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ABSTRACTS
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Animal Behavior, Housing, Well Being

1 Sensitivity and specificity of lameness assessment in sows. L. Anil*, S. S. Anil, and J. Deen, *University of Minnesota, St .Paul*.

Although lameness is a common problem in swine herds, its identification and quantification remains problematic owing to the non-existence of a 'gold standard'. Any intervention to alleviate lameness is assisted by objective methods of identification and quantification of the signs of lameness. Inconsistent assessment of lameness is detrimental to the clinical evaluation of lameness. A study was designed to assess the sensitivity and specificity of lameness assessment in sows by 7 veterinary clinicians. These clinicians were not previously exposed to lameness in swine and were trained with a 5 min video of previously graded lame sows. Differences from a normal gait were considered as indicative of lameness in this study. Clinicians were asked to score the level of lameness in 78 sows (sows with different levels of lameness including non-lame sows) on a scale of 0 to 3. To facilitate scoring, each sow was videotaped while walking through on rubber mats (5.5 m) and on slatted floor (5.5 m) in 1 m wide corridor. Videotapes for each sow included both front and rear views while walking. The data were analyzed using a Bayesian method that identifies the gold standard as a latent class analysis (proc LCA, SAS). The sensitivity (%) and the range of sensitivity agreements for lameness scores 0, 1, 2 and 3 were 71.43 (47.37–100), 85.20 (57.141–00), 78.10 (26.67–100) and 83.93 (43.751–00) respectively. The corresponding specificity (%) and range of specificity agreements were 89.79 (60.72–100), 75.25 (26.67–100), 89.67 (43.751–00) and 99.05 (93.33–100). The study indicated a higher sensitivity and specificity for lameness scoring for level 3. The results also indicated a lower sensitivity for non lame and lower specificity for score 1 indicating difficulty in correctly grading lameness score 1 and non-lame sows. The results are suggestive that often mild cases of lameness are unidentified thereby eliminating chances to opt for preventive/therapeutic measures before lameness is aggravated. It also indicates that there are a range of capabilities in assessment, and that the specificity and sensitivity will increase by selection of persons to do such evaluations, or by further training.

Key Words: Lameness, Latent class, Sow

2 Evaluation of an analgesic intervention based decision-support system for sow removals for lameness on sow performance. S. S. Anil*[1], L. Anil[1], J. Deen[1], S. L. Van Westen[2], and S. K. Baidoo[2], [1]*University of Minnesota, St .Paul*, [2]*University of Minnesota, Waseca*.

Sows are often removed from the breeding herd for productivity related reasons or health/welfare related reasons. While it is relatively easy to decide on sow removals for reproductive inefficiencies based on prefixed production targets, the same decisions for welfare related reasons is hard to make owing to the inability in objectively quantifying the extent of compromise in welfare. Although poor production may not be indicative of compromised welfare, a compromise in welfare can lead to inefficient production and result in poor performance and longevity in the long run, if not immediately. A study was conducted at Southern Research and Outreach Center of the University of Minnesota involving 150 sows to assess the impact of the implementation of a sow removal decision-support system (DSS) based on analgesic intervention for lameness. In the first stage, the level of lameness in 92 gestating lame sows was assessed on subjective scale of 1–3 along with their longevity in that parity and farrowing performance without any analgesic intervention. In the second stage, another group of 68 lame sows from the same herd were assessed for the same factors while providing an analgesic (Flunixin meglumine, 2.2 mg/kg i/m, on 3 alternate days). A DSS prepared based on current veterinary knowledge was used to determine putative removals for lameness. The DSS took into consideration of the lameness score and duration up to 5 days. The performance data were compared using t-test and 2-sample proportion tests. The DSS implemented group had higher litter birth and wean weights ($P \leq 0.05$ for both) and lower ($P \leq 0.05$) pre-weaning piglet mortality. Fewer ($P \leq 0.05$) sows were removed from the group where analgesic was used. Analyses indicated a lesser ($P \leq 0.05$) number of piglets born alive in the group in which the DSS was implemented. The results suggest that retaining sows with health problems such as lameness may affect the herd performance in the long run.

Key Words: Lameness, Analgesic, Sow removal

3 Endocrine response to acute stress in pigs with differing backtest scores. J. P. Cassady*, J. L. Cagle, B. J. Skelly, K. M. Youngs, and C. S. Whisnant, *North Carolina State University, Raleigh.*

If response to the backtest is an indication of coping style, pigs differing in response to the backtest would be expected to have differing endocrine responses to an acute stressor. Eighty-eight gilts from 19 litters were tested twice using the backtest (60 s). Gilts with the greatest (n = 15, High) and least (n = 15, Low) total time struggling were retained for acute stress challenges. Pigs, in two replicates, were fitted with jugular cannulas at approximately 150 d of age. A 24 h acclimation period was allowed between cannulation and testing and between tests. Blood samples were collected at 10 time points (-60, -30, 0, 5, 10, 15, 30, 60, 90, and 120 m relative to treatment). Pigs were challenged with 0.11 mol/kg BW of CRH (n = 9 High, 9 Low) injected through the cannula to test the model. The first acute stressor was snaring the pig with a nose-snare for 1 minute (n = 10 High, 9 Low), and the second was depriving pigs of feed for 24 hours followed by placing feed next to the pig but out of reach (n = 6 High, 7 Low). Plasma samples were assayed for cortisol, epinephrine, and norepinephrine. Data were analyzed using a model including fixed effects of time, replicate, and group (High or Low) and all two-way interactions. In response to the CRH challenge, cortisol levels peaked at 10 m and retuned to basal levels by 90 m and epinephrine and norepinephrine peaked at 5 m and returned to basal levels by 30 m. The least squares means response in norepinephrine of the High exceeded Low at 5 m (376 ± 99 pg/ml). Response in cortisol, epinephrine, and norepinephrine to snaring was similar. Cortisol peaked at 10 m and epinephrine and norepinephrine at 5 m. The least squares means response in norepinephrine of the High exceeded Low at 5 m (474 ± 175 pg/ml). Endocrine response to feed deprivation failed to exceed basal levels. Response to the CRH challenge demonstrated the appropriateness of the model and that High and Low pigs were equally capable of responding. The biological significance of differences between High and Low groups in norepinephrine levels at 5 m following snaring is unknown.

Key Words: Pigs, Behavior, Stress

4 Influence of crowding stress of pigs during the nursery period on growth and subsequent reproductive performance. B. G. Kim*, M. D. Lindemann, H. J. Monegue, and G. L. Cromwell, *University of Kentucky, Lexington.*

The influence of stocking density during the grow-finish period on subsequent reproduction of gilts has been reported. However, crowding stress during the nursery period on future reproductive capacity has not been studied extensively. The objective of this study was to determine the effects of stocking density and floor space allowance during the nursery period on growth and subsequent reproductive performance for two parities. A total of 132 weanling pigs (68 gilts and 64 barrows; 6.4 ± 1.0 kg BW) were allotted to 4 treatments during a 6-wk crowding period (6.4 to 29.5 kg): 1) 6 pigs in a full pen (1.22 × 2.44 m^2, 0.50 m^2/pig), 2) 9 pigs in a full pen (0.33 m^2/pig), 3) 12 pigs in a full pen (0.25 m^2/pig), and 4) 6 pigs in a half pen (1.22 × 1.22 m^2, 0.25 m^2/pig). During the grow-finish period, animals had adequate floor space. As the number of pigs increased in full pens, ADG (575, 573 and 535 g/d for Trt 1, 2, and 3, respectively; P = 0.04) and ADFI (941, 832, and 823 g/d; P = 0.01) declined linearly during the 6-wk nursery period. Pigs with restricted floor space (Trt 4) tended to have lower ADG (547 vs. 575 g/d; P = 0.09) than pigs housed with adequate floor space (Trt 1) with a constant number of pigs/pen. Pigs reared with a greater number of pigs/pen (Trt 3) had less ADFI (823 vs. 904 g/d; P = 0.02) than pigs with a lower number of pigs/pen (Trt 4) with constant floor space allowance. In the first parity, the litter size at birth (total born) was largely unaffected by treatments (10.78, 11.53, 11.44, and 12.38; P = 0.60); whereas, in the second parity, the total (10.86, 10.38, 8.79, and 8.67; linear for Trt 1-3, P = 0.24) and live pigs born/litter (8.43, 9.38, 7.79, and 7.67; quadratic for Trt 1-3, P = 0.30) were numerically decreased by crowding stress. These results suggest that crowding stress during the nursery period negatively affected growth rate.

Key Words: Swine, Crowding stress, Reproduction

5 The effects of feeder space and feed form on pig growth performance and carcass yield in a commercial wean-to-finish facility. B. A. Peterson*[1], M. Ellis[1], R. Bowman[2], O. Mendoza[1], A. Rojo[1], and B. F. Wolter[2], [1]*University of Illinois, Urbana,* [2]*The Maschhoffs, Inc., Carlyle, IL.*

The effects of feeder space and feed form on growth performance and carcass characteristics of pigs housed in a commercial wean-to-finish building were evaluated in a study with 1024 (32 mixed-gender pens of 32 pigs) pigs reared from weaning (17 ± 1 d; 6.2 kg BW) to 130 kg BW. The study was carried out as a RCBD with a 2 × 2 factorial arrangement of treatments: feeder space (5 vs 1; a 5-hole feeder was used with either all holes available or 4 holes blocked and only 1 available) and feed form (feeder operated wet/dry vs dry). At weaning, pigs were individually weighed and formed into outcome groups of four pigs based on similar weight and gender and randomly assigned to one of the feeder space by feed form treatment combinations. Pigs were weighed at weaning and every two weeks thereafter until they reached 130 kg live weight. A 7-phase dietary regimen formulated to meet or exceed NRC (1998) requirements was used. Pigs had ad libitum access to feed and water and feed delivered to each feeder and feed left in the feeder at the time of pig weighing were recorded. There was a feeder space by feed form interaction (P<0.05) for overall average daily gain and average daily feed intake. There was no effect of feed form on growth rate or feed intake when 5 feeder spaces were available, however, with only 1 feeder space, pigs fed wet/dry grew faster than those on the dry treatment as a result of higher feed intake. No differences (P>0.05) were observed in gain:feed ratio between the feeder space treatments, however pigs on the wet/dry treatment had higher (P<0.05) overall gain:feed ratio than those on the dry treatment. Within-pen variation in live weight at the end of the study was higher (P<0.05) for the 1- than the 5-feeder space treatment. Carcass yield was higher (P<0.05) for the 5- than the 1-feeder space treatment. These results show that growth rates are reduced when feeder space is limited but that the extent of the reduction depends on the form of the feed.

