). There were no differences in ADG (P > .26) among animals fed 9% CP - betaine, 15% CP - control (74.8 g/d), 15% CP - betaine (83.8 g/d), or 15% CP - choline (85.0 g/d) diets. Neither DMI nor mohair growth were affected by dietary treatments (P > .05). It is suspected that increased ADG with betaine supplementation of the low protein, coarse feed hulks-based diet was due to the additional methyl groups, which can be used for homocysteine remethylation and carnitine synthesis (lipid transporter). Supplementation with ruminally protected betaine may be useful to increase efficiency of utilization of poor quality, low protein diets.

Key Words: Betaine, Choline, Angora goats

603 Effects of escape protein and energy deprivation on weight change and carcass quality of white-face lambs. W. Pittroff* and H. D. Blackburn, U.S. Sheep Experiment Station, Dubois.

Lamb feedlot diets maximize growth but may lead to overfat lambs. This experiment used escape protein supplementation of a diet deficient in ME or to induce changes in body composition. Growing white face lambs were fed ad lib a concentrate/alfalfa pellet based feedlot diet to an average weight of 56.56 ± 4.58 kg. Lambs were given 3 treatments: Control (CON) continued feedlot diet ad lib, straw-fishmeal (SFM) (barley straw ad lib, plus 75 g molasses and 150 g fish meal/head/d), and straw ad lib plus 75 g molasses/head/d (STR). 54 head were slaughtered over 5 weeks. Data collected: physical dimensions, body wall, loin area, loin depth, tail-end fat, shoulder fat, weight of right carcass half, bone weight, meat weight and weight of primal cuts (shoulder, leg, loin and rack). Data were analyzed with the linear model: yijk=µ+αi+βj+γijk+εijk where α is the effect of the i-th nutritional treatment, β the effect of the j-th slaughter date and ε the effect of covariates: hot carcass weight (CW), or live shrunken body weight at the beginning of experimental treatments (IW). For all but meat/cut weight data CW was used. Weight changes were modeled as four response variables (DVI-1) denoting the percent daily change in weight with weight at the beginning of the period as the base corresponding to weight changes over 5 weeks of serial slaughter. Data for weight change were analyzed with treatment as main effect only. Adjusted means for all saleable lean traits (meat weight, loin eye depth, loin eye area, primal cuts) were expressed as greater than or less than throws for treatments. This difference was significant (P = .0056) only for meat weight. There were significant differences between slaughter dates in backfat, shoulder fat weights.

Key Words: Methionine, Betaine, Cattle
and tail-head fat. Treatment effects were significant for weight changes DW1 and DW2; differences between the two experimental treatments were not significant. For all DW, weight loss of the SPM lambs was lower, and weight change for these lambs was positive in the last two periods while STR lambs continued to loose weight. Further work is required to elucidate the discrepancies between our results and previously reported work, in particular the effects of stage of maturity in the expression of nutrition effects on body composition.

**Key Words:** Sheep, Escape protein, Carcass quality

604 Effects of escape protein and energy deprivation on organ mass and body composition of white-face lambs. W. Pittroff* and H. D. Blackburn, U.S. Sheep Experiment Station, Dubois.

Lamb feedlot diets maximize growth but may lead to overfat lambs. This experiment used escape protein supplementation of a diet deficient in ME₂ₐ to induce changes in body composition. Growing white face lambs were fed ad lib a concentrate/alfalfa pellet based feedlot diet to an average weight of 56.56 +/− 4.58 kg. Lambs were given 3 treatments: Control (CON) continued feedlot diet ad lib, straw-fishmeal (SFM) (barley straw ad lib, plus 75 g molasses and 150 g fish meal /head/d), and straw ad lib plus 75 g molasses /head/d (STR). 54 head were slaughtered after 28 days and proximate analysis of carcass, peripheral organs and meat were performed. Eight lambs were assigned to each treatment and were housed in metabolism crates to measure nitrogen retention. Digestibility of DM, OM, starch and GE was greater (P < 0.01) for the STR diet than for the SFM diet. Calculated DE content of the HO than of the C diet. Calculated DE (Mcal/kg) of the corn was 8.3% greater (3.74; P < .01) for the HO diet and 6.3% greater (3.67; P < .01) for the ISO diet than the corn in the C diet (3.52). Dry matter intake did not differ between the C and ISO diets, indicating that the diets were similar in available energy content. Steers consuming ISO had greater (P < .05) stanch digestibility than steers fed the C diet. While the HO diet had greater GE digestibility and DE content, steers fed this diet had lower total DM intake, therefore treatment differences were not observed (P = .78) for intake of DE. These data indicate that greater available energy can be obtained from high oil corn, but voluntary feed intake must be maintained at an equal level to that of normal corn.

**Key Words:** Corn, Oil, Digestibility

606 Digestibility and net energy of feedlot diets containing steam-flaked high oil corn compared with steam-flaked typical corn plus added tallow. M. J. Jarosz*1, D. R. Brown2, D. E. Johnson3, and S. D. Soderlund1, 1Colorado State University, Ft. Collins, CO, 2Ağland/Farmland, Eaton, CO, 3Optimum Quality Grains, Des Moines, IA.

Eight English/Exotic mixed steers were used in a 4 x 4 Latin square experiment to compare the digestibility and net energy content of 90% concentrate diets containing two steam-flaked corn types, high oil corn (HOC) and typical corn plus added tallow (TC), and two steam-flake densities, 335 and 386 g/L. Fecal and urine output was measured by 7-d collection and heat and methane production by 2-d respiration calorimetry trial chamber. Starch and ether extract digestion averaged 95.9 and 93.5% and did not differ between corn type and/or flake density. The ADF content of the diets was similar, 8% of DM, however, ADF digestion was 27% greater (P < .02) for the HOC diets and was improved by less intensive processing to 386 g/L compared to the 335 g/L. The net energy for gain content of all diets was similar, each containing approximately 1.3 Mcal/kg DM. Nitrogen retention and protein content of gain of steers fed HOC diets were improved by more intensive processing and were compromised with less processed HOC. Replacing typical plus added tallow in 90% concentrate finishing diets with high oil corn results in similar nutrient digestibilities and net energy for gain values, however, more attention may be needed to meet metabolizable protein requirements when HOC is fed.

**Key Words:** Corn, Beef Cattle, Net Energy


In Trial 1, crossbred beef steers (n=536; 391kg) were fed diets containing steam-flaked whole grain sorghum (FWGS), steam-flaked rolled grain sorghum (FRGS), dry-rolled corn (DRC) and steam-flaked corn (SFC) for 142 d to compare finishing performance and carcass traits. Diets (92% concentrate) were formulated to contain 13.2% CP, .70% Ca, .30% P, 33 mg/kg monensin, and 11 mg/kg tylosin. SFC was steam conditioned for 60 min and flaked to .335 kg/L. FWGS was conditioned for 90 min and flaked to .310 kg/L. FRGS was dry-rolled to a course texture, approximately cutting the berries in half, then conditioned for 45 min and flaked to .310 kg/L. Steers were fed in pens of 21 to 23 head, with six pens per treatment. Cattle fed FRGS, DRC and SFC grew faster (P<.01) than those fed FWGS. DMI was higher (P<.03) for DRC than other grains. DMI was lower (P<.03) for FWGS than for FRGS. Efficiencies tended to be better for flaked grains than for DRC. FWGS produced slightly lower USDA yield grades than SFC or DRC (P<0.01). Marbling scores tended to be lower for FWGS than other treatments (P<.15). Trial 2 evaluated finishing performance of yearling heifers (n=345; 357 kg) fed SFC, FWGS, or a 50:50 mixture of the two grains (MIX). Diets (92% concentrate) were formulated to provide 11 or 13% CP, .68% Ca, .3% P, 33 mg/kg monensin, and 11 mg/kg tylosin. Heifers were allotted to 24 pens (4 pens per treatment) and fed for 100 or 130 d. Heifers fed FWGS had lower ADG and DMI and poorer efficiencies than those fed SFC or MIX (P<.02). Higher dietary protein increased ADG and DMI (P<.02) and tended to improved gain efficiency (P<.1). Treatments had no significant effect on carcass traits except for s.c. fat, which increased with protein level (P<.03). Positive associative effects were observed between CP and FWGS for ADG and DMI. Rolling grain sorghum steaming and flaking can improve feed value while reducing energy expenditure for processing. Dietary protein level of 11% is inadequate for diets based on steam-flaked grains.

**Key Words:** Grain Sorghum, Corn, Carcass Traits

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608 Effects of corn silage hybrid and dietary proportion on yearling steer performance. A. DiCostanzo1, C. M. Zehnder1, J. M. Cassidy1, H. Chester-Jones2, D. Ziegler1, and R. Greer1,2. 1University of Minnesota, St. Paul, MN, 2Southern Experiment Station, Waseca, MN.

This study was undertaken to determine effects of increasing dietary corn silage (CS) proportion of two hybrids (regular dent, R, or high leafstalk ratio, L) on feedlot performance and carcass characteristics. Ninety-six Angus crossbred steers (416 d of age) were assigned to one of six dietary treatments resulting from the factorial arrangement of corn hybrid and CS proportion [12% (R pens), 24% (R pens), and 36% (R pens) of diet DM]. Initial BW were taken after an 18-h fast, and final BW were adjusted to a common dressing percentage (62%). There were no interactions between hybrid and CS proportion. No differences (P > .10) between hybrid were observed for ADG, DMI, or feed DM required/kg gain, respectively, for steers fed R vs L hybrid.

Increasing CS proportion beyond 12% decreased (P < .05) ADG, and increased (P < .05) DMI, and increased (P < .05) feed DM required/kg gain (1.67 ± 0.44 kg/d; 1.19 ± 0.20 kg/d; 1.61 ± 0.18 kg/d; 0.71 ± 0.18 kg/d; 1.78 ± 0.18 kg/d; 0.56 ± 0.18 kg/d), respectively, for steers fed 12%, 24% or 36% CS. Steers were market fed when half of them reached choice grade as assessed visually. Steers fed 12% or 24% CS were marketed after 126 d, while those fed 36% CS were marketed after 142 d on feed; 92 or 87 d, respectively, after implanting (Revalor-S). Ribeye area of steers fed the hybrid was larger (P < .05) than that of steers fed the L hybrid (90.10 ± 85.29 cm²). Ribeye area of steers fed 12% CS was larger than that of steers fed 24% or 36% CS (90.71 ± 85.68 or 85.16 cm², respectively, for steers fed 12%, 24% or 36% CS). Steers fed 24% CS had the lightest (< .05) hot carcass weights (385, 367 or 384 kg, respectively, for steers fed 12%, 24% or 36% CS). Results indicate that choosing to feed a given proportion of corn silage in the diet of yearling steers is independent of the hybrid (R vs L) that is used.

Key Words: Corn Hybrid, Steer, Feedlot


A trial was conducted to evaluate degrees of winter restriction on subsequent compensatory growth in yearling cattle. Crossbred steers (180 hd) were used in a completely randomized design with treatments FAST, CORN, FAST/SLOW, SLOW/FAST, and SLOW. The winter had two phases. In phase 1 (78 d), steers were fed 2.3 kg DM wet corn gluten feed (WCGF) (FAST), 1.8 kg DM corn (CORN), or protein supplement (SLOW) while grazing cornstalks. In phase 2 (88 d), cattle were fed 2.3 kg DM WCGF (FAST), 1.8 kg DM corn (CORN), or mineral supplement (SLOW) and ammoniaated wheat straw. After phase 1, half the FAST calves were switched to SLOW, and vice versa, giving degrees of winter restriction. The CORN treatment was used to determine if WCGF in the winter resulted in carry-over effects in grazing or feedlot gains. Winter gains were .61 (FAST), .61 (CORN), .38 (FAST/SLOW), .39 (SLOW/FAST), and .21 kg/d (SLOW). Summer grazing consisted of bromegrass (46 d), native warm-season range (86 d), followed by bromegrass (21 d). Cattle were then placed into the feedlot and finished on 40% WCGF, 48% high moisture corn, 7% alfalfa, and 5% supplement (DM basis). No summer gain differences (P > .10) were found with restricted cattle (FAST/SLOW, SLOW/FAST, or SLOW); however, gains were faster (P < .05) on grass compared to FAST or CORN animals. Summer gains were .47, .43, .53, and .54 kg/d for FAST, CORN, FAST/SLOW, SLOW/FAST, and SLOW, respectively. Summer gains were lower than expected, but compensation on grass did occur. Comparing FAST and SLOW treatments, SLOW cattle compensated 17.4% during grazing. FAST steers had lower (P = .056) slaughter breakevens compared to SLOW (64.05 vs 66.94/45 kg, respectively). No other differences in breakevens were found. Due to little compensation by SLOW cattle, FAST cattle had heavier slaughter weights and lower breakevens. Correlation coefficients (r) showed that higher rates of winter gain (r = -.61, P < .10) and increased final weights (r = -.87, P = .0012) resulted in lower slaughter breakevens.