Key Words: Feeder space, Feed form, Pigs

6 Dietary inclusion of Colicin E: Effect on pig behavior. A. K. Johnson*[1], T. Hoff[1], L. Sadler[1], and C. H. Stahl[2], [1]*Iowa State University, Ames,* [2]*North Carolina State University, Raleigh.*

Prophylactic antibiotics are frequently included in the diets of weanling pigs in the US to prevent post-weaning diarrhea (PWD) but PWD still

causes substantial pig losses. The objective of this study was to determine if dietary inclusion of Colicin E1 (ColE1) altered pigs behaviors and postures when challenged with E. coli. Twenty-four barrows, 21 d of age were assigned to individual pens with weights evenly assigned across treatments. Three dietary treatments were compared; treatment 1 had no ColE1 (C; n=8), treatment 2 added 1.1 mg of purified ColE1 (L; n=8), treatment 3 added 16.5 mg (H; n=8) of purified ColE1. Black and white 12 V cameras were used to record behaviors and postures at 10 frames per second. Behaviors of interest were; time spent at the feeding trough and drinking. Postures included active (that combined standing and walking) and inactive (that combined sitting and lying) and other. Data was analyzed using the Noldus Observer software by 5 min scan sampling for each hour over 5 d. One trained observer was responsible for data acquisition. Data were analyzed using the Proc Mixed procedure in SAS. Random effect of date, date by treatment and pig nested within date by treatment were included. There were no (P>0.05) effects between treatment groups for active posture, drinking behavior or other. Time engaged in inactive related postures was lower (P=0.003) for H pigs (68.44±1.2 %) compared to the C pigs (73.56±1.2 %). The H pigs spent more (17.24±1.04 %; P=0.028) time at the feeding trough compared to the C (13.88±1.04 %) pigs. In conclusion pigs fed the highest concentration of ColE1 were more active and spent increased time at the feeder indicating that ColE1 may have offered some form of protection against E. coli and therefore improved the individual pigs well-being.

Key Words: Behavior, Colicin E1, Piglet

7 Relationships between feeding behaviors in Boer bucks. S. Chavez*, Q. Baptiste, and E. E. D. Felton, *West Virginia University, Morgantown.*

Our objective was to measure behavioral traits associated with feed intake. Twenty-eight 3 month old Boer buck (21.4 kg) crosses were housed together in a partially covered 14.6 × 51.2 m pen during the summer of 2006. Using radio frequency technology (GrowSafe systems Ltd), behavioral intake data was collected for 53 days. Bucks were fed a commercially available pelleted ration provided ad libitum. Feed was offered via two modified GrowSafe feed nodes (A and B) adjacent to one another in the front center of the pen. Data from 22 animals were analyzed for 41 of the 53 days. Feeding behaviors were analyzed using the GLM and FREQ procedures of SAS. Variables investigated were event feed intake, event feeding time, event feeding duration, feeding location preference, average daily gain, and residual feed intake. The goats had a preference towards eating at scale B (closest to the open end of the barn) over scale A at all times of the day (16,300 vs. 11,926 # of events; $P < 0.01$). The amount of time spent at scale A was greater than B (77.3 ± 1.4 vs. 70.5 ± 1.2 s; $P < 0.01$). More non-feeding events occurred during the daylight hours than during the night (6,719 vs. 880; $P < 0.01$). Twenty-one percent of the feeding events resulted in no feed consumption. Feeding events occured predominantly as meals less than 113.5 g (23,987 vs. 4,239; $P < 0.01$). Presumably due to the flocking instinct of goats; feeders may need to be provided at multiple locations so more than 2 animals can consume feed at a time. Feeding durations occurred with gaps suggesting that the animals may have moved with the flock rather than continuing to eat. Although feed was available ad libitum, goats consumed feed during the night when summer temperatures would have been cooler, while during the day animals visited the feed bunk more frequently without consuming feed.

Key Words: Behavior, Feed intake, Goat

8 Effect of trailer floor space allowance on environmental conditions inside a livestock trailer. C. M. Murphy*[1], M. Ellis[1], R. Bowman[2], J. Brinkman[2], T. Funk[1], A. Lenkaitis[1], X. Wang[1], and B. F. Wolter[2], [1]*University of Illinois, Urbana*, [2]*The Maschhoffs, Inc., Carlyle, IL.*

This study evaluated the effect of floor space allowance on the trailer (low = 0.31 m^2/100 kg live weight vs. moderate = 0.36 m^2/100 kg, vs. high = 0.43 m^2/100 kg) on environmental conditions during transport. Data were collected using a single trailer equipped with sensors in all compartments to measure temperature, relative humidity, and carbon dioxide. The study was carried out in four replicates (August, December, February, and April) using 24 trailer loads of finishing pigs (mean BW = 126.6) with the front three compartments on the top and bottom decks being used to investigate the 3 floor space treatments. The incidence of open-mouthed breathing, skin discoloration, and muscle tremors was recorded during loading and unloading. The incidence of non-ambulatory pigs during loading and after unloading, along with the number of DOA's at the plant was recorded. Floor space allowance on the trailer had little effect on temperature (19.2, 19.1, 18.8°C, $P = 0.300$, for 0.31, 0.36, 0.43 m^2 /100 kg treatments, respectively), relative humidity (54.5, 53.9, 53.8%, $P = 0.308$, resp.) or CO_2 concentration (2338, 2277, 2426 ppm, $P = 0.895$, resp.). There was an interaction between trailer deck and replicate for temperature levels. There was no difference between temperature on the top and bottom decks during the April and August replicates, however during the December and February replicates the top deck was significantly ($P < 0.05$) colder. There was no effect of floor space, replicate, or trailer deck on transport losses, however, increasing floor space from the low to high treatment reduced the incidence of open-mouth breathing during loading (13.52 vs. 10.00%; $P < 0.01$). These results suggest that floor space allowance has little effect on the environmental conditions inside the trailer, however, temperature differences can occur between trailer decks depending on the time of year.

Key Words: Pigs, Transport, Environment

9 Effects of swine transport trailer design and season on environmental conditions in the trailer during transport of market weight pigs. C. M. Murphy*[1], M. Ellis[1], D. Orellana[1], R. Bowman[2], B. A. Peterson[1], M. J. Ritter[1], J. M. Young[1], and B. F. Wolter[2], [1]*University of Illinois, Urbana*, [2]*The Maschhoffs, Inc., Carlyle, IL.*

The effects of trailer design and season on the environmental conditions on the trailer were evaluated on 109 loads of market weight pigs (BW 129.6 kg). A split-split plot design was used with a 2 × 2 × 2 × 4 factorial arrangement of treatments: trailer design (pot-belly vs. straight deck), deck (top vs. bottom), compartment (front vs. rear), and season (spring vs. summer vs. fall vs. winter). Trailer was considered the main plot, deck the sub-plot, and compartment the sub-sub-plot. Pigs were transported ~4 h (~290 km) from farm to packing plant. Loads from 2 pot-belly and 2 straight-deck trailers were monitored on each of 7 d/season. Sensors monitored temperature and relative humidity (RH) inside the trailer from start of loading at the farm to end of unloading at the plant. Average compartment temperatures were higher on the straight than the pot-belly trailers with the difference varying with season (2.5°C, 0.0°C, 0.6°C, and 2.9°C; $P<0.05$ for spring, summer, fall, and winter, respectively). Relative humidity was higher in pot-belly than in straight trailers for all seasons, (7.8, 3.5, 6.4, and 7.6%; $P<0.05$, respectively). Temperature during periods when the trailer was stationary at the farm or the plant and during the journey was generally higher on the top

than the bottom deck of both trailer designs. The exception to this was during the winter in the period of waiting at the plant when the top deck was 0.6°C cooler than the bottom (P=0.01). Temperatures in the front compartments were between 1.7 and 4.6°C higher (P<0.001) than in the rear compartments, depending upon season. Results of this study suggest differences in temperature and relative humidity levels among trailer designs and compartments within the trailer and that these differences varied with both season and stage of the journey.

Key Words: Pigs, Trailer design, Transport conditions

10 Piglet mortality in an outdoor farrowing hut: What behaviors contribute to their demise? J. R. Garvey*[1], J. J. McGlone[2], L. J. Sadler[1], and A. K. Johnson[1], [1]*Iowa State University, Ames,* [2]*Pork Industry Institute, Texas Tech University, Lubbock.*

The majority of piglet deaths occur in the first 72-h after parturition with 50% attributed to crushing by the sow. Pre-weaning crushing mortality has been estimated to cost the industry over $100 million/yr and is a serious animal welfare concern. The objectives of this study were to determine behavior, postures, locations and vicinity to the sow for piglets 1-h prior to piglet death. Litters (crossbred) were housed in English-style farrowing huts with a metal fender bedded with wheat straw. Twenty piglets (6 litters) were observed continuously comparing two treatments (N=10 per treatment); piglets that were crushed (CR) and piglets that lived from the same litter over the same time period (NC). Nursing behavior and five postures (walking, standing, sitting, lying and other) were acquired at four locations within the farrowing hut. Behavioral data were collected by one experienced observer viewing videos recorded 2.5 frames/s using the Observer software. Data were arcsine transformed and analyzed using the GLM procedure of SAS. The model included treatment and time. No differences (P>0.05) were found for behavior or postures between CR and NC groups. Piglets engaged in more (P=0.006) standing during the daylight hours. No (P>0.05) differences were observed among treatments and time for location within the farrowing hut. For vicinity to the sow, there were no (P>0.05) treatment differences but for time of day, piglets spent more (P=0.004) time close to the sow during dark hours. In conclusion piglet behavior, postures, location and vicinity to the sow 1-h prior to piglet death did not differ between the two treatment groups. Time of day affected standing postures with more piglets standing during the light hours and at night more piglets preferred to be in the vicinity of the sow. Finding few behavioral differences between CR and NC piglets may indicate that variation among sow behavior is a more significant cause of piglet crushing than variation among piglet behaviors.

Key Words: Behavior, Mortality, Piglet

11 Behavioral validation for nursery pigs. J. M. Bowden*, A. K. Johnson, K. J. Stalder, and L. A. Karriker, *Iowa State University, Ames.*

The most reliable recording rule for the acquisition of a species repertoire is continuous recording. However, one disadvantage is the copious amount of time and labor required to acquire the data. A different approach, using a sampling rule (scan sampling) reduces the behavioral acquisition time, but to ensure accuracy and reliability, a validation trial needs be performed. The objective of this study was to validate the accuracy of scan samples at various predetermined intervals for confined nursery pigs. Thirty five day old (crossbred) nursery pigs (n=20) were housed in four pens within a confinement building. One color camera was positioned over the pen that recorded onto a DVR at one frame per second. The day before validation, each pig was individually marked using an animal safe crayon between the scapulas. Behavioral acquisition was completed by one experienced observer. Phase one screened five pens continuously for 24-h to identify the most active time periods for further observation. Three pig behaviors (eating at trough, eating gel and drinking) and two postures (active; defined as standing and walking and inactive) were continuously acquired for each pig. Phase one identified 0600 to 1000 as the most active period. Phase two; eight scan sample treatments (1, 2, 3, 5, 10, 15, 30, and 60 min) were individually compared to continuous observation(14400 data points). Scan sample was defined as the first second for each scan interval (1 min scan sample intervals provided 60 selected scans of one second duration per pig per hour). Data were analyzed using Proc Mixed procedure (SAS) and the experimental unit was the pen. Drinking differed (P = 0.0019) from the continuous data at intervals greater than 5 min. For all other behaviors and postures there were no (P > 0.05) differences. In conclusion, scan samples were accurate for all behaviors and postures except drinking. Therefore, scan samples under these experimental conditions could be applied to specific activities in behavioral studies to save labor while still accurately depicting pig behaviors and postures.

Key Words: Behavior, Pig, Validation

12 Validation of scan sampling techniques for lactating sows kept outdoors. A. K. Johnson*[1] and J. J. McGlone[2], [1]*Iowa State University, Ames,* [2]*Pork Industry Institute, Texas Tech University, Lubbock.*

Two fundamental types of behavioral patterns are events which are relatively short in duration and states which are relatively long in duration. The methodology accuracy used to collect animal events and states will differ. The objective of this study was to validate scan sampling intervals for sow behaviors and postures when sows were housed outdoors on pasture. A total of 23 PIC sows were kept on 0.45 h pastures (n = 4). Behavior was collected by live observation by one trained observer using a 1 min scan between 0730 and 1130 and 1430 and 1830. Scan sample times of 5, 10, 15, 30 and 60 min were compared against the 1 min scan for three postures; standing, inactive (lying and sitting) walking and three behaviors; feeding, head down (rooting and grazing), and drinking. Analyses were performed using the GLM procedure of SAS. Transformed data for validating the behavioral scan sampling period were analyzed as a completely randomized design. Scanning intervals based on correlations for walking (0.81 vs. 0.34) and head down (0.98 vs. 0.85) were less (P < 0.01) accurate at 15 min scan than when a 1-min interval was used. When LSMeans were compared, standing (6.4 vs. 6.1 %), head down (7.0 vs. 5.7 %) and walking (5.1 vs. 3.7 %) became less accurate (P < 0.05) at a 30 min scan compared to the 1 min scan. For inactive behaviors there was no differences from 1 min scans until a 60 min scan (P = 0.031). Although there were no differences (P > 0.05) for feeding and drinking behaviors there was a pattern that percentage of time engaged in these activities were over estimated as the scanning time intervals increase from 1 to 60 min respectively. Feeding behaviors were overestimated by 7.6 % to 15.7 % and drinking behaviors were overestimated by 3.1 % to 4.4 %. In conclusion, when the period of scanning was shorter, a more precise prediction of behavior and postures was obtained. However, a balance must be struck between

practical feasibility and accuracy when conducting 24 h behavioral observations in the field.

Key Words: Scan, Sow, Validation

13 Stress responses of piglets during routine processing procedures. J. N. Marchant-Forde*[1], D. C. Lay, Jr.[1], R. M. Marchant-Forde[1], E. A. Pajor[2], and H. W. Cheng[1], [1]*USDA-ARS-LBRU, West Lafayette, IN*, [2]*Purdue University, West Lafayette, IN*.

Shortly after birth, piglets undergo procedures that may include teeth resection, tail-docking, iron-injecting, identification and castration. Although these procedures have a sound management basis, certain procedures cause pain-related stress and can negatively affect productivity. They are also under increasing scrutiny from the animal rights lobby. Although research investigating the effects of individual procedures is relatively plentiful, there are little data available describing cumulative effects of multiple procedures performed using industry standards. Alone, castration is painful and the behavioral, vocal and cortisol responses associated with pain are equally evident regardless of the age when castrated. Teeth resection appears to cause short-term, overt, behavioral and cortisol responses with grinding causing higher responses than clipping. There are short- and long-term pain implications of tail-docking with immediate behavioral responses and evidence of the formation of neuromas, which may be increased using hot-blade trimming. Iron administration and identification methods have been subject to very little discernable research, perhaps indicative of their perceived impact. Handling produces maximal cardio-vascular responses irrespective of the iron dosing method but oral dosing takes significantly longer. Ear notching elicits head shaking and high frequency squeals indicative of pain. When carried out singly, clear distinctions in stress response can often be made between the most and least aversive procedure and these are greatly influenced by the time taken to carry out the procedure. However, when applied collectively, the results are less clear. Collective procedures result in fairly maximal stress responses due to the length of time taken to carry out on a young pig that has not had any previous experience of handling and separation from the sow and littermates. Further areas of study could investigate; a) whether the order of procedures has an impact on piglets′ responses, b) whether carrying out procedures separately over several days may be beneficial, and c) whether some ′unnecessary′ procedures could be eliminated.

Key Words: Swine, Well-being, Piglet processing

14 Drinking behavior of seven week old pigs when water is either withheld or provided ad libitum. A. K. Johnson* and C. J. Jackson, *Iowa State University, Ames*.

Detailed information on pigs temporal drinking patterns becomes essential when delivering water-based health products to ensure all pigs receive sufficient vaccine required to offer protection. The objectives of this study were to determine the number, length and percentage of seven-week old nursery pigs that visited the nipple cup drinker when water was either withheld or not withheld for 15 h over two consecutive days. A total of 194 seven week old crossbred pigs, weighing 22.98 ± 5.38 kg were housed in single-sex pens (n = 23) in a commercial nursery facility. Pigs had ad-lib access to feed and water was delivered through a single stainless steel nipple cup drinker. Two treatments were compared; treatment one; withheld (WH; n=4), pigs did not have access to water for 15-h and treatment two, control, (CONT; n=4) pigs had continuous ad libitum access to water. One 12 V black and white camera was positioned over each drinker and drinking behavior (defined as the pig having its head in the nipple-cup drinker for 5 s or longer) was recorded from 0700 to 1300 h onto a DVR at 1 fps. The acquisition of drinking behavior was obtained by an experienced observer who viewed the recordings using 24 h mode (1 frame / s) on the Observer software. Data was analyzed using PROC MIXED of SAS. Number of drinking visits and length of time spent at the nipple cup drinker differed ($P<0.05$) for the first hour (0700) after water was made available between treatments but for all other hours there were no ($P>0.05$) differences. All pigs regardless of treatments visited the nipple cup drinker at least once over the 6-h observation period. In conclusion, the first hour following pen water supply restoration resulted in an increased number of visits and duration of time spent at the nipple cup drinker. After that first hour, there were no differences. All pigs in the pens regardless of treatment took at least one 5 s visit to the drinker. Therefore, withholding water over the 15-h period to make sure all pigs receive a sufficient health product is not needed.

Key Words: Behavior, Drinking, Pig

15 Active euthanasia and animal wlfare. J. Woods*, *J. Woods Livestock Services,, Alberta, Canada*.

Euthanasia is defined as death that occurs without pain or suffering. Euthanasia is one of the most challenging aspects of animal husbandry. Many people find the act of euthanasia visually, emotionally and mentally challenging. Education is one option to help caretakers understand and implement high euthanasia standards on the farm. Current national and international training programs and guidelines are often not practical nor are they written in terminology that is applicable for the employee conducting euthanasia. An effective educational program should contain; ethics, the benefits to animal welfare, methods/training techniques, economics, confirmation of death and timeliness. The natural behavior of pigs can make the euthanasia decision challenging in regards to when to euthanize (timeliness). Pigs might not show outward signs of discomfort and this might result in the caretaker putting off euthanasia (animal not suffering) or the person may be unaware that the pig is in discomfort. Producers need to be able to decide when a pig has either limited or no chance for recovery. The need to work around the premise of 1) wanting to give it a fair chance to recover, 2) prolonging life for salvage value and 3) procrastination of the unpleasant act of euthanasia is challenging. A second challenge is the methodologies of euthanasia. The most common methods for swine are CO2, captive bolt gun, gunshot and blunt force trauma. Each method has its unique challenges and opportunities but non are without fault. To date, we are currently testing some new products that include non-penetrating captive bolt units specifically designed for neonatal piglets, a captive bolt gun with an extended bolt that allows for deeper penetration into the skull and brain, and specialized firearm ammunition designed to ensure death while improving operator safety. In conclusion, as an industry, we need to provide producers with practical tools for euthanasia on farms. We also need to do invest in specific euthanasia research to address the economic reward for not shipping unfit pigs.

Key Words: Euthanasia, Pig

16 A review of transport losses in market weight pigs. M. J. Ritter*, *Elanco Animal Health, Greenfield, IN.*

Transport losses (dead and non-ambulatory pigs) represent animal welfare, legal, and economic concerns to the U.S. swine industry. The objectives of this review are to discuss: 1) the incidence of transport losses; 2) symptoms and metabolic characteristics of fatigued pigs; 3) causes of transport losses; and 4) management strategies to reduce these losses. Dead and non-ambulatory pigs are most commonly observed during unloading at the plant, but these losses can occur at any stage of the marketing process from loading at the farm to stunning at the plant. The percentage of dead pigs, non-ambulatory pigs, and total losses (dead and non-ambulatory) at the plant averaged across 22 commercial field trials (n = 4,607,567 pigs) were 0.25% for deads (range: 0.00% to 0.77%), 0.37% for non-ambulatory pigs (range: 0.11% to 2.34%), and 0.62% for total losses (range: 0.14% to 2.39%). There are two types of non-ambulatory pigs observed under commercial conditions: fatigued (non-ambulatory, non-injured) and injured. The rates of fatigued and injured pigs averaged across 17 commercial field trials (n = 2,913,417 pigs) were 0.24% (range: 0.05% to 1.98%) and 0.06% (range: 0.04% to 0.45%), respectively. Fatigued pigs display signs of acute stress (open-mouth breathing, skin discoloration, and/or muscle tremors) and are in a metabolic state of acidosis characterized by low blood pH and high blood lactate values. Transport losses are a multi-factorial problem consisting of people, pig, facility design, transportation, packing plant, and environmental factors. It is well established that transport losses are increased by aggressive handling with electric prods, porcine stress syndrome, crowding pigs during transport, and extreme weather conditions. Management strategies to reduce transport losses under commercial conditions include better preparing pigs for transport (walking pens daily, routinely handling/moving pigs, pre-sorting pigs prior to loading, and withdrawing feed prior to loading) and minimizing stress throughout the marketing process (minimizing electric prod use, moving pigs in groups of 4 to 6, minimizing loading distances, and utilizing transport floor spaces of at least 0.46 m^2/pig.

Key Words: Pig, Transport losses, Non-ambulatory

17 Effects of handling intensity, distance moved, and transport floor space on the stress responses of market weight pigs. M. J. Ritter*[1], M. Ellis[2], C. M. Murphy[2], B. A. Peterson[2], and A. Rojo[2], [1]*Elanco Animal Health, Greenfield, IN*, [2]*University of Illinois, Urbana*.