Key Words: Compensatory gain, Slaughter breakeven, Steers


Seventy-six Angus x Simmental crossbred steers (initial BW 155.5 ± 5.1 kg) were used in a 2x2 factorial experiment to determine the effects of weaning age and implant regimen on growth, performance, carcass characteristics and composition of gain in steers. Steers were either early weaned (EW) or normal-weaned (NW) and allotted by weight to an aggressive (A) or non-aggressive (NA) implant regimen. The A implant regimen consisted of a Synovex-C implant followed by 2 Revalor-S implants. The NA implant regimen consisted of 2 Synovex-S implants. To evaluate initial carcass composition and characteristics, 4 early-weaned and 4 normal-weaned steers were selected for harvest when BW reached 169 kg (169 and 197 d of age, respectively). Steers were penned individually and fed an 85% concentrate, 13.1% CP finishing diet. Steers were harvested when BW reached 546.5 kg. Compensatory growth experienced by NW steers during period 2 was able to offset their slower growth in period 1 (weaning status x time: P < .01). Normal-weaned steers; therefore, had similar (P > .16) gains to those of EW steers (1.58 vs 1.52 kg/d) for the entire trial (106 d to harvest). Aggressive implant steers gained faster than NA steers (1.43 vs 1.30 kg/d; P < .04) during period 1; however, no significant differences existed for gain in period 2 or for the entire trial. Daily post-weaning DMI was lower for EW than for NW steers, but total post-weaning DMI was higher (P < .01) for EW than for NW steers (1835.2 vs 1401.5 kg, respectively). For EW steers at initial harvest, the A implant regimen resulted in a 54% increase in backfat depth compared with the NA implant regimen (.50 vs .32 cm, respectively); for NW steers at initial harvest, the A implant regimen resulted in a 52% decrease (interaction; P < .01) in backfat depth compared with the NA implant regimen (.13 vs .25 cm, respectively). Early weaned steers had higher quality grade than NW (96 vs 82%; choice; P < .07). The A implant regimen increased (P < .03) L. dorsi area but did not affect quality grade compared with the NA regimen. In general, weaning status affected the timing of tissue growth more than the extent of growth. Early weaning resulted in a very high percentage of choice cattle at an average weight of 547 kg and an average age of only 357 d.

Key Words: Early weaning, implant regimen, growth

611 Accuracy of 1996 beef NRC computer program in prediction of cattle performance in western Canada. H. C. Block* and J. J. McKinnon, Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada.

Two trials were conducted at the University of Saskatchewan to evaluate the 1996 NRC Beef Model as a feedlot nutrition management tool for backgrounding and finishing beef steers. Trial 1 utilized 144 Charolais-cross (304.6 ± 16.3 kg) and 144 Hereford-cross (294.8 ± 20.9 kg) steers while Trial 2 utilized 88 Angus-cross (289.5 ± 15.0 kg), 88 Charolais-cross (299.8 ± 17.7 kg), and 88 Hereford-cross (291.1 ± 20.9 kg) steers. Rations based on barley grain, barley silage, canola meal, and cereal straw were analyzed according to NRC (1996) methodology. Animal performance and environmental data were collected for 24 pens of steers per trial for backgrounding, finishing and overall feeding periods. Level 2 (rumen simulation) of the 1996 NRC Beef Model was utilized to generate predictions of pen DMI and ADG. Predicted and observed pen DMI and ADG were analyzed using GLM and linear regression. Backgrounding ADG was restricted to 0.93 kg by limit feeding a diet formulated to 3.0 Mcal DE/kg dry matter. Predicted DMI was higher (P < .05) than observed DMI for backgrounding and overall feeding periods. No difference (P > .05) existed between predicted and observed DMI during finishing. Linear regression intercepts not different (P > .05) from zero allowed bias analysis for DMI during Trial 1 finishing, Trial 1 overall, and Trial 2 overall feeding periods. Biases were 0%, 20%, and 13% for Trial 1 finishing, Trial 1 overall, and Trial 2 overall feeding periods, respectively. Predicted ADG was lower (P < .05) than observed in all feeding periods. All linear regression intercepts for ADG were different (P < .05) from zero. This prevented bias analysis for ADG. The model indicated metabolizable energy intake as the limiting factor for ADG in all feeding periods. Disparities were not accounted for by microbial nitrogen balance for the different feeding periods. Further investigation and model refinement regarding animal requirements, effects of limiting

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feed intake, and appropriate time period for evaluation may improve estimation of feed digestion and animal performance.

Key Words: Beef, Growth, DMI


Two trials were conducted to evaluate the 1996 NRC Beef Model as a feedlot nutrition management tool for backgrounding calves. Trial 1 utilized 150 (255±19.6 kg) medium frame (MF) and 150 (259±17.2 kg) large frame (LF) steers while trial 2 utilized 340 (285±19.0 kg) LF steers. Western Canadian feed ingredients typical of backgrounding programs were utilized and analyzed according to the Cornell Net Carbohydrate and Protein System (CNCPs) methodology. Diet, animal weights, DMI, feed analysis, measured effective NDF (eNDF), in sacco degradability rates, and actual climatic data were entered into the model. Observed ADG and DMI were regressed on the corresponding 1996 NRC Beef Model predictions to determine the variation (adjusted r²), precision (standard error (Sₑ)) and bias (regression coefficient when the intercept was 0) of each relationship. Deviation of the regression slope from 1 was assessed using a two-tailed t test. Experimentally observed DMI were lower (P<.05) than the predicted DMI (Level 1 and 2). Regression results indicated that the 1996 NRC Beef Model overpredicted DMI of growing steers with an average bias of 11.5% (slope significantly different from 1). Experimentally observed ADG were greater (P<.05) than the predicted ADG (intercept different from 0 (P<.05)). ADG was predicted to be limited by metabolizable energy intake. Revising the carbohydrate B2 (CB2) fraction rates of barley grain (7.6%), B. alfa/alfa hay (1.7%), grain screening pellets (trial 1=2.4%; trial 2=3.1%), and barley silage (3.54 and 1.09%) did not improve ADG predictions and reduced dietary energy predictions. Under the conditions of this study, the 1996 NRC Beef Model overpredicted DMI and underpredicted ADG of backgrounding steer calves. It was concluded that further research is required to improve estimates of carbohydrate and protein fractions, degradation rates, rumen metabolic parameters and kinetics of local feedstuffs to improve the model’s accuracy of animal performance predictions for use in western Canada.

Key Words: 1996 NRC Beef Model, Validation, Backgrounding Cattle

613 Effects of ionophore type and level on performance by newly received beef calves and effects of ionophore type and management program on performance by finishing beef steers. G. C. Duff, M. L. Galvan, and K. J. Malcolm-Callis, Clayton Livestock Research Center, New Mexico State University, Clayton.

In Exp. 1, 250 crossbred (British x Continental; 177 kg) beef calves were used to evaluate the effects of ionophore (IONO) type and level on performance by receiving calves. Treatments (70% concentrate diets) were: control (no IONO), monensin (M) at 22 mg/kg of diet plus tylosin (T) at 11 mg/kg of diet (M22), M at 33 mg/kg of diet plus T of diet (M33), and lasalocid (L) at 33 mg/kg of diet plus oxytetracycline at 8.8 mg/kg of diet. No differences (P > .10) were noted among treatments for daily gain or feed:gain during the study. Daily DMI of concentrate and total DMI were decreased (P < .04) during d 0 to 14 for IONO treatments vs controls and decreased (P < .05) for M33 compared with M22. No differences were noted among treatments for daily DMI during d 15 to 28. Daily DMI was decreased (P < .08) for IONO treatments compared with control for d 0 to 28. In Exp. 2, 240 yearling British x Continental steers were used to evaluate the effects of IONO type and management during starting and finishing phases on performance. Treatments were (90% DM basis): no IONO (CON), M at 27.6 mg/kg; T at 14 mg/kg; rumen-protected choline (RPC) at 11 mg/kg of diet, and L at 33 mg/kg of diet during the first 28 d, followed by LP at 11 mg/kg of diet (L/LP) for the remainder of the finishing period. Daily gain (1.56, 1.56, 1.54, and 1.61), daily DMI (9.19, 9.00, 8.91, and 9.21), and feed:gain (5.87, 5.78, 5.80, and 5.71) for CON, M, LP, and L/LP, respectively did not differ (P > .10) among treatments for the 142-d experiment. Although not statistically significant, finishing diet ionophore altered DMI. Based on our results, both M at 22 or 33 mg/kg and L at 33 mg/kg can be used in the diet of newly-received beef calves without adversely affecting daily gain. However, decreased DMI should be an important factor to consider when determining the type and level of ionophore to feed to calves.

Key Words: Beef cattle, Ionophores, Performance


The objective was to determine the effect of feeding Lactobacillus acidophilus BG2FO4 (LA) and Propionibacterium freudenreichii P-63 (PB) either alone or in sequence on growth performance and carcass traits of finishing heifers. Yearling heifers (n=450; 384 kg) were allotted to 50 pens in a randomized complete block design and fed once daily for 126 d. Blocking factor was pen location: block 1=20 pens, block 2=20 pens, and block 3=10 pens. Treatments were: 1) no microbial feed additive (control); 2) LA, 3) PB, 4) LA, d 1-28, PB d 29-126 (LA/PB), and 5) PB, d 1-28, PB d 29-126 (PB/LA). Microbial feed additives were dissolved in water and added daily to the TMR. We fed LA at 5x10⁵ cfu/head/day and PB at 1x10⁵ cfu/head/day. Cattle were steppped up (21 d) to a final diet (12.5% CP, 2.5% CP from urea) 10% corn silage, 42% steam-flaked corn, 42% high-moisture corn, 3% soybean meal, 3% mineral supplement. Monensin and tylosin were included at 33 mg/kg and 11 mg/kg, respectively. Initial weight was based on two consecutive daily weights and final weight was determined by dividing daily carcass weight by the average dressing percent (62%). The experiment took place from September 9, 1998 to January 13, 1999 at the Southwest Research and Extension Center at Garden City, KS. We conclude that greater efficiency can be achieved by targeting the microbial feed additive to the phase of production.

Key Words: Microbial Feed Additive, Feedlot Cattle, Feedlot Performance

615 Rumen protected choline and free betaine effects in finishing feedlot steers. S. R. Goodall and J. R. Brethour, Gladwin A. Read Company, Kansas State University.

Rumen protected choline and free betaine effects in finishing feedlot steers. S.R. Goodall and J.R. Brethour, Gladwin A. Read Company, Elgin, IL and Kansas State University.

This experiment evaluated the effects of feeding 4.5 g/hd/d rumen protected choline (RPC), 20 g/hd/d free betaine (FB), the combination of 4.5 g/hd/d RPC plus 20 g/hd/d FB or a control diet (C) on finishing performance and carcass characteristics of yearling crossbred steers (n = 290 and BW = 463 kg). Initially, steers were allotted to three optimal days on feed (DOF) blocks based on a projection model that included weight and ultrasound estimated backfat and marbling score (DOF = 99, 126, 148). Within each DOF block, steers were sub-blocked by initial weight and source, then randomly allotted to the four treatments (C, RPC, FB, RPC+FB). Each treatment contained three pen-replicates with 24 steers/ pen. Cattle were fed milo-based finishing diets until reaching their optimal DOF targets and were then harvested. Final weights were determined from carcass weights divided by a constant (ADG, kg ab 1.20 1.21 1.18 1.26 1.25 .02 Feed/gain a 7.05 6.99 7.14 6.69 6.81 14 Carcass backfat, cm 1.15 1.21 1.17 1.09 1.16 .04 Choice + Prime, % c 64.15 59.55 76.96 66.15 68.20 4.6

 LA/PB vs. Control, P = .06; PB/LA vs. Control, P = .10; PB vs. Control, P = .05.

Key Words: Microbial Feed Additive, Feedlot Cattle, Feedlot Performance

615 Rumen protected choline and free betaine effects in finishing feedlot steers. S. R. Goodall and J.R. Brethour, Gladwin A. Read Company, Elgin, IL and Kansas State University.
BF accretion (k = (ln final - ln initial)/DOF) were also determined within each pen for steers with low versus high initial BF thickness. Subsequent AOV of these two BF sub-groupings revealed that RPC, FB and RPC + FB treatments significantly increased k values for steers with high initial BF thickness, but not for steers with low initial BF thickness. These findings suggest the RPC, FB and their combination causes cattle with a greater BF accretion propensity to fatten at a faster rate.

**Key Words:** Choline, Betaine, Fattening


Six dairy (mean weight 310.9 ± 15.3kg) and six beef (mean weight 310.8 ± 10.0 kg) yearling heifers were used to compare daily methane (CH4) emissions relative to animal type (dairy vs beef), forage quality (High vs Medium vs Low NDF) and feeding regime (ad libitum vs restricted). A DOF of 4 was used to compare 24h periods at both feeding regimes and📂

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620 Effects of abomasal casein or essential amino acid infusions on splanchnic metabolism in lactating dairy cows. C. K. Reynolds*, B. Lupoli, P. C. Aikman, D. J. Humphries, L. A. Crompton, J. D. Sutton, L. France, D. E. Beever, and J. MacRae. 1 The University of Reading, Reading, UK, 2 The Rowett Research Institute, Aberdeen, UK

Milk production and splanchnic metabolism were measured in 6 multiparous, catheterized, rumen cannulated, early-lactation Holstein X Friesian cows (636 kg BW) during 6-d abomasal infusions (18 L/d) of water followed by either casein (CAA) or essential amino acids (EAA) equal to 800 g milk protein/d for 6 d in a balanced single-reversal experiment with a 5 wk interval. Hourly measurements (6) of splanchnic (portal-drained viscera [PDV] and liver [LIV]) blood flow and net nutrient flux (mmol/h) were obtained on the last day of water and treatment infusions. Dehydrated lucerne, grass silage and concentrates (33, 17 and 50 %, respectively, on a DM basis) were fed hourly at 97 % of ad libitum DMI. Infusions had no effect (P > .07) on DMI (33.6 ± 3.54 and EAA (38.2 ± 37.2). Milk protein (g/kg) was increased (P < .01) by CAA (33.1 ± 3.42) and EAA (31.1 ± 3.20). Blood flow for PDV and LIV (2050/2509 L/h, respectively) and their oxygen removal (-4160 and -4224, respectively) were not affected (P > .38), but CAA and EAA increased (P < .05) LIV glucose release (818 vs 901 and 775 vs 855, respectively) and changed (P < .05) LIV lactate flux from removal to release (-24 vs 4 and -24 vs 40, respectively). The recovery of total EAA infused as increased PDV release was 68 % for CAA, but only 22 % for EAA. For nonessential amino acids (NEAA) in CAA the recovery as increased PDV release was 72 %, but increased LIV removal of NEAA and EAA exceeded the increase in their PDV release. The EAA infusion had little effect on NEAA flux for PDV and LIV, or LIV uptake of most EAA, but LIV uptake of Met and Phe were increased (P < .03) by both infusions. The net recovery of infused EAA as increased splanchnic uptake was low, but this may in part be due to increased splanchnic uptake of EAA from arterial blood.