Three studies were carried out to determine the effects of handling intensity, distance pigs are moved, and transport floor space on the stress responses of market weight pigs (130.8 ± 1.16 kg). Study 1 investigated the effects of handling intensity using 48 pigs that were moved ~50 m through a handling course with 0, 2, or 4 shocks from an electric prod. Study 2 evaluated the effects of distance moved and utilized 48 pigs that were moved with livestock paddles through a handling course for distances of 25, 75, or 125 m. Study 3 employed 42 pigs to evaluate the effects of transport floor space (0.45, 0.50, or 0.56 m^2/pig) during a 2 h journey. Two hours before and immediately after the handling treatments (studies 1 and 2) or transportation treatments (study 3), rectal temperature was measured and blood was collected for the determination of blood acid-base balance (pH, lactate, bicarbonate, and base-excess) and plasma creatine kinase values. Also, the number of handling interventions administered and the time to complete the handling course were recorded for all pigs in studies 1 and 2. Data were analyzed as a randomized complete block design by using Proc Mixed of SAS. In study 1 as the number of shocks administered increased from 0 to 4, immediately post-handling rectal temperature and blood lactate values increased ($P = 0.01$) linearly, while the time to complete the handling course decreased ($P < 0.01$) linearly. In study 2, the change from baseline to post-handling values for rectal temperature and blood lactate increased ($P = 0.01$) linearly, while the change in blood pH decreased ($P < 0.05$) linearly as the distance pigs moved increased from 25 to 125 m. In study 3, transport floor space had no effect on any of the parameters measured at the end of the journey. These data suggest that rectal temperature and blood lactate values increase linearly as electric prod use and distance moved increase, while the transport floor spaces evaluated in this study, which represent levels commonly found in commercial practice, had minimal effects on stress responses of market weight pigs after a 2 h journey.

Key Words: Pig, Handling, Transportation

18 Factors that increase the frequency of stressed, crippled, and dead pigs at a commercial abattoir. R. Fitzgerald*[1], K. Stalder[1], N. Matthews[2], C. Schultz-Kaster[2], and A. Johnson[1], [1]*Iowa State University, Ames*, [2]*Farmland Foods, Milan, MO*.

The objective of this study was to identify the effects of season, trailer attributes, rest time, and load crew that increase the frequency of stressed, crippled, and dead pigs on arrival and in the resting pen at a commercial abattoir. Decreasing the number of mortalities and non-ambulatory animals can increase the profitability of pork production systems. In this study, stressed, crippled, and dead pigs were summed into a variable called defects. Defect counts per trailer load (n = 10,589 loads) were collected from May 2005 to April 2006. Weather data were collected during the same period. Other variables relating to pig transport, load crew, and pig rest times were recorded and used as fixed effects in the model for the analysis of the defect percentage per load using Glimmix procedures (SAS). Density was calculated by multiplying the average live weight by the number of pigs per load and temperature-humidity index (THI) was calculated using an equation published by NOAA (1976) and both were used as model covariates. The ILINK function was used to convert logarithmically-transformed trait means to their original units of measure. The linear covariate density accounted for the greatest portion of variance ($P<0.0001$) followed by the linear covariate minutes of rest before harvest ($P<0.0001$), fixed effect load type ($P<0.0001$), load time per pig linear covariate ($P<0.0001$), and the THI quadratic covariate ($P<0.001$). Assuming other factors are held constant, the log of percentage of defects per load increased by 0.00018 units of density, by 0.022 per minute of rest time, and by 0.93 per minute of load time per pig. Further, the poorest load crew's median equaled 0.18% more ($P<0.0001$) defects per load when compared to the best load crew. Similarly, of 37 farms, the poorest farm's median equaled 0.84% more defects per load than the best farm. The results of this study demonstrate that multiple factors influence and could be modified to reduce the percentage of defects per load of finishing pigs.

Key Words: Defects, Pigs, Transport

19 Factors associated with open mouth breathing and mortality in market hogs following transport to a packing plant. K. B. Kephart* and M. T. Harper, *Penn State University, University Park.*

The following observational study was undertaken to identify factors affecting the incidence of open mouth breathing and mortality of market hogs following transport to a single packing plant. Hogs were evaluated on 21 dates from April through October 2007 from 149 deliveries transported by drivers (n=21) employed by the packing plant. The presence of open mouth breathing (OPEN) was recorded for all pigs immediately after unloading, in addition to the number of dead on the trailer (DEAD). Factors recorded for each load included: driver, trailer type, temperature at the time of unloading, and farm of origin. Trailer types included three-deck trailers with internal ramps (3DECK), standard two-deck trailers (STD), and two-deck trailers with a wide unloading door (WIDE). The number of DEAD or OPEN pigs as a percentage of the total on the trailer were subjected to analysis of covariance. OPEN was affected by trailer type and trailer type x temperature (both P<0.001); farm of origin (P<0.10) and driver (P>0.20) were included in the model as random effects. There were no differences (P>0.05) in the least squares means of OPEN among trailer types when temperatures were below 18.3°C. At 18.3°C the percentage of OPEN was higher (P<0.05) for 3DECK trailers compared to that of WIDE trailers (2.8% vs. 1.1%, respectively). At 29.4°C the proportion of OPEN on 3DECK trailers was higher (P<0.05) than that observed for both STD trailers and WIDE trailers (6.7% vs. 4.3% vs. 2.0%, respectively). The observed percentage of DEAD was not affected by trailer type or trailer type × temperature (P>0.25) and averaged .055%. Analysis of mortality records collected by the packing plant for each trailer type (January through September 2007, approximately 3026 deliveries) revealed that average mortality on 3DECK trailers exceeded that of WIDE trailers (0.087% vs. 0.031%, P<0.05). We conclude that market hogs transported on trailers with internal ramps have increased incidence of open mouth breathing at warm temperatures, and that mortality on trailers with internal ramps may be higher.

Key Words: Swine, Transportation, Mortality

20 Evaluation of a Porcine Circovirus Type 2 vaccine on finishing pig growth performance and mortality rate. J. Y. Jacela*, S. S. Dritz, M. D. Tokach, R. D. Goodband, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University, Manhattan.*

A total of 2,553 pigs were used in two experiments in a commercial research barn to evaluate the effects of a commercially available Porcine Circovirus Type 2 (PCV2) vaccine on finisher pig growth rate, feed efficiency, and mortality rate. Previously, PCV2 infection had been noted in this farm but clinical presentation of PCVD (Porcine circovirus disease) did not meet the epidemiological case definition. Pigs were vaccinated at 9 and 11 wk of age in Exp. 1; and at 5 and 7 wk of age in Exp. 2. In Exp. 1; 1,300 pigs (24.3 kg) were individually weighed and the vaccine treatment administered 15 and 1 d before being placed on test in the finisher. In Exp. 2; 1,253 pigs (5.5 kg) were used and randomly allotted based on nursery pen average pig weight with the vaccine treatment administered at 41 and 27 d before being placed on test in the finisher. Pen weights were obtained on d 0 and every 2 wk until the end of the trial. Feed intake was recorded on a pen basis. Histopathologic evidence of circoviral disease was confirmed in both experiments. In Exp. 1, there were no sex by treatment interaction for any response criteria but barrows were heavier (P<0.05), had greater (P<0.05) ADG and ADFI, but poorer (P<0.05) G:F than gilts. Vaccinated pigs had improved (P<0.05) growth rate (0.95 vs 0.92 kg), ADFI (2.40 vs 2.36 kg), G:F (0.40 vs 0.39), and mortality (3.0 vs 5.6%) compared to unvaccinated pigs. In Exp. 2, there were vaccine by sex interactions (P<0.01) for ADG and market weight because the vaccine increased ADG more in barrows than in gilts. Vaccinated barrows were 5.0 kg heavier compared to unvaccinated barrows while vaccinated gilts were only 1.2 kg heavier than unvaccinated gilts at market. Vaccinated pigs had numerically higher ADFI and G:F compared to control pigs. Mortality rate was lower (P<0.05) in vaccinated pigs than in non-vaccinated pigs (8.9 vs 3.0%). The commercial PCV2 vaccine used in this study was effective at reducing mortality and increasing growth performance in finisher pigs.

Key Words: PCVD, PCV2, Vaccine

Billy Day Symposium: Delivering Semen to the Swine Industry

21 Benefits accured by the swine industry following adoption of artificial insemination. R. G. Campbell*, *Pork CRC, Willaston, South Australia, Australia.*

The major benefits accrued by the swine industry by the adoption of artificial insemination(AI) relate to reduced labor inputs assocaited with mating,improved occupational health and safety,reduced disease risk and an easier working environment for those involved in this important aspect of commercial swine production.AI also offered the potential for more consistent production/reproduction compared to using boars and natural mating and greater genetic gain since elite sires can be utilized across more sows.AI additionally provided more flexibility in the tailoring of sires for individual businesses,the introduction/evaluation of new lines whether from national or international sources and for genes and genetic technologies and breakthroughs to be introduced at the commercial level relatively quickly.Further advantages in terms of genetic gain and cost effectiveness will flow from advances in AI and breeding technologies which enable sperm doses and the number of inseminations required to maximize reproduction to be reduced.

Key Words: Artificial insemination, Swine, Reproduction

22 An overview of the current status of technology for artificial insemination in the swine industry. E. A. Martinez*, J. M. Vazquez, J. Roca, M. A. Gil, C. Cuello, I. Parrilla, X. Lucas, and J. L. Vazquez, *Murcia University, Murcia, Spain.*

Standard pig intracervical insemination (ICI) protocols employ 3 billion spermatozoa per dose two or three times during estrus. Thus, one ejaculate can only be used to inseminate a limited number of sows, constraining the efficient use of boars. In addition, ICI is inefficient when applied to emerging sperm technologies, such as frozen-thawed (F-T) spermatozoa, sperm sexing (SS) and sperm-mediated gene transfer (SMGT). For these reasons, new methods have been developed for

depositing spermatozoa into the uterine body (postcervical insemination; PCI) or deep into the uterine horn (DUI), which allow a reduction of the number of spermatozoa per dose. When fresh semen is used under field conditions, the sperm dose can be reduced to 1 billion (PCI) or 0.6 billion (DUI) with similar results to those obtained after standard ICI. These practical procedures should allow optimization of the use of fresh semen from superior boars or in sanitary contingencies when the number of doses to be used is decreased. While no data are available using PCIs and F-T spermatozoa, the DUI technique can achieve high fertility using as few as 1-2 billion total F-T spermatozoa. DUI technology could counteract factors limiting routine application of F-T spermatozoa: the high number of spermatozoa required per dose and the low fertility achieved. The number of available flow sorted spermatozoa is too low for an extended use of SS technology in pig production even when DUI is used. Laparoscopic insemination (LI) into the oviduct might be an alternative method, at least when applied under specialized production situations. Although some aspects of the SMGT technology still need to be improved, either DUI or LI have been shown to be efficient insemination procedures to obtain transgenic piglets. With the use of these new insemination methods a more efficient application of currently available and emerging sperm technologies might be expected. Supported by Seneca Foundation (04543/GERM/06).