Key Words: Splanchnic, Cows, Amino Acids

621 Milk protein response to abomasal and mesenteric vein infusions of essential amino acids in dairy cows fed low protein concentrates. P. C. Aikman, C. K. Reynolds*, D. J. Humphries, J. D. Sutton, L. France, D. E. Beever, and J. MacRae. 1 The University of Reading, Reading, UK, 2 The Rowett Research Institute, Aberdeen, UK.

Comparison of separate experiments suggests that the milk protein response to supplemental essential amino acids (EAA) is greater for i.v. compared to abomasal or duodenal infusion. Our objective was to directly compare the milk protein response to supplemental EAA provided via abomasal or mesenteric vein infusion in 5 multiparous, ruminally cannulated, multicatheterized Holstein X Friesian cows (676 kg BW and 17 wk postpartum). Cows were fed dehydrated lucerne, grass silage and low protein concentrates at 30, 20 and 50 %, respectively; of DM offered at 95 % of ad libitum DMI. Daily total-mixed rations (14 % CP) were fed as equal meals at 8 h intervals. The design used was a single reversal of site with two 10-d infusion periods separated by a 10-d rest period. Four-d control infusions (mesenteric vein saline [2.2 ml/min] and abomasal water [9 L/d using tubing inserted via the rumen]) were followed by 6-d infusions of a mixture of EAA equal to 400 g milk protein/d into one site. Control infusions were maintained for the site not used for EAA infusion. Milk yield and composition and DMI were measured for the last 3 d of control and EAA infusions. Intakes (19.9 kg/d), milk yield (28.7 kg/d) and milk fat concentration (39.5 g/kg) were not affected (P > .36) by EAA infusions. Milk protein concentration (g/kg) was increased (P < .005) by both abomasal (32.8 vs 34.0) and mesenteric vein (33.1 vs 34.6) EAA infusions, but the response was a small effect by infusion site (P > .47). Milk lactose concentration (g/kg) was decreased (P < .03) by abomasal (47.6 vs 46.8 g/kg) and mesenteric vein (47.2 vs 47.0 g/kg) EAA infusion, but the response was greater (P < .03) for abomasal infusion. At the level infused in these cows, the recovery of EAA infused as increased milk protein output (11.9 %) was not enhanced by i.v. compared to abomasal delivery.

Key Words: Milk Protein, Amino Acids


The objective of this study was to characterize the potential expression of four transport proteins (GLAST1, GLT-1, EAAC1, EAAT4) capable of mammalian System X-AG amino acid transport activity (high affinity; Na+-dependent; L-glutamate, D- and L-aspartate) in tissues important to intestinal absorption and gluconeogenic metabolism of glutamate in ruminants. The expression of mRNA for these proteins by sheep and cattle tissues, and their homology to rat cDNAs, was demonstrated by reverse transcription-polymerase chain reaction (RT-PCR) and Northern analyses, respectively. Membrane-bound cellular proteins were isolated from the scraped epithelium of rumen, omasum, duodenum, jejunum, ileum, cecum, and colon, and from homogenates of liver, kidney, and pancreas, of growing wethers (n = 4, mean BW = 28.4 kg) and steers (n = 3, mean BW = 426 kg) fed forage-based diets. After separation by 7.5 % SDS-PAGE, the expression of GLAST1, GLT-1, EAAC1, and EAAT4 proteins was evaluated by immunoblot analysis, using antibodies designed against rat proteins (Matthews et al., 1998, Am. J. Physiol. 274:C603-C614). For both sheep and steers, GLT-1 (—203, 188, and 142 kDa) and EAAC1 (93 kDa) were expressed in all tissues examined. In contrast, GLAST1 (140 kDa) was expressed only by the pancreas, whereas EAAT4 was not detected in any tissue of either species. These results indicate that the examined sheep and cattle epithelia display the same pattern of glutamate transporter expression, which differs among tissues and transporters. The size and tissue distribution profiles for sheep and cattle glutamate transporters are consistent with those reported for non-ruminants, when applicable. This study provides the physiologic knowledge necessary to study the role of glutamate transporter expression in ruminant N metabolism.

Key Words: Ovine, Bovine, Excitatory Amino Acid


Pancreata collected from steers (BW~200 kg) are perfused (40 mL/min) through the vascular system with Ham’s F12 medium that contains 160 U/mL collagenase (Type 1, Sigma) and hyaluronidase (Type I-S, Sigma) followed by 160 U/mL collagenase (Type 1, Sigma) and hyaluronidase (Type I-S, Sigma) for 25 min. The tissue is then minced and filtered through sterile gauze. Cells are recovered by centrifugation at 900 × g for 4 min at 25°C and rinsed 3 times with Ham’s F12. Acinar cells are separated from other cells by centrifugation through 40% Percoll gradients at 900 × g for 15 min. The acinar cells from each gradient are resuspended and pooled in culture medium consisting of Waymouth’s 752/1 medium, 25 mM HEPES buffer, 1% bovine serum albumin, and antibiotics (100 U penicillin, 100 mg streptomycin and 0.25 mg amphotericin B/L). Typically more than 1.5 × 10⁸ acinar cells are recovered per pancreas with greater than 90% viability. Cells are cultured at 37°C with 5% CO₂/95% air in 1 mL of culture medium per well using rat tail collagen-coated 24-well tissue trays. After 2 h, non-attached cells are removed by changing the culture medium. To determine appropriate cell seeding densities for α-amylase secretion, cells were seeded from 1250 to 750 × 10⁶ cells/well. After 24 h, the media was changed (5 mL/well). One h later, the fresh media was assayed for α-amylase activity and cellular protein was determined. Secreted α-amylase activity (U/g protein/h) and cellular protein (mg/well) were linearly (P < .001) proportional to seeding density. Therefore, 5 × 10⁶ cells were seeded per well in subsequent experiments. To determine the appropriate time for measuring α-amylase secretion, activity was measured in media collected 4, 8, 12, 16, 20, and 24 h after cell attachment. α-Amylase activity increased (quadratic effect, P < .001) by 87% up to 12 h. This procedure describes a method for the isolation and primary culture of viable pancreatic acinar cells that secrete differing levels of α-amylase and may prove useful for evaluating substrates mediating α-amylase secretion.

Key Words: Cell Culture, Bovine, Pancreas
624 Effects of plane of nutrition on blood metabolites and hormone concentration in goats. K. Koukou1, O. S. Gazu1, T. H. Terrill1, G. Kannan1, S. Gelay1, and E. A. Amoah1, 1Agricultural Research Station, Fort Valley State University, Fort Valley, GA 31030, 2Department of Biological Sciences, Saint Cloud State University, Saint Cloud, MN 56301.

A study was conducted to determine the effects of plane of nutrition on blood metabolites and hormone concentrations in goats. Sixteen mature dairy bucks (51 ± 7 kg) were selected and fed a concentrate diet (2.9 Mcal, DE; 16% CP) for two weeks to maintain their body weight. They were then blocked by weight and randomly assigned to two groups. Group I bucks (n = 8) were fed at maintenance for two consecutive periods (treatment 1) while group II animals (n = 8) were fed at 50% of their maintenance intake during period 1 (treatment 2) and then at 25% of maintenance during period 2 (treatment 3). During the third period, animals in both groups were allowed ad libitum feed consumption (treatment 4 for group II, and 5 for group I). At the end of each dietary treatment period, blood samples were collected and serum was assayed for non-esterified fatty acid (NEFA), blood urea nitrogen (BUN), luteinizing hormone (LH), testosterone (T), and growth hormone (GH). Overall, bucks fed at 25% of maintenance intake had a significantly lower (P < 0.02) serum NEFA than when fed at 50% maintenance, or during refeeding. During ad libitum consumption, goats previously at 25% maintenance had a significantly lower (P < 0.01) serum NEFA than those previously fed at maintenance (402 vs 632 ng/dl). Also submaintenance feeding increased (P < 0.002) BUN. Blood urea nitrogen level in ad libitum fed goats was dependent (P < 0.003) upon the previous level of feeding. Serum LH and GH were not affected by the plane of nutrition. Serum T was basal during both submaintenance and maintenance feedings. However, T concentration in ad libitum fed goats were higher (P < 0.05) for maintenance- than in submaintenance-fed goats. These results suggest that effects of plane of nutrition on metabolic and hormonal changes in the goat are manifested at different times. Furthermore, short-term refeeding did not reverse the effect of previous underfeeding on LH and GH secretion, but increased T secretion with magnitude dependent upon previous plane of nutrition.

Key Words: Submaintenance, Maintenance, Metabolites

625 Differences in blood metabolites and glucose metabolism in hair sheep and meat goat females during late pregnancy and lactation. S. Wilde*1 and J. M. Fernandez2, 1Virginia State University, Petersburg, VA, 2Louisiana State University Agricultural Center, Baton Rouge, LA.

This experiment compared pre- and postpartum plasma metabolite concentrations, and i.v. glucose tolerance (IVGTT; 250 mg glucose/kg BW) in Katahdin hair sheep ewes (n=10) and Myotonic, Nubian, Pygmy and Spanish meat-type does (n=10/breed) during late-pregnancy and early lactation. Females were bred to like-breed sires in November and January to represent spring (SP), summer (SU), autumn (AU) and winter (WI). Cows were exposed during 1998 to severe drought (rain = 386 mm) and their grazing diet was mainly buffelgrass (Cenchrus ciliaris) during SP and AU. The lowest level of BUN was observed in SU and AU. Blood GLU and BUN were very low during late pregnancy and early lactation. It was an interaction (P<0.01) breed x season for GLU and BUN. Blood GLU was higher during SP and it was reduced to the lowest point during SU. Simmental cows maintained their GLU level on AU and WI (41 and 44 mg/dl) but GLU was reduced in BR (50 to 32 mg/dl) and CH (47 to 38 mg/dl). All cows had the lowest level of BUN on SU (6.2 mg/dl). The highest levels of BUN were measured on AU with 18.2, 14.8 and 19.1 mg/dl for BR, CH and SI cows, respectively. Brangus and CH cows reduced their BUN to 9.9 and 6.4 mg/dl, respectively, but SI cows maintained a high level (17.2 mg/dl) on WI. Blood GLU and BUN were very low during SU and they can negatively affect cow productivity.

Key Words: Glucose, Blood Urea Nitrogen, Beef Cows

626 Seasonal changes in body weight, condition and serum glucose and urea nitrogen in Brangus, Charolais and Simmental cows grazing semi-arid lands. E. M. Romero-Trevino1, E. Gutierrez-Ornelas1, A. M. Garcia-Garza2, and H. Bernal-Barragan1, 1Universidad Autónoma de Nuevo Leon, Mexico, 2Union Ganadera Regional de Nuevo Leon, Mexico.

A study was conducted in Northern Nuevo Leon, Mexico to determine changes in body weight (BW), body condition score (BCS), glucose (GLU) and blood urea nitrogen (BUN) in Brangus (BR, n = 5; BW = 548±36 kg), Charolais (CH, n = 12; BW = 591±77 kg) and Simmental cows (SI, n = 15; BW = 545±68 kg). Blood samples and animal data were collected on April, July, October of 1998 and January of 1999 to represent spring (SP), summer (SU), autumn (AU) and winter (WI). Cows were exposed during 1998 to severe drought (rain = 386 mm) and their grazing diet was mainly buffelgrass (Cenchrus ciliaris) during SP and AU. Burned pricklypear (Opatnia spp) on SU and dry buffelgrass on WI. Simmental cows grazed sorghum residue during December.

Animals were daily supplemented (500 g/animal) on SU with a mixture of cottonseed meal-salt. A free choice mineral mix was provided all time. Blood samples were collected by coccygeal venipuncture, they were drawn from 09:00 to 15:00 hrs. and put on ice until centrifugation and stored at -20°C until analysis. Breeds had the same (P>0.05) BW and BCS throughout the year. Cows were heavier (P<0.05) on SU but it was associated with pregnancy or early lactation. It was an interaction (P<0.01) breed x season for GLU and BUN. Blood GLU was higher during SP and it was reduced to the lowest point during SU. Simmental cows maintained their GLU level on AU and WI (41 and 44 mg/dl) but GLU was reduced in BR (50 to 32 mg/dl) and CH (47 to 38 mg/dl). All cows had the lowest level of BUN on SU (6.2 mg/dl). The highest levels of BUN were measured on AU with 18.2, 14.8 and 19.1 mg/dl for BR, CH and SI cows, respectively. Brangus and CH cows reduced their BUN to 9.9 and 6.4 mg/dl, respectively, but SI cows maintained a high level (17.2 mg/dl) on WI. Blood GLU and BUN were very low during SU and they can negatively affect cow productivity.