Key Words: Uterine insemination, Sperm technologies, Pigs

23 Opportunities to increase the benefits of artificial insemination to the swine industry. R. Schmitt*, *Seaboard Foods, Guymon, OK.*

The technology necessary to perform artificial insemination (AI) has not changed appreciably over the last several decades. What has changed is the increase in the size of sow farms resulting from the adoption of AI technology, the increase in the use of disposable products and the specialization of the skills of the farm staff performing AI. Over the last ten years, the increases in efficiency and automation of AI have mainly been on the boar side. Going forward, the same type of technological advancement will be applied to the estrous detection and insemination side of AI at the sow farm. Currently, the use of exogenous hormone therapies that, in the past, were considered too expensive or difficult to implement on-farm, are being considered economically feasible. These therapies may allow for a tighter window of the expression of heat and better utilization of the heat check crew. The increased utilization of automation in semen collection, estrous detection and artificial insemination will continue in the future, with the efforts of innovators being to develop on-farm tools that will accurately determine the onset of estrus. These could be innovations that monitor for the outward signs of estrous behavior (restlessness, lordosis) or on-farm estrous detection kits, similar to home pregnancy tests, which could be used to determine hormone changes indicative of the onset of heat to allow for the proper timing of insemination. Likewise, portable ultrasound equipment could be used to monitor follicles for ovulation; so that only one insemination is needed for conception. The increased sophistication and affordability of robot technology could result in a combination of these technologies being used to monitor females 24 hours a day, accurately determine the onset of estrus or ovulation, and inseminate females at the optimum time for conception. The increase in automation for on-farm heat detection and insemination would not necessarily be used to replace workers but would be used to utilize skilled workers more efficiently, help to retain them longer and optimize both production and profitability.

Key Words: Swine, Artificial insemination, Reproduction

24 Opportunities for improving sperm production in boars. W. L. Flowers*, *North Carolina State University, Raleigh.*

Production of large quantities of fertile semen is important for swine A.I. A number of different factors have been shown to influence semen production in boars. The main purpose of this presentation is to review some of the more important of these with particular emphasis on recent developments. Heat stress is universally recognized as a situation that has a negative effect on spermatogenesis. Recent retrospective studies indicate that certain genetic lines are able to maintain high levels of sperm production under conditions of elevated ambient temperature and humidity. If this observed variation has a significant genetic component, then it should be possible, in theory, to develop genetic lines that posses a high degree of heat tolerance in terms of their semen output. Similarly, high collection frequencies also have been shown to decrease both the quality and quantity of spermatozoa. Several studies have demonstrated that boars maintained under high collection frequencies with consistent intervals between consecutive collections experience only minor decreases in sperm production. Thus, the consistency of the collection regimen appears to be an important, yet often overlooked, variable that influences spermatogenesis. Positive relationships among body weight, testicular size, and sperm production are well established. Recent work has shown that boars reared in small litters from birth to weaning have superior sperm production, semen quality, and fertility compared with their counterparts raised in large litters. Because the lactation period in swine coincides with an active period of Sertoli cell mitosis, management decisions during the neonatal period of replacement boars are likely to have an important influence on adult reproductive performance. Nutrition does influence boar reproduction. Supplementation of balanced diets with nutrients has produced equivocal results on sperm production. Dietary supplementation is more likely to have positive effects on spermatogenesis when measurable increases of the compounds are observed in semen. Several different vitamins, minerals, and fatty acids meet this criterion and, thus, would be expected to enhance semen quality and quantity.

Key Words: Boars, Semen, Spermatogenesis

25 Opportunities to improve liquid and frozen storage of boar semen. H. D. Guthrie* and G. R. Welch, *Animal Biosciences and Biotechnology Laboratory, Agricultural Research Service, Beltsville, MD.*

Artificial insemination has facilitated the utilization of superior genetics and reduced boar costs. The use of frozen semen permits the flexibility to inseminate animals at unscheduled times and to use semen of deceased boars. While good long-term storage extenders for liquid semen have been developed, the composition of semen extenders should be redesigned to improve energy production and utilization in sperm cells, which decreases after 5 d of hypothermic storage compared to fresh semen. Frozen semen is not widely used in the swine industry because the technology is difficult, but the primary problems with frozen-thawed semen are that 50% of the cells are killed and surviving cells must be inseminated during the 4 h interval before ovulation to optimize fertilization. Different combinations of permeant and impermeant cryoprotectants and different methods of their application to sperm cells are being tested to increase the resistance of sperm to osmotic stress, temperature change, disruption of membrane lipids and proteins, and ice crystal formation. Cyclodextrin delivery of cholesterol into sperm cells increased the resistance of sperm cells to osmotic stress and increased

post-thaw motility and viability, but the impact on fertility is unknown. Progress in the use of frozen boar semen may be achieved through genetic analysis of boar lines at the USDA Meat Animal Research Center with > 60% sperm survival after freeze-thawing. Attention to the timing of insemination to relation to ovulation can improve sperm fertility using current freezing technology. We used a single, fixed time insemination of 5×10^9 thawed sperm 0-4 h before the expected time of ovulation in 40 altrenogest-treated gilts (controlled by an injection of 750 IU of hCG i.m. 130 h after the last feeding of altrenogest). The farrowing rate was 75% and the mean number/litter of pigs born, born alive, and weaned were 9.7, 8.8, and 8.6, respectively. Use of frozen boar semen is facilitated because it can be held for 48 h in commercial extenders before freezing without impairing farrowing rate. Changes in semen extender composition and improved application of cryoprotectants will improve the fertility of liquid and frozen semen.

26 Molecular evaluation of semen quality. P. Sutovsky*, *University of Missouri, Columbia*.

Increasing the average litter size by one piglet would bring an extra yield of $135 million per year to US pork industry. This increase can be achieved by better reproductive management of both boars and sows. Accurate evaluation of the quality of sperm production is crucial for the management of boar gonadal function and for the reduction of detrimental seasonal effects on boar fertility. Our goal is to develop and disseminate novel, objective, more accurate semen evaluation techniques, based on molecular markers present mainly in the defective spermatozoa. Ubiquitin is a small chaperone protein that binds to defective protein molecules (protein ubiquitination) to mark them for recycling by ubiquitin-specific proteolytic enzyme complex, the 26-S proteasome. Tagging with ubiquitin occurs on the surface of defective spermatozoa during sperm maturation in the epididymis. The 15-lipoxygenase (15-LOX) is a lipid peroxidating enzyme with high affinity to organelle membranes that participates in organelle degradation together with ubiquitin. In boar sperm 15-LOX is present exclusively in the cytoplasmic droplet. By labeling sperm samples with fluorescently-conjugated anti-ubiquitin and anti-15-LOX antibodies, the defective spermatozoa can be distinguished from the normal ones based on the presence of ubiquitin and 15-LOX by epifluorescence microscopy, and sperm ubiquitin levels can be measured objectively by high throughput flow cytometry. Large scale studies already established the validity of ubiquitin as a semen quality marker in bulls. Similar trials in boars showed significant, negative correlations of flow cytometric values of sperm ubiquitin and 15-LOX with farrowing rates and litter sizes. In contrast to other available semen evaluation techniques, our marker-based method is not skewed by damage caused during semen collection, processing and cryopreservation. Raw boar semen samples can be shipped from producers to a reference laboratory on wet ice for such evaluation, requiring minimal processing time and expense from pork producers. We are currently developing techniques for the immunodepletion of defective spermatozoa from ejaculates during semen extension.

Key Words: Boar, Fertility, Sperm

Breeding and Genetics

27 A multivariate approach for Parma's ham quality evaluation. N. Bacciu*[1], A. Rossi[2] and N. P. P. Macciotta[1] , [1]*University of Sassari, Sassari, Italy*, [2]*C.R.P.A., Reggio Emilia, Italy*.

Multivariate factor analysis was carried out on 26 technological and morpho-histological variables measured on dry–cured Parma ham along the whole processing period in order to extract indicators of product quality. Data from 166 hams with short period ageing (<15 months) and 158 hams with long period ageing (>15 months) were compared. Suitability of the data set to factor analysis was evaluated by Kaiser`s Measure of Sampling Adequacy (MSA) which was found to be 0.73. Five factors of explaining 72.1% of the total variability were extracted using a maximum likelihood procedure. The first factor, which explained 22% of the total variability, showed high positive correlations (>0.90) with all measures of instrumental consistency of the aged muscle. The second factor, which accounted for 17% of the total variability, had high positive correlations (>0.85) with weight losses of the thigh and a medium-low negative correlation with fat thickness at the end of ageing (–0.66). The third factor (which explained 13.5% of the total variability) was negatively correlated (–0.62) with weight loss measured at the presugnatura phase. Moreover, the third factor showed a positive correlation (0.62) with red color intensity, which is a very important consumer preference characteristic of the Parma ham. The fourth factor was highly and positively correlated with instrumental measures of luminosity of the sample. The fifth factor presented high and positive correlations with the quantities of salt added during the salting phase of the processing procedure. A one way ANOVA on the scores of the five factors was performed, considering ageing time as a fixed effect. Hams with shorter ageing period had average scores for the third and fifth factor clearly lower than those of the second period. Therefore, a longer processing procedure for the Parma ham, which implies higher additions of salt in the salting phase and lower weight losses in presugnatura phase, will also result in a higher red intensity at the aged cut.

Key Words: Dry–cured ham, Quality evaluation, Multivariate factor analysis

28 Application of various selection methods for genetic improvement of rate of gain and lion depth while maintaining back-fat thickness constant in pigs. A. Toosi*[1], R. Fernando[1], F. Pita[2], and F. Gunsett[2], [1]*Iowa State University, Ames*, [2]*Newsham Genetics, West Des Moines, IA*.

Stochastic simulation was employed to compare different characteristics of six methods to develop selection indices. Selection strategies were compared based on their ultimate cumulative responses for three traits, accuracies and their associated inbreeding rates.
An additive model with 600 loci was used to simulate data for three traits in a pig population with overlapping generations. The traits were designed to model three production traits common to the swine industry; number of days to market (DTM), back-fat thickness (BF) and lion depth (LDP). Environmental effects were sampled from standard normal distribution. Phenotypic value of each trait was calculated as the sum

of the above two components. Each generation was consisted of four cycles. In each cycle, 6 boars were mated with 30 sows. Litter size was set to two, one male and one female piglet per each sow. Simulation was run for 12 cycles and was replicated for 5000 times. The breeding objective was to increase rate of gain and lion depth while keeping back-fat constant. The following selection methods were evaluated: ad hoc index, economic index, desired-gain index, polar coordinates index and empirical restricted selection index (ERIS). A random mating scenario was also considered for the sake of comparison. Among the different scenarios, the random mating one resulted in less inbreeding rate, followed by the ERIS method and the economic index. The highest inbreeding rate resulted from the desired gain index, while the highest amount of improvement in LDP was also obtained by this method. The ERIS method outperformed all other methods (in terms of the mean and standard deviation of the cumulative response) with regard to improvement of the LDP while maintaining BF minimally changed. Various evaluated methods of selection did not much differ in terms of the accuracies and heritabilities of the traits in each cycle.