Key Words: Glucose, Blood Urea Nitrogen, Beef Cows


An experiment was conducted to test the effect of supplementing the drinking water of transition dairy cattle with dextrose had on dry matter intake (DMI), water intake and blood metabolites. Thirty multiparous Holstein dairy cows were randomly assigned to one of three treatments for a trial period from 10 d prepartum to 21 d postpartum. The treatments were control and two supplementation levels of dextrose (1 and 2% of total daily drinking water). Cows were fed a total mixed ration twice daily through the pre- and post-partum period. DMI and water intake was recorded daily and coccycgeal blood samples were collected every other day throughout the trial period. Data was analyzed using repeated measures analysis of variance. DMI was depressed for all cows and although not significant cows treated with 2 % dextrose had a higher body condition score (3.7 vs 2.7; P<0.001) than does, but BW varied markedly (P<0.001) between goat breeds (26.0 to 49.6 kg). Ewes had higher (P<0.01) pre- and postpartum plasma urea-N concentrations does (11.1 and 12.2 mEq/L vs 8.72 and 9.55 mM, respectively). Similarly, pre- and postpartum plasma glucose concentrations were higher (P<0.01) in does (3.94 and 4.07 mM) than does (3.27 and 3.31 mM), however, there was a decrease in plasma glucose from pregnancy to lactation in ewes and increase in does (interaction: P<0.001). Plasma NEFA concentrations were higher in prepartum does (40.0 mM) than ewes (28.0 mM), and increased from pregnancy to lactation in ewes (21 to .30 mM), but remained unchanged in does (interaction: P<0.05). Plasma albumin was lower (P<0.001) in ewes than does postpartum (23.7±29.6 g/L). Glucose and insulin clearance (2.02 and 3.75 %/min) and basal insulin (43.4 and 18.9 pmol) following glucose infusion were not affected by species or physiological status. Basal insulin concentrations were similar between species, but higher (P<0.001) in pregnant (19.2 uIU/ml) than lactating females (12.1 uIU/ml). In the present experiment, hair sheep and meat goat females managed similarly differed in some key blood metabolite levels, but exhibited similar glucose kinetics in response to an IVGTT.

Key Words: Hair Sheep, Meat Goats, Metabolic Profile
To examine the impact of diet on gastrointestinal tracts, enteric decarboxylases, and tissue polyamine concentrations, K. A. Johnson* and J. J. Michal, Washington State University, Pullman, WA.

628 The impact of diet composition on gastrointestinal tract enteric decarboxylase activity and tissue polyamine concentrations. K. A. Johnson* and J. J. Michal, Washington State University, Pullman, WA.

The objective was to develop procedures to label with $^{15}$N three nitrogen (N) fractions excreted by ruminants. Insoluble fecal N was labeled using maize residues grown with $^{15}$N-fertilizer. Preparations were made in four replicates with two plant parts (leaf, stem) treated at two levels of incubation in the rumen (without, with) each followed by three types of treatment (control, neutral detergent solution-NDS- and NDS followed by acid detergent solution-ADS). Both ADS and incubation in the rumen reduced ($P<.01$) $^{15}$N % atom in leaf and stem. After incubation in the rumen NDS or ADS had little or no effect on $^{15}$N. Fecal soluble and urinary N were labeled by dosing four Peuhl Oudah rams, $k_2=0.0530$ (SD=.0092) and $T=3.2$ (SD=1.0) for urinary $^{15}$N-labeling of nitrogen fractions excreted by ruminants. Insoluble fecal N, which decomposes slowly in the soil, can be prepared by incubating $^{15}$N-labeled forage in the rumen and treating the residue with NDS.

Key Words: Cattle, Polyamines


Six beef steers (236 ± 15 kg) were used in a crossover design to quantifi- y intravenous glucose metabolism in response to site of carbohydrate supply to the intestine increases glucose uptake across the PDV and peripheral glucose utilization without increasing PDV glucose utilization.

Key Words: Bovine, Metabolism, Glucose

630 Ruminal versus abomasal carbohydrate infusion alters glucose metabolism in steers. C. J. Richards*, K. C. Swanson1, J. A. Howell1, J. C. Matthews1, D. L. Harmon1, A. D. McHarg1, G. B. Huntington2, S. A. Cabal1, and P. N. Rue1, 1University of Arkansas, Fayetteville, 2Zinpro Corp., Eden Prairie, MN.

Six beef steers (236 ± 15 kg) were used in a crossover design to quantify intravenous and whole body glucose metabolism in response to site of carbohydrate supply to the intestine increases glucose uptake across the PDV and peripheral glucose utilization without increasing PDV glucose utilization.

Key Words: Cattle, Glucose Tolerance

631 Effect of dietary chromium-L-methionine on glucose metabolism of beef calves. E. B. Kegley*, D. L. Galloway1, and M. T. Socha2, 1University of Arkansas, Fayetteville, 2Zinpro Corp., Eden Prairie, MN.

Thirty-six crossbred steers (288 ± 3.7 kg, initial BW) were used to determine the effect of chromium as chromium-L-methionine (CrMet) on glucose tolerance and insulin sensitivity in beef calves. Calves were fed a control diet or the diet supplemented with 400 or 800 µg chromium/kg of diet as CrMet. Calves were kept in drylots (6 calves/pen; 2 pens/dietary treatment). Calves were caught twice a day in looking headgates and individually fed their respective diet for a period of 22, 23, or 24 d prior to the metabolic challenges. Calves received a totally mixed ration containing 55% corn, 38% cottonseed hulls, and 5.2% soybean meal. On d 21, 22, and 23, 4 calves/dietary treatment were fitted with an indwelling jugular catheter. Approximately 24 h after catheterization, an intravenous glucose tolerance test (500-mg glucose/kg of BW) followed 5 h later by an intravenous insulin challenge test (.1 IU insulin/kg of BW) was conducted. There was no effect ($P>.10$) of dietary treatment on ADG or ADFI. After the intravenous glucose tolerance test, serum insulin concentrations were increased by supplemental CrMet (linear effect of Cr; $P<.10$) of dietary treatment on ADG or ADFI. After the intravenous glucose tolerance test, serum insulin concentrations were increased by supplemental CrMet (linear effect of Cr; $P<.10$). There was a time by treatment interaction ($P<.05$) of dietary treatment on ADG or ADFI. After the intravenous glucose tolerance test, serum insulin concentrations were increased by supplemental CrMet (linear effect of Cr; $P<.10$) of dietary treatment on ADG or ADFI. After the intravenous glucose tolerance test, serum insulin concentrations were increased by supplemental CrMet (linear effect of Cr; $P<.10$). There was a time by treatment interaction ($P<.05$) of dietary treatment on ADG or ADFI. After the intravenous glucose tolerance test, serum insulin concentrations were increased by supplemental CrMet (linear effect of Cr; $P<.10$) of dietary treatment on ADG or ADFI.
632 The effects of level of inorganic and organic mineral sources on in vitro dry matter disappearance of starch. G. B. Salter*1 and M. L. Galyean, Texas Tech University, Lubbock, TX.

The sulfate form (SUL), a polysaccharide complex (POLY), two proteinates (P1, P2), and an amino acid complex (AAC) of both Cu and Zn were used in an in vitro system with a starch substrate. Each source of Cu or Zn was included at levels of 3, 1, 2, and 3 times the NRC (1996) recommended requirement (X, 2X, and 3X) and evaluated for mineral sources at 3X Cu. The 48-h PDMD for SUL was less (P < 0.04) than for other sources at 3X Cu. The 48-h PDMD for SUL was less (P < 0.04) than for other sources at 3X Cu, but not different at other levels or times. For POLY, 4-h PDMD decreased (linear, P < 0.01) with increasing Cu level, whereas P2 responded quadratically (P < 0.01) to Cu level. At 24 h, PDMD for AAC increased linearly (P < 0.04) with increasing Cu. With the .5X level of Zn, 4-h PDMD for POLY was greater (P < 0.02) than for AAC, and PDMD for POLY was less (P < 0.03) than for other organic sources at 3X Cu. The 48-h PDMD for AAC was less (P < 0.04) than for other sources at 3X Cu, but not different at other levels or times. Similarly at 8 h and 1X, PDMD was greater (P < 0.02) than for P1 and P2 than for AAC, and PDMD for POLY was less (P < 0.03) than for other organic sources at 3X Cu. At 48 h, PDMD for AAC was greater (P < 0.04) than for other sources at 3X Cu, but not different at other levels or times.

Key Words: In Vitro, Zn, Cu


Fifty Angus x Hereford crossbred heifers were randomly assigned to bahiagrass pastures treated with biosolids containing mineral content, and evaluated for mineral status, with special attention to Cu. Biosolids were applied to pastures for the following treatments: 1) Baltimore biosolids (B1X) applied at 22.4 t/ha, 2) Baltimore biosolids (B2X) applied at 44.8 t/ha, 3) TAMPA biosolids (T1X) applied at 16.8 t/ha, 4) TAMPA biosolids (T2X) applied at 33.6 t/ha, or 5) control NH4NO3 applied at two times. Copper loads varied from 8.8 to 42.2 kg/ha, and Mo loads varied from .27 to 1.11 kg/ha. Heifers (two per pasture) grazed their assigned pastures exclusively for 153 d. Liver biopsies were taken to a linear increase in fecal Ca excretion (g/d), described by the equation Y = 0.207 + 0.00005X (R2=0.74, P<0.01); a linear increase in Ca balance (mg Ca/kg LW/d), described by the equation Y = -141 + 1.83X (R2=0.82, P<0.01) and a quadratic increase in urinary Ca excretion (mg Ca/kg LW/d), described by the equation Y = 1.23 + 0.0124X - 0.000021X2 (R2=0.39, P<0.05). Ca intake did not affect plasmatic Ca (12.6±1.7 mg/dl), plasmatic P (3.9±0.95 mg/dl) and P true absorption (132±15.3 mg/kilowatt/hour). The intake of Ca affects Ca fecal excretion and does not influence on P absorption.

Key Words: Calcium, Phosphorus, Goats

634 Effect of vitamin E and Chromium-Methionine supplementation on growth performance response of calves recently arrived to feedlot. R. Barajas* and L. Almeida, Universidad Autonoma de Sinaloa (Mexico).

To determine the effect of Vitamin E and Chromium-Methionine supplementation on growth performance response of calves recently arrived to feedlot, sixty Drought Master bull calves (BW=134 kg) just arrived to feedlot after 330 km truck transported, were used in a 28 days randomized block design (2X2 factorial experiment). Fifteen calves (three groups of five calves) were assigned to consume one of four diets in that consist the treatments: 1)Reception corn-based diet (14% CP) with 35.65 roughage/concentrate relationship(Cr); 2)Control diet supplemented with 150 IU of Vitamin E/kg (Vit.E); 3)Control diet supplemented with 1.0 ppm of Chromium from Chromium-Methionine(Cr); and 4)Control diet supplemented with Vit.E and Cr (Vit.E+Cr). Vitamin E supplementation had not effect (P>0.05) on final weight, average daily gain of weight(ADG), dry matter intake and feed/gain ratio. Chromium-Methionine supplementation had not effect on final weight and dry matter intake, but Chromium-Methionine supplementation increased (P<0.01) 21% the ADG (0.977 vs 1.189 kg), and improved (P<0.04) in the feed/gain ratio (5.402 vs 4.560) through the period. The plasma Cu was observed in feed/gain ratio, with values of 5.677, 5.128, 4.565, and 4.573 for Control, Vit.E, Cr, and Vit.E + Cr treatments respectively. It is concluded that Chromium supplementation from Chromium Methionine improve the growth performance response of calves recently-arrived to feedlot.

Key Words: Chromium, Methionine, Calves

635 Levels of calcium for growing kids. Calcium excretion and phosphorus true absorption. M. S. Bueno*, E. A. Cunha1, L. E. Santos2, and D. M. S. S. Vitti3, 1Instituto de Zootecnia, Nova Odessa, SP, Brazil, 2Centro de Energia Nuclear na Agricultura - USP, Piracicaba, SP, Brazil.

This study aimed to evaluate the influence of Ca intake on Ca metabolism and P true absorption. Growing kids raised for twelve weeks (from six to nine months old) in individual pens on high concentrate diet were changed to digestibility cages and Ca and P metabolism studied. Sixteen nine month old Saanen male goats, averaging 48.2 kg of live weight (LW), were fed diets with forage concentrate ratio of 40:60 (16%CP, 0.52%P) with increasing levels of Ca (66.2, 163.5, 341.2, 532.7 mg/kg LW/d). Radioactive phosphorus (32P) were injected into each animal through the jugular vein. After 6 hours, blood samples were collected, and feces and urine were measured and sampled during seven days. The increase in Ca intake (X) (mg/kg LW/d) led to a linear increase in fecal Ca excretion (g/d), described by the equation Y = 2.02 + 0.0188X (R2=0.64, P<0.01); a linear increase in Ca percentage in feces, described by the equation Y = 0.314 + 0.00534X (R2=0.92, P<0.01); a linear increase in Ca balance (mg Ca/kg LW/d), described by the equation Y = -141 + 1.83X (R2=0.82, P<0.01) and a quadratic increase in urinary Ca excretion (mg Ca/kg LW/d), described by the equation Y = 1.23 + 0.0124X - 0.000021X2 (R2=0.39, P<0.05). Ca intake did not affect plasmatic Ca (12.3±1.7 mg/dl), plasmatic P (9.68±0.95 mg/dl) and P true absorption (132±15.3 mg/kilowatt/hour). The intake of Ca affects Ca fecal excretion and does not influence on P absorption.

Key Words: Calcium, Phosphorus, Goats
taken from both cows and calves at calving and colostrum samples were collected for IgG and mineral analyses. Liver biopsies were taken to determine the trace mineral status of cows prior to the initiation of the trial and on both cows and calves at 10 and 30 days ± 3 after calving. Cow liver Cu levels were 49 ppm (DW basis) before supplementation. By 30 d after calving, cow liver Cu levels in Trt. 1 had declined to 14 ppm (Cu deficient). Trt. 2 levels had increased to 95 ppm, (P<0.05) and Trt. 3 levels were similar to base levels at 54 ppm. At 30 d of age, calf liver Cu levels were all normal with 99 ppm for Trt. 1 compared to 149 ppm for the other two treatments (P<0.05). No differences were found in colostrum Cu or IgG levels, or in the incidence of calf sickness among treatments. No differences were found in cow or calf serum Cu concentrations, cow weights and condition scores or in reproductive performance of the cows. A numerically greater percentage of cows in Trt. 3 conceived early in the breeding season; however, a numerically greater percentage of cows in Trt. 1 conceived during a 60-d breeding season. The organic and inorganic sources appeared to be equally available to the cows. Cu supplementation did not impact passive transfer of immunity to the calf or calf growth rate. Results indicated that feeding supplemental Cu did not improve cow reproduction or the health and performance of their calves.

Key Words: Copper, Cow, Reproduction


This study was conducted to determine the effect of level of chromium-methionine (Cr-Met) in receiving diets on growth performance of bull calves. Sixty four brahman bull calves (BW=219 kg) were used in a 28-day feedlot experiment. Groups of 16 calves were randomly assigned to consume one of four receiving diets consisting of: 1) Corn based diet with 14%CP, and 35:65 roughage:concentrate ratio, without supplemental chromium (control); 2) Control diet supplemented with 0.4 PPM of chromium from chromium methionine (Cr=0.4); 3) Control diet supplemented with 1.0 PPM of Cr from Cr-Met (Cr=1.0). Supplementation with 0.4 PPM of chromium increased (P<0.05) final weight (255 vs 264 kg) and average daily gain (1.425 vs 1.765 kg/day) relative to control. Compared to control the Cr=0.7 treatment, tended (P<0.10) to increase final weight (255 vs 260 kg) and average daily gain (1.425 vs 1.607 kg/day). Compared to control the Cr=1.0 treatment had no effect (P>0.10) on final weight (255 vs 258 kg) nor average daily gain (1.425 vs 1.418 kg/day). Dry matter intake and feed/gain were not affected (P>0.10) by supplemental chromium level. It is concluded that supplementation with 0.4-0.7 PPM of chromium from chromium-methionine improved the growth performance response of bull calves during their first 28 days in the feedlot, but an excess of supplemental chromium (1.0 ppm) did not show a response.

Key Words: Chromium, Calves, Feedlot

638 Impact of dietary salt concentration on feed and water intake and physiological measurements of feedlot cattle. A. F. La Manna, F. N. Owens, and S. Janloo, Oklahoma State University, Stillwater, OK.

Nine ruminally cannulated heifers (510 kg) in a triplicated 3 by 3 Latin square design were fed one of three levels of supplemental salt (0, 0.25, 0.50% of DM). Effects of salt level on intake and blood and ruminal macrominerals were monitored. Latin square periods included two weeks for diet adaptation and one week for sampling and measurement. Although water intake was not significantly (P = .27) increased by added salt, water intakes averaged 14 and 30% more with the .25 and .5% salt levels than without added salt. Daily dry matter intakes also tended to increase with 0.25% (8.1, 10.2 and 10.4 kg with 0, .25, .50% salt, respectively). The water to dry matter intake ratio was not (P = .55) significant (4.45, 4.15 and 4.53 with 0, .25, .50% salt, respectively). Arterial blood pH tended to respond quadratically (P = .09) and partial pressure of oxygen increased (P = .08), while partial pressure of carbon dioxide decreased (P = .07) linearly with added salt. Added salt linearly decreased ruminal pH (P = .06). None of the serum macrominerals were altered by added salt. Although total VFA concentrations were not altered, the butyrate percentage was lower (P < .05) with the 0% salt diet than the diets with .25 or .50% added salt (8.5 vs. 10.8 and 11.2%). Added salt linearly increased percentages of butyrate (P = .03) and iso-butyrate (P = .05) leading to an increased (P < .05) energy charge of ruminal VFA. Effects of dietary salt concentration on ruminal pH, evacuated weights of ruminal liquid and solids, and urinary pH were not significant.

Key Words: Salt, Intake, Feedlot Cattle

639 Phosphorus and calcium status in goats grazing the semiarid region of Zacatecas, Mexico. I. Mejia-Haro1, R. Espinoza2, A. Mejia3, and J. Mejia4, 1University of Nebraska, 2CIGA ITA 20, 3UAZ.

To determine the P and Ca status in goats grazing the semiarid region of Villa de Cos, Zacatecas, Mexico, soil, forage and animal samples were collected. Samples of 20 forage species were hand-collected monthly for 1 year, and blood serum samples from 70 adult female goats were obtained by puncture of the jugular vein. Twelve bone samples were collected from dead animals, and 22 soil samples were taken at the beginning of the study. A completely randomized design was used with sampling times as treatments and each sample as an experimental unit. Data were processed by analyses of variance, and differences among treatments were assessed with the multiple range test of Tukey. Student’s t-test was used to compare Ca and P contents of the samples against normal and adequate values as reported in the literature. Perennial forages presented deficient P contents (mean values ranged from .05 to .60%) and high Ca levels (mean values ranged from .97 to 1.81%) through the year, and no differences (P > .05) among sampling times were found. However, P content of annual forages was higher (x = .14%, P<.05) during the months of the rainy season than during the dry season (x = .09%). Phosphorus content in blood serum collected in the rainy season was normal (x = .57 ppm) and higher (P <.01) than those collected in the dry season (x = .42 ppm), which were considered deficient in P. Mean values of mineral content in soil samples were 1ppm for P and .97% Ca, the former was considered deficient and the latter high. Low P content (x = 15.6%) and high Ca (x = 40.4%) were found in ash of bone samples. Low amounts of P and high amounts of Ca in soil were reflected in low P and high Ca content in forages collected in the dry season, as well as the blood and bone samples of goats. P content in forages and blood samples collected in the rainy season was higher than those of the dry season. Calcium content of forages was not different (P >.05) among sampling times.

Key Words: Mineral, Content, Grazing


There is dearth of information on sheep performance on diets containing Phyllanthus discoideus. Farmers feed this multi-purpose tree (MPT) to their livestock without any knowledge of their potential benefits or anti-nutritional factors (ANF). The objective of this study was to investigate the effects of Phyllanthus discoideus supplementation to a basal hay diet on fermentation parameters, digestibility and nitrogen balance. Eight West African Dwarf sheep, all castrates with mean liveweight (28.8±4.2 kg) were used in repeated measurement analysis in a completely randomised design. Four of the sheep were rumenally fistulated and used for ruminal ammonia and volatile fatty acid (VFA) determination. Dried leaves of Phyllanthus discoideus were offered at two levels (25% and 50% of DM requirement) as supplements to a basal hay diet. Rumen liquor was sampled one hour before and one, three and five hours after morning feeding. Sheep fed the control diet had a higher (P<0.05) ammonia concentration in the rumen than those fed the diet supplemented with 25% (D25%) and 50% (D50%) Phyllanthus discoideus (8.9, 8.5 and 8.1 mg N/100 ml, respectively with 0, 25 and 50% of DM, respectively). The nitrogen balance showed a trend of increased retention with increasing level of supplementation.
It was concluded that *Phyllanthus discoideus* has a great potential as a fodder tree for supplementation because of the contribution of its nitrogen to the nutrient economy. This could be probably due to its low content of condensed tannins (12.8g/kg) and high crude protein (156g/kg) content.

**Key Words:** *Phyllanthus discoideus*, Sheep, Fermentation parameters

### 641 Effect of ruminally protected choline on productivity of Angora goats.

T. Shenkoru*  

**Abstract**  

Twenty-five Angora wethers (29 ± 6 kg initial BW and > 1 yr old of age) were used to evaluate effects of ruminally protected choline (PC) on BW gain, blood metabolites, and wool production. Animals were randomly allocated to five treatments and had ad libitum access to 55% concentrate diet (oat-based, 13% CP) for 90 d. Treatments were 1, 2, and 3 g/d of PC, 3 g/d of unprotected choline (UP), and no added choline (control). In situ ruminal disappearance of PC was 7%, whereas disappearance of UP at 2 h was complete. Total tract digestibility of PC was 56%. Dry matter intake and feed efficiency were similar among treatments (*P* > .10). Body weight gain for 3 g PC was greater (*P* < .05) than for the control and UP. No difference in gain-to-catch weight was observed among treatments. Mohair diameter differed (*P* < .05) between UP and PC and between UP and 3 g PC. Ruminal VFA concentration was higher for 3 vs 1 (*P* < .01) and 2 g PC (*P* < .05). The molar percentage of butyric acid was lowest for 3 g PC (*P* < .05). Plasma protein concentration for the control was lower (*P* < .05) than for 2 and 3 g PC. The level of NEFA in plasma was decreased by PC supplementation (*P* < .05). In conclusion, supplementation of growing Angora wethers with 3 g/d of protected choline increased ADG without change in DMI, but had no effect on mohair growth or quality. Effects of PC on plasma NEFA and cholesterol levels suggest altered lipid metabolism.

**Key Words:** Angora goat, Rumen protected choline, Body weight gain

### 642 Effects of methylpalmitoxirate in mature sheep.

W. Pittroff1,*, M. Friedman2, S. Das3, and H. D. Blackburn1  

**Abstract**  

Interference with long-chain fatty acid oxidation by methyl 2-tetradecylglycidate, methylpalmitoxirate (MP, Johnson Pharmaceutical) has been shown to reduce plasma levels of circulating ketone bodies and increase food intake during the activity period of MP in monogastric animals. MP binds irreversibly to CPT I and thus inhibits mitochondrial uptake and oxidation of long-chain fatty acids. In sheep liver, but not in monogastrics, methyl-malonyl-CoA is a quantitatively significant inhibitor of CPT-I. Therefore, examination of the effects of MP on ketogenesis and correlated feeding responses may produce results different from monogastrics. This experiment examined the effects of MP on plasma ketone bodies, plasma glucose and cumulative feed intake for 4 h and 28 h post-administration in mature sheep. 14 mature ewes were randomly allocated to MP treatment at 50 mg/kg fasted body weight i.m., and to control (vehicle only). Initial tests indicated that MP takes approx. 4 h post i.m. administration in sheep. Sheep were fed ad libitum a pelleted diet containing 70% straw, 20% alfalfa hay, 3% molasses, 4% rumen-protected fat, 2% casein and 1% urea (w/w). Sheep were fasted for 12 h prior to administration and during sample collection but had access to water at all times. Plasma samples were collected just prior to administration, and hourly for 7 hours starting 4 hours post administration. Samples were analyzed for ketone bodies and glucose. Metabolite data were analyzed with linear MANOVA and a repeated measures linear model. Feed intake data were analyzed with weighted ANOVA. Within-subject effect (time) bordered significance (*p*=.0677) when analyzed with MANOVA. Between subject effect MP treatment on plasma concentration of ketone bodies was highly significant. There was a tendency for glucose to be depressed under MP but the difference to controls was not significant. Cumulative feed intake (kg/kg body weight) measured over 28 hours with an automated self-feeder, tended to be lower for MP treated animals but the difference was not significant. Cumulative feed intake in the first 4 h p.a. did not differ between groups. This is the first report of effects of MP on long-chain FA oxidation in ruminants. More detailed analysis of feed intake responses and metabolism hormone activities is required.

**Key Words:** Sheep, Methylpalmitoxirate, Feed Intake

### 643 Serum α-tocopherol concentrations for Venezuelan dairy cattle.

O. Rosendo1,*, L. R. McDowell2, N. S. Wilkinson2, and A. Boning2  

**Abstract**  

A survey of three dairy herds in Lara state, Venezuela determined α-tocopherol serum concentration(α-T; μg/mL) of cows as related to breed (Holstein = H & Jersey = J), location (mountain = M & valley = V), and both lactation (LS) and reproductive stages (RS). Cows from each herd were grouped into five RS: C) 21 to 1 d prepartum (pp), F) 1 to 21 d postpartum, O) open, G1) ≤150 d pregnant (pu), and G2) > 150 d pp to < 21 d pp. Herds had similar feeding systems based on fresh-cut forages, corn silage, and grass hay as forage sources. Concentrate was separately offered twice a day. None of the herds received supplemental vitamin E. Data was analyzed as factorial models. A first and second model included herd, RS, and herd by RS interaction effects to analyze α-T for H and J, respectively. Since α-T values for H in two herds were similar (H vs J > .10), α-T data were pooled, and a third model with location, breed, RS, location × breed, location × RS effects was examined. α-T were 8.0 vs. 4.4 (M vs. V), and 7.1 vs. 5.4 (H vs. J) for location and breed, respectively (*P* = .0001). α-T for C and F groups did not differ within locations (*P* > .10). For group C, α-T did not differ between locations (*P* > .10), but for F, O, G1, and G2, α-T was higher at M than at V (*P* < .05). For V, α-T of G1 group was higher than C and F but not different from O and G2, while for M, O group was the highest (*P* < .05). To evaluate α-T for H as affected by LS, an additional model compared the following LS groups based on days in milk (DIM), f ≤21, e 22 to 100, m 101 to 200, and l > 200 DIM. α-T values were 3.0, 4.6, 7.4, and 7.2 for f, e, m, and l groups, respectively. α-T were similar for e and f, and for m and l groups (*P* > .10) but, m or l was higher than e (*P* < .05) or f (*P* = .0001). Results indicated that location and RS were important factors in determining variation in α-T among herds. α-T in peripartum cows was the lowest, and open cows or those in early to mid gestation had the highest values. Holstein fresh cows or early in lactation had lower α-T values than those in mid or late lactation.