Key Words: Selection Index, Simulation, Desired gain

29 Heritability estimates for structural soundness traits in commercial gilts. M. Nikkilae*[1], K. Stalder[1], B. Mote[1], J. Lampe[2], B. Thorn[3], M. Rothschild[1], A. Johnson[1], L. Karriker[1], and T. Serenius[4], [1]*Iowa State University, Ames,* [2]*Swine Graphics Enterprises, Webster City, IA,* [3]*Newsham Genetics, West Des Moines, IA,* [4]*FABA Breeding, Vantaa, Finland.*

The objective of this study was to estimate leg soundness and body conformation trait variance components using 1449 gilts in a commercial sow unit. The gilts were from two commercial genetic lines and were progeny of 58 known sires and 836 dams. Sire information was not available for 52 animals. Gilts averaged 124±11 kg and 190±7 days of age when trait evaluation occurred. Evaluated structural traits consisted of 6 body traits; body size (length, depth, width) and body shape (rump shape, rib shape, top line), 5 leg traits per leg pair and leg action. All traits were independently evaluated by two experienced scorers using a 9 point scale. Variance components were estimated with a single trait model using DMU software. The statistical model included gilt line, evaluation day and scorer as fixed effects, animal as a random effect and weight at evaluation as a covariate. Estimated heritabilities for body size traits ranged between 0.20 and 0.32. Heritability estimates for body shape traits were slightly lower ranging from 0.16 to 0.21. Turned front legs, buck knees, foot size and uneven toes had relatively low heritabilities (0.06–0.13). Turned rear legs, weak or upright rear legs and both front and rear pastern postures had moderate heritabilities (0.20–0.30). Leg action had a heritability of 0.10. The relatively low heritabilities of several leg traits indicate that the portion of additive genetic variance was small and genetic improvement through selection would likely be slow. The low heritability of leg action might be explained by the varying problems behind impaired movements, some having genetic background and others caused by environmental factors. Despite the relatively low heritability, the majority of estimates differed significantly from zero, which warrants further investigations regarding associations of soundness traits with reproductive performance and sow productive lifetime.

Key Words: Gilts, Heritability, Structural soundness

30 Association of candidate genes to leg and body conformation traits in pigs. S. K Onteru*, B Fan, B Mote, T Serenius, M Nikkilae, K. J. Stalder, and M. F. Rothschild, *Iowa State University, Ames*.

Feet and leg soundness influences the health and reproductive performance of sows and boars. It has been estimated that culling rates range from 10 to 40% due to soundness problems in breeding stock. Soundness traits have been shown to be low to moderately heritable. Marker assisted selection is one method to improve these low to moderately heritable traits. Though research has been conducted on genetic control of structural soundness in pigs, studies on large numbers of candidate genes (SNPs) and their association with lameness are scarce. Therefore, candidate genes from published QTL regions for locomotion and osteochondrosis related traits in pigs as well as from genes involved in skeletal development pathways and diseases of human bone and joints were chosen for discovery of SNPs relevant to body conformation as well as feet and leg soundness scores in pigs. High throughput genotyping was performed by Sequenom's MassARRAY system. In 134 selected genes, over 370 SNPs have been identified to date and are being mapped using ISU Berkshire Ã*f*â€" Yorkshire (BY) resource family. The mapping of first 22 genes revealed that *HDBP, CALCR, OXTR, IHH* and *ANKH* were mapped to suggested QTL regions for leg and body conformation traits in pig. A total of 2067 commercial females were scored for 17 traits describing skeletal conformation which were used for association analyses. The association analyses of the first 22 genes found that the genes *CALCR*, *HDBP*, *CALCA*, *MTHFR*, *OXTR*, *IHH*, *ANKH*, *LRCH1* and *OPN* were significantly associated with leg and body conformation traits such as leg action, pasterns (weak or upright), body length (short or long) and depth (deep or shallow bodied). The remaining 112 genes are being evaluated for their association with skeletal traits as well. Research to date recommends that the associated genes can be considered as candidates for marker assisted selection to improve feet and leg soundness in pigs.

Key Words: Pig, SNP, Feet and leg soundness

31 Genetic relationships among temperament score, weight, and backfat measurements in pigs. J. W. Holl*, G. A. Rohrer, and T. M. Brown-Brandl, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE*.

Genetic parameters for temperament score were estimated from generations five and six of a randomly selected, composite population composed of Duroc, Large White, and two sources of Landrace (n = 1,704). Temperament score (TS), weight (WT), and three backfat measurements (BF1, BF2, and BF3) were recorded at approximately 156 d of age. Temperament score ranged from 1 (calm) to 5 (highly excited); where 56.9%, 28.8%, 9.7%, 4.3% and 0.3% were scored as 1, 2, 3, 4, and 5, respectively. Pearson′s correlations of phenotypic data were -0.07, -0.04, -0.07, and -0.08 for TS with WT, TS with BF1, TS with BF2, and TS with BF3, respectively. Statistical model effects were year-week of measurement, sex, covariates of age for TS and WT or weight for BF1, BF2, and BF3, and an animal direct genetic effect. Model 1 was a five-trait linear mixed model. Model 2 was a five-trait threshold-linear mixed model, where TS was treated as a categorical trait. Estimated heritabilities using Model 1 were 0.19, 0.42, 0.41, 0.49, and 0.50 for TS, WT, BF1, BF2, and BF3, respectively. Model 1 estimated genetic correlations between TS and WT, TS and BF1, TS and BF2, and TS and BF3 were -0.26, -0.16, -0.16, and -0.20 respectively. Estimated heritabilities using Model 2 were 0.30, 0.37, 0.37, 0.46, 0.43 for TS,

WT, BF1, BF2, and BF3, respectively. Model 2 estimated genetic correlations between TS and WT, TS and BF1, TS and BF2, and TS and BF3 were -0.35, -0.23, -0.20, and -0.24, respectively. Results indicated TS had a heritable genetic component and genetic correlations were slightly stronger in the combined threshold-linear model. Estimated genetic correlations between TS and backfat measurements adjusted to a common weight were negative for both models. Therefore, selection for more docile animals would be expected to result in faster growing, fatter pigs.

Key Words: Genetic correlation, Pigs, Temperament

32 Genetic parameters for kyphosis in pork carcasses. J. W. Holl*, G. A. Rohrer, S. D. Shackelford, T. L. Wheeler, and M. Koohmaraie, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Genetic parameters for degree of kyphosis were estimated in pigs from a Duroc-Landrace F_2 population (n = 316) and in pigs and sows from a composite population (Line C) composed of Duroc, Large White, and two sources of Landrace (n = 1,552). Live presentation did not indicate kyphosis in pigs or sows. Degree of kyphosis was measured by scoring the shape of the vertebral column of split carcasses on a scale from 0 (normal) to 3 (severe). There were no significant differences in kyphosis between sows and pigs in Line C. Of the animals slaughtered, 75.6% and 68.9% were normal, 11.1% and 23.3% were mild, 11.1% and 6.2% were moderate, and 2.2% and 1.5% were severe in F_2 and Line C, respectively. Using linear models, fixed effects of age, sex, number of ribs, number of lumbar vertebrae, number of nipples, carcass length, and hot carcass weight, were not significantly associated ($P > 0.10$) with kyphosis score. Using an animal model, estimated heritabilities for kyphosis score were 0.30 and 0.32 in F_2 and Line C, respectively. Estimated genetic correlations between kyphosis score and number of ribs, number of lumbar vertebrae, number of nipples, carcass length, and hot carcass weight were 0.05, -0.13, 0.00, 0.05, and 0.03, respectively. Estimated phenotypic correlations between kyphosis score and number of ribs, number of lumbar vertebrae, number of nipples, carcass length, and hot carcass weight were 0.03, -0.05, -0.05, 0.05, and 0.01, respectively. Selection to decrease kyphosis should be effective and not affect the number of ribs, lumbar vertebrae, nipples, or carcass length. In addition, selection for growth should not affect the genetic potential for incidence of kyphosis.

Key Words: Heritability, Kyphosis, Pigs

33 Covariance functions for weights of young dual purpose Simmental bulls using splines. M. Kaps*[1,2] and W. R. Lamberson[2], [1]*University of Zagreb, Zagreb, Croatia*, [2]*Univeristy of Missouri, Columbia.*

Phenotypic, genetic and environmental covariance functions were estimated for weight of young dual purpose Simmental bulls. Data consisted of the records of 1360 young bulls measured monthly from 6 to 12 mo. Covariance functions were estimated by using polynomial (POL), piecewise cubic spline (PCS) and cubic smoothing spline (CSS) random regressions on Legendre polynomials of weight measurements. Age, season and year of birth and their interactions were defined as fixed, while animal and permanent environment due to repeated measurements were defined as random effects. The parameters were estimated by REML, and the model fits were analyzed using Akaike information criteria (AIC). The shape of the overall covariance functions (phenotypic) and partial functions (additive genetic and environmental) were analyzed. By comparing models using AIC, the POL models with degrees 2 and 3 showed slightly better overall fit than other models, however, they had more parameters and consequently were more computationally demanding. Further, the fit of the partial random effects was not satisfactory. The CSS showed moderate overall and partial fit, but they tend to smooth the original data showing average increase in variability. The PCS showed the best partial fit, and good overall fit, although slightly worse than the other models. Their performance depended on defined degree and position of knots. The heritability estimates ranged from 0.37 to 0.40 for PCS, 0.40 to 0.44 for CSS, and 0.40 to 0.49 for POL. The choice of the models, including the defined degree of the overall and spline polynomials, and position and numbers of knots, depends not only on overall fit but also on the fit of genetic and environmental components. This can be verified by looking at graphs of partial covariance functions. Splines fit on Legendre polynomials, which reduces possible estimation numerical problems, proved to be very good method for estimating changes in genetic parameters over age in dual purpose Simmental cattle.

Key Words: Random regression, Simmental cattle, Spline

34 Maternal inheritance of pulmonary arterial pressure in Angus cattle and its correlation with growth. D. W. Beckman*[1] and D. J. Garrick[1,2], [1]*Iowa State University, Ames*, [2]*Massey University, Palmerston North, New Zealand.*

High-altitude or brisket disease occurs in cattle residing at or above altitudes of 1,500 m and is characterized by right ventricular hypertrophy resulting in congestive heart failure. Pulmonary arterial pressure (**PAP**) measures resistance of blood flow through the lungs, and is a reliable predictor of an animals susceptibility to high-altitude disease. It was theorized that a threshold may exist in which animals with PAP scores above the threshold exhibit signs of high-altitude disease, while individuals below the threshold remain disease free. Previous analyses suggest no evidence of maternal effects on the continuous trait PAP. Consequently, the objective of this research was to quantify the role of maternal effects on PAP as a binary trait. Birth weight (**BWT**), weaning weight (**WWT**), and a single measure of PAP were collected on 2,305 registered Angus calves born from 1984 to 2003 on a Colorado ranch at an elevation of 1,981 m. Continuous traits BWT and WWT were evaluated with PAP as a binary trait in three multivariate analyses where thresholds for PAP were set at 35 mmHg, 40 mmHg, and 45 mmHg, respectfully. REML procedures were used to estimate (co)variances for direct genetic, maternal genetic and residual random effects for each multivariate analysis. Estimates of direct and maternal effects for BWT and WWT were similar to those in the literature. Heritability estimates for PAP direct were moderate. Maternal heritability estimates for PAP were low, but higher than previously reported, with an average of 0.14 across the three thresholds. Results suggest PAP is moderately heritable in Angus cattle acclimatized and tested at high altitude. However, further investigation of maternal effects on PAP fit as a binary trait is necessary before sound inferences can be made.