**Key Words:** α-Tocopherol, Dairy cows, Reproductive stages

### 644 Effect of a dietary supplement of folic acid on net flux of urea N, ammonia N and α-amino N across the ruminal wall of lactating dairy cows.

C. Benchaar1,*, A. Desrochers2, J. J. Matte1, and C. L. Girard1  

**Abstract**  

Our previous studies demonstrated that an exogenous supply of folic acid increases milk production and milk protein yield in multiparous dairy cows. Suggesting that dairy cow requirements for folic acid can not be met only by rumen microbial synthesis. However, before making a recommendation on the dose of folic acid to include in dairy cow diet, it is necessary to evaluate the effect of supplementary folic acid on rumen metabolism. This study was therefore undertaken to determine the effects of dietary supply of folic acid on the net flux of nitrogenous compounds (urea N, ammonia N and α-amino N) across the ruminal wall of dairy cows. Five lactating cows (574±45 kg) fitted with catheters in the right ruminal vein and the ileo-colic artery and with an ultrasonic flow probe around the right ruminal artery were used in a cross-over design. They were fed ad libitum in seven equal meals daily a TMR based on 60% of silage (corn and grass). Dietary supplements of folic acid were 0, 1.8 and 3.9 g/d. A total of fourteen sets of arterial and venous blood samples were collected separately at 30 min intervals over 6 consecutive hours. During the sampling period, right ruminal artery blood flow was recorded continuously. Ammonia N, urea N and α-amino N were analyzed on whole blood samples immediately after sampling. Blood flow in the right ruminal artery was not affected (101 L/h; *P*=.58) by the addition of folic acid in the diet. Arterial and venous ruminal concentrations of ammonia, urea and α-amino N were not changed by treatments (*P*>.20). Ammonia net release and urea net uptake were not affected by supplements of folic acid (+35 and −38 mmol/h; *P*=.72
645 Effect of Agrado™ on the Health and Performance of Transport-Stressed Heifer Calves. T. C. Stovall*, H. Han, and D. R. Gill, Oklahoma State University, Stillwater, OK.

Six hundred ninety mixed breed heifers (196 kg average initial BW) were used to determine the effect of adding Agrado™, an antioxidant produced by Solutia, St. Louis, MO., to the receiving ration on rate and efficiency of gain, and response to medical treatments. Heifers were blocked by weight within each of 7 truckloads of cattle and randomly assigned to one of two diets (0 or 150 ppm added Agrado™) within each weight block with eight pens of 10 to 16 head per load. All cattle, purchased at sale barns in Oklahoma and Arkansas by order buyers, were given free choice access to a moderately high energy receiving diet (51 Meal NEE / cwt) consisting of 32% soybean hulls, 27% corn, 16% wheat middlings, and 10% cottonseed hulls. Health and performance were monitored for 42 days following arrival. Diets were supplemented with 15 IU vitamin E/kg and either 0 or 150mg Agrado™/kg. Cattle were observed for signs of morbidity daily and frequency, duration, and extensiveness of medical treatments were recorded. Morbid heifers fed supplemental Agrado™ required fewer medical treatments for recovery (1.2 vs 1.0; P<.05) indicating that Agrado™ may reduce medical costs. No significant effects of Agrado supplementation on rate and efficiency gain during these 42-day receiving trials were detected.

Key Words: Agrado™, shipping stressed cattle, feedlot

646 Impact of Agrado™ on Tocopherol Metabolism by Transport-Stressed Heifers. H. Han*, T. C. Stovall, and D. R. Gill.

Eighty mixed bred heifers (5-7 months old, 196 kg initially) were selected from a group of 690 heifers used in receiving trials in order to investigate effects of Agrado™ on tocopherol metabolism. Cattle, purchased by order buyers from Oklahoma and Arkansas sale barns, were given ad libitum access to a moderately high energy diet composed of soybean hulls, whole corn, wheat middlings, and cottonseed hulls with either 0 or 150 ppm added Agrado™. Diets were supplemented with 15 IU vitamin E acetate/kg. Jugular vein blood was collected on days 0, 14, 28, 42 and 68 after arrival in Stillwater. Plasma alpha tocopherol concentration was analyzed by HPLC. On day 0, plasma tocopherol levels were 7.2 (control) and 8.5 µg/ml (Agrado™ treatment); by day 42, tocopherol concentration level remained below 3 µg/ml; this is below the level considered to be normal. The drop from day 0 to day 14, 28, and 42 tended to be higher for heifers receiving 150 ppm Agrado™ (5.2, 4.8, and 4.8 µg/ml vs 6.3, 6.0, and 5.9 µg/ml) indicating that even though Agrado™ is an effective antioxidant, it did not increase the blood tocopherol concentration. However, there was no significant difference between treatments (P>.05). On day 68, plasma tocopherol had significantly (P<.05) decreased to 2.0 (control) and 2.2 µg/ml (Agrado™ treatment). Through day 42, tocopherol concentration level remained below 3 µg/ml; this is below the level considered to be normal. The drop from day 0 to day 14, 28, and 42 tended to be higher for heifers receiving 150 ppm Agrado™ (5.2, 4.8, and 4.8 µg/ml vs 6.3, 6.0, and 5.9 µg/ml) indicating that even though Agrado™ is an effective antioxidant, it did not increase the blood tocopherol concentration. However, there was no significant difference between treatments (P>.05). On day 68, plasma tocopherol had significantly (P<.05) decreased to 7.0 and 6.5 µg/ml for heifers receiving Agrado™ and control diets, respectively. Results indicate that transport and other changes occurring at this time (mixing of cattle, diet changes, vaccination, and respiratory challenges) are associated with decreases in plasma tocopherol levels that do not return to pre-transit concentrations for more than 42 days. Whether increases in plasma tocopherol concentrations are responsible for performance and health benefits sometimes noted with diet supplementation of shipping stressed calves with vitamin E needs further study.

Key Words: Agrado™, tocopherol, shipping stress

647 Influence of dietary vitamin A restriction on growth performance, concentrations of plasma thyroid hormones, carcass characteristics, and marbling scores in Japanese Black steers. K. Horante1, T. Odawara2, Y. Sasa3, and M. Yosiiwa1. 1National Institute of Animal Industry, Tsukuba, 2Qita Animal Experimental Station, Japan.

The objective of this study was to determine the effect of dietary vita- min A restriction on growth performance, plasma concentrations of thy- roid hormones, carcass characteristics, and marbling scores in Japanese Black steers. Ten half-sib Japanese Black steers (13 mo of age, 422 kg initial body weight) were randomly assigned into two treatments. The treatments were no vitamin A supplementation (DA) or oral vita- min A supplementation of 700,000 IU per100 kg of body wt every 28 d (CN). The ten steers were fed a diet (90% concentrate) ad libitum during the 252 d period. Feed intake was measured daily and body wt was recorded biweekly. Blood samples in each steer were obtained on d 0, 28, 56, 84, 140, 196 and 252. Concentrations of retinol in plasma were determined using HPLC. Concentrations of plasma triiodothyronine (T3), thyroxin (T4), growth hormone (GH) and cortisol were measured by RIA. Twelve levels of marbling scores and ribeye area in all carcasses were evaluated following 24-h chill. From d 28 of the trial, greater than 50% decreases (P<.05) in plasma retinol in DA steers compared to CN steers were found, however no clinical symptoms of vi- tamin A deficiency were found during the study period. No differences (P>.05) between vitamin A treatments were found in average daily gain (DA=.86, CN=.91 kg ), daily feed intake (DA=9.31, CN= 9.33 kg), feed efficiency (DA=10.8, CN=10.3 kg) during the 252 d period, and carcass weights (AD=378, CN=389 kg). However, DA steers had higher marbling score (5.0 vs 3.2, P<.05) and greater ribeye area (46.2 vs 39.4 cm², p<.05) than CN steers. T3 concentrations were lower (P<.05) in DA steers than CN steers on d 56, 84, 140, and 196, and T4 concentrations were lower in DA steers than CN steers on d 84 (6.12 vs 7.58 ng/dl, p<.05). No treatment differences were found in plasma GH and cortisol. Our findings suggest that low concentrations of blood retinol and altered metabolisms in thyroid hormones during the fattening period increase intramuscular fat deposition in Japanese Black steers.

Key Words: Vitamin A, Marbling, Thyroid hormone


Six crossbred steers (mean wt 355.7 kg) of similar genetics were used in a replicated 2 X 2 Latin square design to determine mineral balance and ruminal fluid pH when fed 26% BIOSAF® (Saccharomyces cerevisiae 8 X 109 CFU/g). BIOSAF® was substituted for 26% of the corn in a feedlot finishing diet. During each period, the steers were group fed (11.4 kg/head·d⁻¹) the control or BIOSAF® diets containing 80% steam rolled corn, 10% cottonseed hulls, and 10% protein-mineral supplement for a 21-d diet adjustment period. Following the diet adjustment period, steers were fed 9.08 kg/d and housed in metabolism stalls for a 7-d stall adjustment period and 7-d collection period. Mineral intake, excretion (fecal and urine), apparent absorption, and retention were determined. On the last day of the collection period, a ruminal fluid sample was obtained via rumenocentesis and pH was measured. Apparent absorption and retention of Ca were increased (P=.0307) 8% with the addition of BIOSAF®. There was no difference (P=.9566) in apparent P absorption; however, P retention as a percentage of absorbed P was increased (P=.0584) by BIOSAF® (67.7 vs 52.6 %). BIOSAF® increased (P=.0013) apparent Na absorption (10.7 vs 8.1 g/d) and (P=.0074) re- tention (4.3 vs 1.1 g/d). Steers fed BIOSAF® had a greater (P=.0069) apparent Mn absorption (147 vs 70 mg/d) and (P=.0002) retention (146 vs 69 mg/d). There were no differences in absorption or retention of N, K, Mg, Fe, Zn, and Cu when either of the diets were fed. BIOSAF® increased (P=.0176) ruminal fluid pH (6.47 vs 5.48). The results of this research indicates that BIOSAF® has a positive effect on Ca and P utilization in feedlot steers and may be valuable in reducing P excretion in concentrated animal feeding operations.

Key Words: Mineral, Steers, Yeast
649 Effects of source and level of ruminally protected choline on performance and carcass characteristics of finishing beef steers. G. A. Nunney*, M. L. Galayan, S. C. Harris, G. B. Salzer, and P. J. Defoor, Texas Tech University, Lubbock, TX.

Two hundred eighty British x Continental crossbred steers (initial BW = 362.1 kg) were used to examine the effects of source and level of ruminally protected choline (RPC) on performance and carcass characteristics. Steers were divided into two blocks (light and heavy) with 140 steers per block. Within each weight block, steers were stratified by BW and assigned randomly within BW strata to one of the seven dietary treatments. After steers were assigned to treatments, pens (four pens of five steers each per treatment within each weight block) were assigned randomly to the seven dietary treatments. Treatments included 90% concentrate (steam-flaked corn base) diets with: 1) Control (no added choline); 2) RPC from Source A at .137% of dietary DM; 3) RPC from Source A at .274% of dietary DM; 4) RPC from Source B at .137% of dietary DM; 5) RPC from Source B at .274% of dietary DM; 6) RPC from Source C at .137% of dietary DM; and 7) RPC from Source C at .274% of dietary DM. Percentages of RPC were designed to supply 2.5 (.137%) or 5 g (.274%) of ruminal escape choline per steer daily. Steers were fed for 112 (heavy block) or 140 d (light block), and carcass data were collected. From d 0 to the end of the trial, there were no differences (P > .10) in ADG (1.66 kg/d across all treatments). Dry matter intake ranged from 8.96 to 9.29 kg/day and did not differ (P > .10) among dietary treatments. Feed:gain ratio also did not differ (P > .10) among treatments. Control steers had more (P < .01) fat over the 12th rib and higher (P < .01) yield grades than the average of steers fed all RPC treatments. Longissimus muscle area tended (P = .11) to be less for Control steers than for steers in the average of all RPC treatments. Feeding RPC did not affect performance but decreased carcass fatness and thereby decreased carcass yield grade.

Key Words: Choline, Beef Cattle Performance, Carcass

TEACHING

650 Regionalization within the Northeast and Mid-Atlantic: today's reality and tomorrow's vision. P. A. Schoknecht* and H. D. Hafs, Rutgers University, New Brunswick, NJ.

The field of animal science is expanding from our traditional production agriculture base to include the study of laboratory and exotic animals, biotechnology, wildlife, and companion animals. For academic departments to meet the needs of this diverse clientele without sacrificing quality, we must create ways to cooperate rather than compete. For the last 3 years, Animal Science departments throughout the Northeast and Mid-Atlantic have been meeting to discuss and implement programs in regionalization. Our four-year plan calls for us to develop mechanisms to share students, faculty, and courses, with agreements presently in place among three regional schools. We are creating computer-based and computer-assisted instruction to share expertise, with work progressing in animal genetics and animal nutrition. We have developed regional extension training in dairy herd health, with more programs planned. We are building a database of internships to help students find opportunities across the region and increase the employee pool for regional industries, and we are linking this effort to a regional course in careers to help students understand the breadth of available choices. Some schools have also begun sharing research animals and research facilities, an endeavor that will truly transform those institutions. These efforts are being supported in part by the Kellogg Foundation, but primarily by the institutions and departments themselves. These departments believe that they can no longer "be everything to everyone". Instead, they must each create incentives and develop mechanisms to cooperate so that they can continue to progress in their areas of strength, while relying on others in the region to provide assistance where they are weak. We believe that by developing mechanisms to institutionalize this type of cooperation, the Animal Science departments in our region will become stronger and more focused, while meeting the increasingly diversified needs of our stakeholders.

Key Words: Regionalization, Education, Animal Science

651 A regional approach to career seminar in animal science. G. E. Dahl† and P. A. Schoknecht‡, 1University of Maryland, College Park, MD, 2Rutgers University, New Brunswick, NJ.

Numbers of animal science undergraduates continue to grow within the Mid-Atlantic/Northeast regions, with over 90% of these students preparing for application to veterinary school. However, only 15-20% are actually successful in pursuit of entry to veterinary school, thus, a large number of students are left to find other careers. Our approach to increasing student knowledge of alternative careers in animal science is one of exposure and experience. First, students are exposed to alternative careers by participation in a Regional Career Seminar. Second, we will increase students' ability to experience these opportunities by use of a Web-based regional database for internships. The career seminar course was initiated in the spring semester of 1999. A variety of stakeholder participants have been recruited to make presentations in the career seminar course; internship placement is also sought from these stakeholders. Delivery of the seminar course is via interactive video conferencing. Thus, the efficiency of stakeholder recruiting efforts will be maximized while maintaining student-stakeholder interaction. The course emphasizes resume writing and internship skills development at each local site. A website has been developed as a clearing-house for internships in animal agriculture within the Mid-Atlantic/Northeast regions, and access to the site is enhanced in the career seminar course. Changes in student participation rate in internships is being evaluated as well as student and stakeholder satisfaction with the course and internships. Additionally, stakeholders will provide input on the preparedness of animal science students for jobs within their industries, and asked for feedback regarding curriculum changes needed to better prepare students. We believe this approach will enhance the undergraduate experience, strengthen university-stakeholder ties, and promote the movement of animal science students into agriculture and related careers. In addition, the project will further enhance the regionalization of animal science activities in the Mid-Atlantic and Northeast regions.

Key Words: Career Course, Internship, Regional


This project is designed to produce a multimedia compact disk (CD) program for the purpose of enhancement and mastery of anatomical and physiological concepts by undergraduate students in animal science and related agricultural sciences. A problem-oriented approach for the presentation of fundamental principles of functional anatomy as applied to farm animals is used. Students are presented text, graphics, animation, and audio and video aspects relative to the anatomy and physiology of the somatic portion of the peripheral nervous system in nine lessons. Mastery level of the lessons is assessed by 20 randomly selected multiple-choice questions. Four real-life case studies of neuromuscular abnormalities in the horse and cow are documented. Expert prompts, including history and details pertinent to each case, are provided in video and text format to aid the student in formulating initial observations. Upon successful completion of the lesson material and test, the students are permitted to enter conclusions as to the nature of the abnormality. This information, along with student's notes and quiz responses, are stored on a diskette and subsequently reviewed by the instructor. At the end of the program the expert gives a synopsis of the neuromuscular involvement in each case. This program underscores the practicality of understanding structural and functional relationships of the nervous and skeletal muscle systems that underlie commonly occurring neuromuscular abnormalities in farm animals. Experience in this mode of instruction will improve problem-solving skills of students as they practice applying physiologic concepts to their own observations. This program should significantly reduce the number of animals used in teaching laboratories and in addition, provide institutions that have limited access to animals and/or prepared specimens similar advantages commonly afforded to larger universities directly associated with colleges of veterinary medicine.

Key Words: Teaching, Multimedia, Functional Anatomy
Designing feeds and feeding for internet delivery. K. K. Ragland* and R. M. Hales, University of Kentucky, Lexington, KY.

Long a popular correspondence course for students seeking to enter schools of veterinary medicine, Feeds and Feeding needed to make the leap from its traditional paper offering to an interactive, multimedia format available to students via the Internet. Faculty with expertise in animal nutrition and distance learning course design worked with Web designers to create a course specifically for veterinary medicine students with almost all course materials being located within the course software package (TopClass). All interaction, homeworks, quizzes, and tests are submitted and graded within the TopClass framework. The structure is fully interactive with students responding to questions and activities on-line and interacting with the instructor and one another via personal messages and announcements. The Web-based platform supports not only text, graphics, and still images, but animation, audio clips, and full-motion video. A text, supplementary NRC tables, and a study kit of feedstuffs round out the course materials. After a year in development, the course was first offered to UK students in the spring of 1999 with five enrolled. On-line demonstration of the course structure, highlights of the TopClass version, and student responses to the initial offering will be presented.

Key Words: Distance Learning, Internet, Feeds and Feeding

Use of web pages to both enhance animal science courses and serve as outreach mechanisms. A. D. Her- ring* and B. L. Barham, Texas Tech University, Lubbock.

Web pages for two upper-level animal science courses, one animal breeding and genetics course and one beef production course, have been utilized since 1997. During this time use of internet resources and e-mail has increased among students. A survey of students in 1998 in beef production showed that 44.7% used e-mail and 80.9% used the internet regularly. Survey of students in the same course in 1999 showed that 75.4% used e-mail and 93.4% used the internet regularly. Average number of e-mail messages sent per week was 3.9 in 1998 and 6.2 in 1999. Average internet accesses per week was 2.4 in 1998 and 3.7 in 1999. The primary purposes for which these web pages were created were to (1) provide supplemental information to students, (2) give students more accessibility to instructors and (3) allow more flexibility for students to monitor grades. These objectives have been effectively accomplished, based on student feedback. However, another use of these web pages has been determined, university outreach. A commercially available web page tracking program was obtained to monitor our web page activity beginning in 1997. This program tracks usage by time of day, day of week, and country of origin. The computer addresses of the last 100 visitors are also shown. As of February 1999, visitors from 19 countries outside the United States have viewed our web pages, which are not advertised on any internet search engines. Students at all levels are increasingly using internet resources. There is no certain way to estimate how many potential new students in high schools and transfer students at junior colleges may see these course web pages, but they are sure to get some sort of impression from ones they do find. The primary focus of course web pages should be to effectively enhance classroom experiences, with these other potential uses secondary. However, in times when faculty accountability is increasingly important, documentation of course web page usage can provide additional quantitative data in assessment of faculty activities and workload.

Key Words: Teaching, Computers, Technology

The integration of the world wide web in undergraduate and graduate education. J. J. Parrish*, University of Wisconsin, Madison WI.

World wide web based instruction was integrated into three animal science courses ([http://www.wisc.edu/animalsci/]), the first course was an equine laboratory within the freshman introductory animal science course with 110 students. The equine laboratory site was designed to stand alone as there were no equine lectures in this course. The lab exercise was intended to provide an experience in equine handling and routine management. Students were able to view color images of the breeds and photos of the anatomy and handling procedures that were part of the lab. This proved useful in being able to conduct the laboratory during the allotted 3 hours. A particularly successful application of the web-based instruction was in the health management section. Students isolated internal parasites and used computers to view an image map within the web site to classify parasites and identify treatments. The next course was reproductive physiology. The course is offered at the junior/senior level with 42 students. The site is much more extensive containing the course syllabus, lecture outlines and notes, lab exercises along with supporting handouts and answer keys, old exams in both text and interactive formats, and information on how to conduct and present the required group research projects. One of the goals in the development of the class site was to completely replace all handouts with digital material. Although this was accomplished, the students still printed material from the site. However, given time, familiarity with digital material should increase and the need for hard copies should decrease. Students were enthusiastic about the use of the web site during the laboratories. The last course was a graduate level class in genetology and embryology biology with 9 students. A unique objective of the web site was to provide a forum for students to present their term papers as mini-web sites. Student manuscripts were prepared using Adobe PageMill. The students were excited about this opportunity and produced excellent work demonstrating quality and unique creativity in web site design. Web sites are useful in a variety of educational settings but require student access to and knowledge of technology.

Key Words: Email, Discussion, Beef industry issues

Electronic Storage of Journal Articles and Technical Manuals on Personal Computers. R. D. Muller1, J. E. Weatherford1, M. M. Glassburn1, and T. Moore2, Elanco Animal Health, Purdue Univ.

An evaluation was conducted on methodologies for storage of journal and related scientific articles on personal desktop and portable computers. A separate study was undertaken to evaluate storage of internally created desktop publications such as technical manuals. A high priority was given to the ease with which documents could be electronically searched and retrieved once made electronically resident. Particularly important was the ability to search simultaneously within the contents of many documents as opposed to searching only the bibliography-type information: (title, author, keywords, etc.). High
priority was also given to the ease with which information could be exported to other programs should technology changes demand, thus preventing obsolescence of the data files. Also important was the ease with which documents could be imported into the system (either from electronically resident files or from scanners). Labor requirements for rework of the information once it had been made electronically resident were also considered. Once made electronically resident, the information should be able to be distributed via a number of methods - CD, client-server databases, internet distribution, etc. Somewhat lower priority was placed on software and hardware costs to fulfill these objectives.

Five major publications (technical manuals) were electronically published with Folio Views (TM Open Market Inc.). Several projects involving a total of some 30,000 pages of journal articles, university and experiment stations reports, internal reports etc. were scanned to a TIFF file format and electronically indexed with LaserFiche (TM Compulink Management Center).

These technologies have proven to be a highly effective means of storing and retrieving documents for the individual animal scientist as well as being economical to implement.

Key Words: document retrieval, document search, document storage

658 Teaching Styles: “Active Learners” Make the Best Learners. W. W. Ellis*, Missouri State University, Cape Girardeau.

Dr. Craig Nelson’s workshop on critical thinking presented at the 1998 Animal Science Meeting in Denver further stimulated interest in using more “classroom active learning”. Thus, in the fall of 1998 a course offering in Animal Science was converted from high percentage lecturing to an active group participation style of teaching. Dr. Nelson indicated less material would be covered, but student understanding would be greater. Thus, as an instructor, a major concern was the volume of material that would be covered with active learning. It was determined that the disciplines of animal breeding, reproductive physiology, nutrient-digestion, and feeding management would be the course content of comparison. The same examinations were used as students were not permitted to retain the previous years. Class size was 51 for 1998 and 49 in 1997. The average ACT score for 1998 was 23.2 compared to 23.0 in 1997. The text, laboratories and classroom were the same. Students in 1998 were assigned to groups of six, changed three times during the term. Changes in teaching style led to several conclusions. Students scored higher on exams (79.9% and 84.3% in 1997 and 1998, respectively). Problem solving activities were very popular as a group learning activity. Students adapted quickly to group changes but preferred to stay within a group. Non-traditional students demonstrated less comfort in the group setting. While course content was sacrificed, students were more open to class discussion and the instructor became more involved with the class. Active learning increased teaching effectiveness at the expense of additional preparation time for the instructor.

Key Words: Teaching, Active Learning, Classroom Groups

659 A freshman seminar in animal and veterinary science. A. T. Mallilo and M. M. Nippo*, .

A one-credit course called “A Freshman Seminar In Animal and Veterinary Science” has been developed at the University of Rhode Island. The class meets one hour per week and has five specific student directed goals: enhance the student’s knowledge of the role of the animal scientist and veterinarian in everyday life; develop the student’s understanding of the scientific method by critically evaluating current “in the news” research; work together collaboratively in small groups; further writing and speaking skills; and enjoy a “special experience”. As instructors we had the following goals: retain a higher proportion of students; develop a close relationship with students early on in their education; and share the “special experience” with our students. The class is taught in sections of 12-15 students. All students have taken an introductory animal science course and are concurrently enrolled. The course is available only to freshmen (without exception). The classes generally employ one of three approaches. The first is skills based where students are asked to analyze something in the animal sciences that has been in the news recently and report on it orally, in writing or both. This is done in a group discussion format. A second strategy is the use of electronic media. While not computer intensive a personalized web page is written for the class that gives them a jumping off point in terms of future opportunities in the field as well as things of immediate interest. Web use begins in a class held in a computer lab. This allows students to interact with each other as well as the instructor. The last type of class involves outside speakers. These include a veterinarian, a veterinary student, students who have done internships and graduate students. This is designed to show some of the choices students have for the future.

Key Words: Teaching, Freshman, Animal Science

660 Linking graduate and postdoctoral training in equine reproduction to client outreach and service: the South Texas experiment. G. L. Williams*.

The nature and progress of modern science has by necessity evolved in an environment of reductionism. This reductive approach spills over into the training of graduate students and postdocs, as graduate mentors must usually maintain an independent, extramurally-funded research effort that is narrowly-focused. In animal science, this often involves only a single species, resulting in graduates that have limited expertise outside their narrow sphere of graduate training, thus limiting employment opportunities. Similarly, veterinarians are often confronted with client demands that exceed their disciplinary or species knowledge base. In 1989, a program was begun at the Animal Reproduction Laboratory, Texas A&M University Agricultural Research Station, Beeville, to simultaneously address regional deficits in availability of equine reproduction expertise and to provide expanded opportunities for graduate and postdoctoral training in a second species. Transmitted by word of mouth only, these services were made available to local and regional veterinarians who wished to refer clients, as well as to non-referral inquirers willing to comply with requirements of the program. In particular, client services involving palpation, ultrasound, or other female reproductive manipulations require the client to 1) allow at least one trainee to examine mares, and 2) sign a hold-harmless agreement releasing faculty, students, and The Texas A&M University System from damage liabilities. Since 1989, 9 graduate students and 4 postdoctoral trainees have participated in the program. Current clientele includes 62 horse owners and about 12 veterinarians. The number of client interactions has increased exponentially since inception, with a 73% increase in activity over the last 2 years. In 1998, this included 359 palpation/ultrasound examinations. Other components of the program include consultations and assistance with ovulation induction, induction of parturition, estrous synchronization, management of twin embryos, handling and use of cooled semen, behavioral anomalies, endocrine diagnostics, and nutrition. An added benefit of the program is an increased willingness of owners to loan or donate mares for research.