Key Words: Beef cattle, Maternal effects, Pulmonary arterial pressure

35 Responses to genomic selection in livestock. J. M. Young*, H. Zhao, R. L. Fernando, D. Habier, and J. C. M. Dekkers, *Iowa State University, Ames*.

Genomic Selection (GS) on genome-assisted breeding values (GEBVs) estimated from dense marker data is promising for genetic improvement in livestock. The objective here was to compare GS to selection on traditional BLUP-EBV. A population was simulated with single nucleotide polymorphisms (SNPs) and quantitative trait loci (QTLs) across 20 chromosomes of 150 cM. In generation 0 (G0), 100,000 SNPs were simulated with frequency 0.5 and in HW and linkage equilibrium. Random mating with effective population size 100 was simulated in G1-1000. Mutations were simulated at a rate of 2.5×10^{-5} per SNP per generation. G1001 was expanded to 1000 individuals and used to simulate phenotypes for analysis and the start of selection; a random 100 segregating SNPs (minor allele frequency ≥0.1) were designated as QTL and 2000 as genotyped SNPs. To simulate phenotypes, QTL effects were drawn from a gamma distribution and environmental effects were added to generate phenotypes with heritability 0.3. To simulate G1002, 20 males and 60 females were randomly selected and mated to produce 4 sons and 4 daughters per female. G1003 through G1013 were simulated by selecting 20 males and 60 females with highest EBV. GEBVs were estimated with Bayes-B using phenotyped and genotyped animals from G1001 only (GS1) or with updating using data from all generations (GSall). BLUP-EBVs were estimated using phenotypic data in G1001 only (BLUP1) or from G1001-1013 (BLUPall). Cumulative responses to selection (CR), inbreeding (F), accuracies, and rates of QTL fixation were evaluated. Based on 100 replicates, GS1 had 400% higher CR in G1013 than BLUP1 and 50% lower F. GS1 had 35% lower CR by G1013 than BLUPall but also 50% lower F and only used phenotypes in G1001. When phenotypes were available in all generations, GSall had 16% higher CR than BLUPall in G1003-1005 but extra CR declined to 8% in G1013. GSall, however, resulted in 30% lower F and fewer QTL lost. Thus, GS can lead to extra response at lower rates of inbreeding. Further work is in progress by investigating more scenarios. Financial support from Hy-Line Int., PIC-Genus, Monsanto Co., and USDA-CSREES National Needs Grant no. 2007-38420-17767.

Key Words: Genomic selection

36 Placental transcriptome profile differences associated with selection for uterine capacity. B. A. Freking*[1], J. R. Miles[1], S. R. Bischoff[2], Y. Xia[3], D. J. Nonneman[1], J. L. Vallet[1], and J. A. Piedrahita[2], [1]*USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*, [2]*North Carolina State University, Raleigh*, [3]*University of Nebraska, Lincoln*.

Selection for 11 generations for uterine capacity (UC) resulted in 1.6 more live pigs born with no change in birth and placental weights. It was determined that the critical time period for the difference in litter size was established between d 25 and 45 of gestation. Our objective was to gain insight into placental transcriptional changes after selection for uterine capacity. Thirty gilts from the UC and control (CO) lines were subjected to unilateral hysterectomy-ovariectomy at approximately 160 d of age and mated within line at approximately 280 d. Gilts were slaughtered at d 25, 30, or 40 of gestation. Fetal and placental tissues were obtained from each live embryo. Two male and two female embryos closest to the litter mean for placental weight were chosen to represent each litter (n = 3 litters per line and time point combination). Placental tissues were pooled within litter and total RNA was extracted. Samples were labeled and hybridized to Affymetrix porcine array chips (n = 18) using manufacturers suggested protocols. Signal intensities were normalized using GC content Robust Multi-array Average (GCRMA) on the probe level data. Two-way ANOVA (two lines and three stages) was performed. Threshold values were set at a minimum of 1.5 fold difference and the false discovery rate was set to $P < 0.05$ (Benjamini and Hochberg algorithm). A total of 4171 targets on the array exceeded P value and threshold limits for the main effect of stage (2230 up-regulated and 1839 down-regulated from d 25 to d 40). Two targets, LIM domain and actin-binding protein 1 (LIMA1) and dedicator of cytokinesis 4 (DOCK4) approached significance for line ($P < 0.08$). Both genes appear to play roles in cell migration, suggesting participation in placental folded bilayer formation.

Key Words: Microarray, Pigs, Uterine capacity

37 A novel estimator for the proportion of true null hypotheses based on subsampling with applications to microarray data. L. Qu*, D. Nettleton, and J. C. M. Dekkers, *Iowa State University, Ames*.

Microarray data analysis often involves testing many hypotheses simultaneously. The proportion of true null hypotheses (π_0), a global measure of the strength of biological responses, is a critical quantity for false discovery rate (FDR) control. We develop a new procedure for estimating π_0 through novel use of data subsampling. Based on the fact that power increases with sample size up to 1 for infinite sample size, our procedure repeatedly deletes a random set of biological samples to produce many subsamples of various sample sizes. For each subsample, the same set of hypotheses is tested and a kernel density estimator with data reflection is used to estimate the *p*-value density at 1. Note that most existing methods use the *p*-value density at 1 from the full sample as an estimate of π_0, despite its large positive bias. Our procedure takes a further step by regressing the *p*-value density at 1 over the sample size and then extrapolating the regression curve to infinity to get an estimate of π_0. This corresponds to the *p*-value density at 1 with an infinite sample size, which is exactly π_0 in theory. To stabilize estimation, bootstrapping is used in regression and the final estimate is the bootstrapped median. Assuming *p*-values are from *t*-tests and the standardized effect sizes corresponding to false null hypotheses follow a normal distribution with 0 mean, we derive the exact functional relationship between the *p*-value density at 1 and the sample size. Based on this heuristic, we propose a flexible regression function which includes the above exact form as a special case to increase robustness. Simulations show that the new estimator has smaller mean squared error (MSE) than the currently most widely used λ-smoother method by reducing bias. But when the full sample sizes are small, our method over-corrects the bias. Averaging the λ-smoother estimate with the new estimate can correct this problem and is preferred in such cases. In conclusion, our new procedure leads to improved statistical power and has smaller MSE compared to the λ-smoother method. (Supported by USDA-NRI-2005-3560415618)

Key Words: False discovery rate, Multiple testing, Microarray analysis

38 Genetic background influences pig growth rate responses to porcine circovirus type 2 (PCV2) vaccines. M. L. Potter*[1], L. M. Tokach[2], S. S. Dritz[1], S. C. Henry[2], J. M. DeRouchey[1], M. D. Tokach[1], R. D. Goodband[1], J. L. Nelssen[1], R. R. R. Rowland[1], and R. A. Hesse[1], [1]*Kansas State University, Manhattan,* [2]*Abilene Animal Hospital, PA, Abilene, KS.*

Commercial porcine circovirus type 2 (PCV2) vaccines have become available as aids for the prevention and control of losses due to porcine circovirus disease (PCVD). Reports that genetic background affects severity of PCVD expression prompted this field study to compare PCV2 vaccine effects on growth rate across pigs from different genetic backgrounds. This 130 d study used 454 weaned pigs (21 d of age; 6.1 kg) in a PRRS and Mycoplasma negative multiplier farm. The presence of PCV2b virus in the herd was noted but clinical disease did not meet the epidemiological case definition for PCVD. Comparisons between vaccinate and unvaccinated control, genetic background, and gender (boars and gilts) were made in a 2 × 4 × 2 factorial treatment design. The 4 genetic backgrounds used were A×A (Duroc based sire and dam), B×B (Synthetic line for the sire and dam primarily derived from Duroc, Pietrain, and Large White), A×B, and B×A. Commercial PCV2 vaccine (Intervet) was administered according to label dose at weaning and again 2 weeks later. Pigs were individually weighed at weaning, end of the nursery phase (d 40) and off-test (d 130) to measure ADG. No significant three-way interactions were observed. There was a vaccine treatment by genetic interaction (P=0.05) for finisher ADG and off test weight. The ADG was 0.77±0.017, 0.87±0.018, 0.87±0.024, and 0.85±0.019 kg for control pigs and 0.86±0.018, 0.92±0.018, 0.91±0.025 and 0.88±0.019 kg for vaccinated pigs for A×A, A×B, B×A and B×B, respectively. This resulted in 9.0, 2.9, 4.7, and 2.3 kg heavier vaccinates compared to controls for each of the 4 genetic backgrounds. The vaccine was effective in increasing finisher growth rate while the magnitude of the weight difference was almost 4 times greater in the A×A pigs compared to the B×B pigs. These data indicate that the genetic background has an influence on the expression of PCVD or response to PCV2 vaccination.

Key Words: Growth, Circovirus, PCV2

39 Analysis of incidence of Porcine Circovirus Associated Disease (PCVAD) in a Landrace/Large White composite population. J. Bates*, R. Johnson, and A. Doster, *University of Nebraska, Lincoln.*

The objective was to determine the importance of genetic and environmental effects on the incidence of Porcine Circovirus Associated Disease (PCVAD) in pigs. 2,554 pigs from Generations 24-26 of two lines selected for increased reproduction and growth and two control lines were scored for symptoms of PCVAD. From 60 d of age pigs were grown in confined buildings or outside lots containing straw-bedded hoop structures. Scoring was on a scale of 0 (no symptoms), 1 (suspect), or 2 (positive) for symptoms of muscle wasting, growth retardation, rough hair coat, and diarrhea, and was done weekly from 70 to 180 d of age. 17.7% of the pigs received a score of 2. A sample of 37 pigs with a score of 2 were necropsied and lung, lymph node, tonsil, liver, kidney, thymus, spleen, ileum, and colon tissue were microscopically examined for lesions suggestive of PCVAD. Immunohistochemistry and RT-PCR were used to detect the presence of PCV-2 in collected tissues. All 37 pigs scored as a 2 were positive for PCV-2. PCVAD score was analyzed with ASREML using the Binomial and Probit functions to estimate genetic and environmental effects. Pigs receiving at least one score of 2 were considered positive for PCVAD; pigs scored only as 0 or 1 were considered negative. Direct and maternal heritabilities were 0.01 ± 0.001 and 0.11 ± 0.006, respectively, with a correlation of 0.61 between direct and maternal genetic effects. The proportions of variance due to common birth litter, common finishing pen, and common year/contemporary group/area were 0.11 ± 0.032, 0.05 ± 0.035, and 0.06 ± 0.035, respectively. Males had a significantly higher probability of PCVAD score than females (P<0.025). Significant differences (P<0.05) in weight between PCVAD pigs scored as positive or negative, estimated in ASREML, were -0.1 kg at birth, -0.52 kg at weaning, -4.35 kg at 60 d, and -20.17 kg at 180 d. Maternal genetic and common litter effects, as well as sex, environmental effects of finishing pen and year/contemporary group/area, affect incidence of PCVAD.