Key Words: Graduate training, Equine, Reproduction

661 Providing hands on experience in a senior-level beef cattle science course with cooperater-owned cattle. F. A. Thrift*.

Most students enrolled in Animal Sciences at the University of Kentucky come from an urban background, have high expectations of being a veterinarian and little experience working with large animals, especially cattle, which poses some unique problems in teaching a senior-level beef cattle course. To deal with this situation, the first part of a beef cattle science course, which is taught during the fall semester, is devoted to all aspects of beef cattle handling equipment. Also, one lab is devoted entirely to equipment design, layout and usage. Thereafter, almost all labs involve hands on contact with various classes of cattle (identification, pregnancy diagnosis, castration, implanting, dehorning, vaccinations, selection protocols, body condition scoring). Most of the labs involve usage of cooperating-owned cattle and may or may not involve usage of cattle equipment depending on cattle worked and facilities at each cooperators location. Utilization of cooperating-owned cattle not only provides students with opportunities to gain hands on experience but has the added advantage that students are exposed to different management scenarios. Student response to the opportunity to gain hands on experience in the course has been excellent and students have, beyond expectation, embraced moving the classroom outside in the real world, rain or shine, each Friday afternoon of the fall semester.

Key Words: Teaching, Cattle
**662 Undergraduate internship in reproductive management of beef cattle.** T. A. Strauch*1, J. E. Williams1, M. F. Smith2, P. A. Kunkei2, R. F. Hilt2, G. K. Bates2, and D. J. Patterson1.1Department of Animal Science, University of Missouri-Columbia, 2Select Sires, Inc., Columbus, OH.

Internships promote active learning among undergraduate students and provide students with opportunities to develop critical thinking and problem solving skills. An internship program was developed in cooperation with Select Sires, Inc., and the University of Missouri (F. B. Miller Endowment Fund) to provide students with practical training in reproductive management of beef cattle. Objectives of the internship are: 1) provide students with practical training in the development and execution of estrus synchronization (ES) and artificial insemination (AI) programs, and 2) provide extensive hands-on experience in ES, estrous detection (ED), semen handling (SH), and AI. Selected students receive classroom and on-farm instruction with emphasis on ES, ED, SH, and AI. The majority of students do not have extensive experience in the preceding techniques prior to the internship. Students are required to attend weekly training sessions and a 3 d Select Sires AI Training School. Other responsibilities include: formulating a statement of specific learning objectives, a written protocol of overall plans, participation in ES, ED, SH, and AI on designated farms, and a written report of individual experiences. Students accompany Select Sires personnel to assist in on-site ES, ED, SH, and AI and are exposed to diverse beef production systems. In the past 3 years, 26 students have participated in ES, ED, SH, and AI on farms and ranches in MO, KY, MT, OR, and SD. Students in the first two years worked with 15,722 heifers and cows. Of the students involved in the first two years, 10 of 15 pursued graduate degrees or veterinary medicine. Student-faculty interaction and student-producer interaction was facilitated through this internship. Participation fostered greater working appreciation of beef cattle reproductive management, created links for students with allied industry, and expanded career opportunities following graduation.

Key Words: Reproductive Management, Internship, Al

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**664 Use of a lamb feeding trial to integrate nutritional principles and practice.** A. W. Bell and D. J. R. Cherney*, Cornell University, Ithaca, NY.

Energy and protein are primary nutritional requirements of all classes of animals and types of production, including growing ruminants. A semester-long animal feeding trial has been conducted as an integral part of the introductory Animal Nutrition course for nine years with approximately 150 students per year participating. An important principle demonstrated in the trial is that an animal’s ability to productively use protein may be limited by its energy supply and vice versa. Specific objectives of the trial are to demonstrate effects of dietary energy and protein level on voluntary feed intake, average daily gain and efficiency of feed utilization in growing lambs and explain performance responses in terms of measured effects of dietary treatments on apparent digestibility of dry matter and on plasma concentration of selected metabolites. Thirty-two weaned lambs (1 mo, 25 kg, 16 male, 16 female) are ranked according to liveweight, semi-randomly allocated to one of four dietary treatments and housed in pairs in floor pens. Dietary treatments consist of 1) high energy, high protein; 2) low energy, high protein; 3) high energy, low protein; and 4) low energy, low protein. All diets meet or exceed NRC requirements for maintenance. Students weigh lambs and sample blood via external jugular venepuncture on a weekly basis. In addition, each student is assigned to regularly feed, water and examine lambs throughout the 7-wk trial. Students measure plasma urea nitrogen and glucose concentrations by enzymatic, colorimetric assays. One lab session is devoted to collation and summary of results for each individual lamb. Each student is then required to write a report attempting to relate results to nutritional principles discussed in lectures and laboratories, and described in recommended textbooks. Many students feel that the report allows them to integrate theoretical lecture material with practical laboratory material, allowing them to leave the class with a much more thorough understanding of nutrition. An additional benefit is the experience students gain in handling and care of farm animals.

Key Words: Nutrition, Teaching, Animal Feeding

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**666 Use of peer-graded student projects in an introductory course.** J. A. Moore*, North Carolina State University, Raleigh.

Introduction to Equine Science (ANS 110) is a 3-credit course taught for the first time in Spring 1998. Students were required to complete a horse-related project (40 points, 6.7% of final grade), the most popular being a scrapbook or construction of the “visible horse” model. Mid-semester, the instructor decided projects would be peer-graded, and each student graded 5 projects during the class period dedicated as “project day.” Three students asked for a re-grade by the instructor, who found each was the victim of an “outlier” (one low grade and one high grade). On course evaluations, 3 students complained about having their projects graded by peers, one indicating the instructor was “lazy.” For Spring 1999, students (n = 62) were told on the first day that projects (50 points, 6.8% of final grade) were to be peer-graded, and a “project day” was included on the syllabus. Student classifications for 1998 and 1999, respectively, were 83%, 84% female; 27%, 26% non-majors; 35%, 47% freshmen (FR); 31%, 26% sophomores (SO); 18%, 21% juniors (JR); and 16%, 6% seniors (SR). Project scores in 1998 were not influenced (P = .20, protected LSD) by gender (P = .68), class (P = .07), or major (P = .56), but did tend to be lower for freshmen. Final grade in the class (expressed as a percentage of total points) was influenced (P < .05) by all three, with females (89%) scoring higher than males (82%; P = .03); FR (80%) scoring lower than SO (89%) or SR (90%) (P < .01) [HR at 84% were not different than any other class; P > .10], and Animal Science majors (89%) scoring higher than non-majors (82%; P = .02). In summary, it is recommended that students be made aware of a peer-grading policy at the onset of the semester, and that the instructor check for outliers prior to recording project grades. Gender, class, and major did not influence student scores on the project, but did influence final grade in the class.

Key Words: Students, Class projects, Peer grading
Writing intensive, undergraduate courses typically require that students receive frequent feedback. Providing feedback can be instructor- and time-intensive. A strategy to provide students with meaningful feedback about their writing, minimize instructor time commitment, yet encourage active student engagement is through the use of students as peer reviewers. We have designed a peer review system that is based on a model used in professional scientific writing. All students in our Anatomy and Physiology, Introductory Endocrinology and Physiology of Reproduction courses are required to write a scientific review paper. At the beginning of the semester, each student selects a topic of their choice. Explicit written directions for writing the paper are given to each student. Additionally, students are also provided with the Journal of Animal Science (JAS) guidelines for authors (JAS Style and Form). Importantly, students are given a timetable for paper submissions and reviews. Students are assigned to serve on editorial boards (composed of 4 students) and trained by the instructor to review papers. Afterward, each student on each board reviews two papers. (Thus, each paper is reviewed by half the members of each board.) The editorial board discusses the reviews, then visits with the student writers, providing the writers with relevant feedback. During the semester, all papers are read by two reviewers (on one of three different editorial boards) on three different occasions. Hence, each paper is read by six different reviewers. As the end of the semester approaches, students submit a draft to the instructor for a final review. The writing exercise culminates in the submission of all rough drafts (7), comments of review boards as well as the final copy of the paper. This packet of materials constitutes a scientific writing portfolio. The key to success of peer reviews include: dedicating traditional seat time to peer reviews, training student reviewers and providing frequent opportunities for review of student writing. The value of peer review includes engagement of students in active learning and improvement of scientific writing.

Key Words: Teaching, Writing Intensive Courses, Peer Review

A new writing intensive (WIC) course involving ethical issues in animal agriculture. S. L. Davis* and L. V. Swanson, Oregon State University.

We have recently developed a new course that combines the WIC concept with a brief discussion of how ethics can be used to resolve socially contentious issues related to animal agriculture. (All OSU students must complete a senior-level WIC course in their major.) The writing intensive portion of the course was designed after the writing activities previously described by Aaron (J. Animal Sci. 74:2810-2827, 1996). In brief, the students write ‘Letters to the Editor’ on assigned topics; they participate in ‘Animal Advisory Committee Hearings’ in which they serve both as one testifying before a mock advisory committee and as a member of a different advisory committee on assigned issues previously discussed in lectures; and they write a term paper on a topic of their choice and then give a 15-minute oral summary of their term paper using PowerPoint graphics. Writing the term paper is a multi-stage process, including peer reviews of each other’s papers at the draft stage. Students are encouraged to search the scientific and popular press literature for information, using the library computer databases. The major focus of the term paper must include a discussion of the ethical components of the issue. The course content is delivered by lectures and discussions on issues such as factory farming, animal biotechnology, environmental problems, animal welfare, animal rights, etc. To describe ethics and the role of a social contract, lectures are presented on the nature of contentious issues, similarities between the scientific method and the philosophical method, fundamental ethical theories and how a social ethic can change over time. The course objectives are, therefore: (1) Help students develop written and oral communication skills. (2) Develop critical thinking skills. (3) Learn more about current contentious issues in animal agriculture. (4) Consider how ethics (moral reasoning) may be used to resolve contentious issues.

Key Words: Ethics, Writing Intensive, Contentious Issues

Pigs fed phytase-supplemented diets are more prone to the adverse effects of an elevated Ca:P ratio than those fed inorganic P-supplemented diets. C. H. Stahl*, J. M. Porees, T. Xiang, K. R. Roneker, W. G. Pond, and X. G. Lei, Cornell University, Ithaca, NY.

This experiment was designed to compare the effects of two Ca:P ratios in phytase or inorganic P-supplemented diets containing 800 mg Fe/kg on pig growth, body P status, and bone strength. Forty-eight weaning crossbreds were fed one of the four dietary treatments from weaning to finishing. Diets 1 and 2 were a P-deficient (.36%) corn-soybean meal basal diet, plus .15% inorganic P with a Ca:P ratio of 1.2:1 and 2:1, respectively. Diets 3 and 4 were the basal diet plus phytase (Natuphos, BASF, peer reviewers. We have designed a peer review system that is based on the 1.2:1 and 2:1 Ca:P ratios respectively. Body weights (BW) were recorded monthly, and blood samples and radius and metacarpal bones were collected at 7 wk and the end of experiment. At wk 7, pigs fed Diet 4 had lower (P < .01) BW than pigs fed Diet 1, as well as higher (P < .01) plasma alkaline phosphatase activity (AKP), and lower (P < .01) plasma inorganic phosphorus concentration (PP) than all other treatment groups. There were no significant differences in these measures among the other groups. Pigs fed Diet 1 had greater (P < .05) strength of both bones than pigs fed either phytase-supplemented diet. Pigs fed Diet 2 had bone strengths that were similar to those of pigs fed Diet 3, but that were greater (P < .05) than those of pigs fed Diet 4, which showed clinical signs of severe P deficiency. At the end of the trial, there were no significant differences in AKP, PP or metacarpal bone strength among pigs fed Diets 1, 2 and 3. Pigs fed Diet 1 had higher (P < .05) BW than pigs fed Diet 3. Compared with those fed inorganic P-supplemented diets, pigs receiving a P-deficient diet supplemented with phytase might be able to maintain similar P status and bone strength, but appeared to be more susceptible to the adverse effects of a high dietary Ca:P ratio on body P status and bone strength.

Key Words: Pigs, Phytase, Bone

ADDENDUM

The following abstract from the Nonruminant Nutrition section was inadvertently omitted from that section.

666 Using editorial boards to peer review: enhancing scientific writing of undergraduate students. R. C. Rhodes III*, University of Rhode Island.

667 A new writing intensive (WIC) course involving ethical issues in animal agriculture. S. L. Davis* and L. V. Swanson, Oregon State University.

668 Teaching Values and Ethics in Agriculture and Forestry. R. Dailey* and R. Cochrane.

We have taught a section of the University Honors Program Senior Seminar, which is required for graduation, since fall 1986. The course, Values and Ethics in Food and Fiber Production, has a limited enrollment. Class size has ranged from 4 to 17 students, mostly non-agricultural majors (e.g., education, English, sociology, pharmacy). Topics range from animal usage, or environmental issues, to human concerns (education, diet, health and nutrition). Class meets weekly for three hours. The instructors serve as catalysts in a discussion format. Each week, a different topic is discussed. In the spring, we teach a writing-intensive class that follows a similar format. This class is primarily agricultural majors. Enrollment has grown from 17 to 99 and is now capped. In both classes, students keep a journal and read three novels on issues in agriculture and forestry. In the spring class, they write reports on three case studies, discuss three other cases in class through role playing, write three distinctively different letters and write an eight page paper on a controversial issue. Each student presents his/her paper orally in one of the class meetings. Entrance/exit summaries serve to keep roll and have students formulate short opinions. The classes are well received by students and serve as capstone courses to enhance knowledge and understanding of issues critical to agriculture.

Key Words: values, ethics, agriculture