Key Words: Genetic variation, PCVAD, Immunity

40 Genetics relationships among breeds of beef cattle. Y. Huang*[1], M. D. MacNeil[2], L. J. Alexander[2], and J. P. Cassady[1], [1]*North Carolina State University, Raleigh,* [2]*USDA, Agricultural Research Service,, Miles City, MT.*

The objective was to estimate genetic distance among 16 populations of beef cattle from within the U.S. Thirty-three microsatellite markers representing 26 autosomes were used. MicroSatellite Analyzer 3.15 (MSA) was used to quantify number of alleles per marker, and observed and expected heterozygosity. Differentiation of allele frequencies among populations was also quantified with MSA. CONVERT 131 was used to prepare data for submission to PHYLIP 3.67 where Nei's unbiased genetic distance was estimated. Arlequin 2.0 was used to estimate within and among breed variation. The FST for these loci ranged from 0.05 to 0.22. On average, 11% of total genetic variation was between breeds. Unrooted neighbor-joining trees were constructed from Nei's unbiased genetic distance. Populations were roughly placed into five groups that were consistent with documented breed history and geographical origin. Angus, Red Angus, and Shorthorn were grouped as "Scottish A"; Highland and Hereford were grouped as "Scottish B"; Salers, Charolais, and Limousin were grouped as "French"; Texas Longhorn, Pineywoods, Florida Cracker, and Criollo were grouped as "Spanish"; and Braunvieh, Brown Swiss, Tarentaise, and Simmental were grouped as "Alpine". Min and max intra-group genetic distance are 0.12 ("French" and "Spanish") and 0.19 ("Alpine" and "Scottish A"). Angus and Red Angus diverged in the 1950s and Braunvieh and Brown Swiss diverged in the 1880's. As expected, Angus and Red Angus had the least genetic distance between them of any two populations. Surprisingly, shorter genetic distances were estimated between Braunvieh and Tarentaise (0.17), Braunvieh and Limousin (0.17), and Braunvieh and Charolais (0.15) then between Braunvieh and Brown Swiss (0.19). The greatest genetic distance was between Brown Swiss and Highland (0.44). Results may identify populations that would be expected to provide the greatest amount of hybrid-vigor when crossed, although we are unaware of experimental data with which to test this hypothesis.

Key Words: Cattle, Genetics, Diversity

41 Identifying genes associated with bacterial shedding through transcriptional profiling. J. J. Uthe*[1,2], Y. Wang[2], S. M. D. Bearson[1], A. M. O'Connor[2], J. McKean[2], D. Nettleton[2], J. C. Dekkers[2], and C. K. Tuggle[2], [1]*USDA, ARS, National Animal Disease Center, Ames, IA,* [2]*Iowa State University, Ames.*

Breeding animals with enhanced resistance to infection will reduce the use of antimicrobial agents during animal rearing without increasing

on-farm morbidity and mortality or microbial contamination at slaughter plants. The goal of this study was to identify porcine genes with predicted importance in resistance to *Salmonella*. The criteria for gene selection included: 1) transcriptional regulation of the gene early during *Salmonella* infection, 2) literature evidence of gene involvement during microbial infection, and 3) literature evidence of the gene′s ability to respond to pathogens during re-infection. To date, we have identified putative single nucleotide polymorphisms (SNPs) in 16 of such genes. Using several commercial swine breeds, DNA sequence analysis of PCR products containing the putative SNP region has confirmed 7 of the expected SNPs. The SNPs are being genotyped using three porcine populations with phenotypes associated with *Salmonella*: 40 pigs with quantitative *Salmonella* shedding data following *Salmonella* Typhimurium experimental challenge, a *Salmonella* Choleraesuis challenge population of 228 pigs (Compton study), and a field population of ~450 *Salmonella* positive and negative pigs from Iowa farms. Our resource populations have proved to be useful in 10 recent SNP analyses and their associations with *Salmonella* shedding status and/or blood parameters in the pig. Specifically, a positive association ($p<0.05$) was identified for the CCT7 gene SNP A/G at nucleotide 1026 (relative to start codon) with *Salmonella* shedding as well as circulating neutrophils and WBCs at 7 dpi compared to the G/G heterozygote genotype. Furthermore, 6 out of the 10 markers segregated in the Compton population. Investigating genetic polymorphisms and their associations with selective phenotypes may reveal genetic markers useful in identifying *Salmonella* resistant pigs.

Key Words: Salmonella, SNPs, Disease resistance

42 Estimation of heritability, phenotypic and genetic trends for monthly test day fat corrected milk yield using legendre function.
R. Lotfi*[1], H. Farhangfar[2], and H. Naeemipour[2], [1]*Tarbiat Modares University, Tehran, Iran,* [2]*Birjand University, Birjand, Iran.*

A total of 94910 monthly test day milk yield (corrected for 4% fat, FCM) belonging to 12058 Iranian Holstein heifers calving for the first time from 1991 to 2005 and distributed in 163 herds was used to estimate heritability , phenotypic and genetic trends. A test day animal model including herd-year-season of production-milking times, Holstein gene percentage, age at calving, additive genetic and permanent environment effects was used. In the model, orthogonal Legendre polynomials (of order four) were also used to take account of the shape of the lactation curve at the phenotypic level. The results indicated that the heritability of FCM was found to be 0.09 indicating that a little genetic gain is expected when genetic selection is based upon FCM. Positive and statistically significant phenotypic (0.837 Kg) and genetic (0.035 Kg) trends were found for FCM during the period of study suggesting that most of the phenotypic changes in FCM have been due to environmental improvement.

Key Words: Fat corrected milk, Heritability, Phenotypic and genetic trends

43 Advanced selection for feed efficiency, carcass composition and growth using FIRE-stations and computer tomography (CT).
B. Holm*, *Norsvin USA, Harmony, MN.*

How to obtain genetic progress for feed efficiency and carcass composition? For decades, feed efficiency (FE) and lean meat growth have been very important to the Scandinavian pig producers due to the high feed and housing cost per pound pork produced. Norsvin designed a genetic development platform to deliver efficient and productive genetic input to that industry. This includes approximately 2,400 purebred boars individually tested annually for feed efficiency and growth using FIRE-stations. In addition, 3,000 sibs annually have been dissected for carcass, meat and fat quality, OCD scoring etc. This has been done since the early 1990s. As the US market started to focus more on FE, further steps were taken to increase the annual genetic progress. The annual test capacity for purebred boars is now increasing to 3,500. Additional FIRE-stations, with weight platforms to obtain individual growth curves, are added. The final off-test will include CT-scanning of live boars to obtain highly accurate carcass and structure data on the individual selection candidates, the boars. Continuous spiral scanning is the method selected to be used. Carcass dissection of sibs will end when the amount of CT-scanning data is great enough to ensure accurate breeding values.

The CT-scanning based off-testing of boars will start in March 2008. However, Norsvin were in 2007 scanning animals going through the half-sib carcass dissection. Scanning data from these animals were analysed together with carcass dissection data, FIRE data and other production parameters. Preliminary analysis, including the fact that the selection intensity increases, show possibilities for joint genetic progress in mentioned traits as well litter size, reproduction related traits and maternal ability. More detailed results from the initial CT-scanning and predicted future achievable progress will be presented.

Key Words: Feed efficiency, Computer tomography, Carcass quality

44 Evidence of allelic suppression for transcripts expressed in day 30 pig embryos by SNP genotyping.
B. A. Freking*[1], D. J. Nonneman[1], G. A. Rohrer[1], S. R. Bischoff[2], S. Tsai[2], and J. A. Piedrahita[2], [1]*USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE,* [2]*North Carolina State University, Raleigh.*

Genomic imprinting results in alleles being differentially expressed in a parent-of-origin specific manner. Parthenogenetic and biparental pig embryo gene expression profiles were compared using three cDNA microarray platforms. Comparison of the profiles of the two tissue types indicated differential expression for maternally and paternally imprinted genes previously established in the human or mouse as well as novel loci without prior imprinting evidence. Genomic DNA from parents, two Meishan and four occidental white composite, and two crossbred embryos were sequenced for discovery of single nucleotide polymorphisms (SNP) within transcribed regions of targets. Successful amplicons (n=178) were sequenced both directions and SNP (n=303) were identified. Four litters (n=44 embryos) of crossbred d30 embryos were used to test differential allele expression using 138 SNP assays from 49 unique loci. Amplification products from templates representing genomic, as well as, cDNA from fetal liver were generated in multiplex Sequenom MassArray assays. Peak areas for cDNA templates were adjusted to correct for ratio of alleles in genomic DNA within each embryo. Frequency of the cDNA allele was expressed as an absolute value deviation from 0.50. A mean value for this deviation was calculated for each assay and a one tailed t-test was used to detect significant deviations of allele frequency from 0.5. Thirty-six loci were detected with significant allelic suppression ($P < 0.05$). Seventeen of these loci were previously known imprinted genes and nineteen loci were novel. These data allow a more complete estimate of the conservation

of imprinted loci across mammals as well as provide data for novel imprinted genes in the pig.

Key Words: Pigs, Imprinting, Expression

45 Association of insulin-like growth factor binding protein 2 genotypes with growth, carcass and meat quality traits in pigs. S. Prasongsook*[1,2], R. O. Bates[1], I. S. Choi[1], V. D. Rilington[1], N. E. Raney[1], C. C. Beattie[1], M. E. Doumit[1], and C. W. Ernst[1], [1]*Michigan State University, East Lansing*, [2]*Kasetsart University, Bangkok, Thailand*.

Insulin-like growth factor binding protein 2 (IGFBP2) is a growth-associated gene and we have previously mapped the pig ortholog to SSC15 using a *Msp*I restriction fragment length polymorphism. For this study, 417 F_2 pigs from our Duroc x Pietrain resource population were genotyped and we estimated the IGFBP2 position on SSC15 at 78.0 cM in a region we previously found to contain significant QTL affecting meat color and tenderness. The IGFBP2 allelic frequencies among the 417 pigs were 13.55% and 86.45% for the A and B alleles, respectively. Pigs from litters segregating both alleles (N=226 F_2 pigs) were used to determine potential associations between IGFBP2 genotype and growth, carcass and meat quality traits. For growth traits the model included fixed effects of genotype and sex, and random effects of farrowing group and finishing pen. For carcass and meat quality traits the model included the same fixed effects, random effects of farrowing group and harvest date, and covariates of carcass weight (wt) or harvest age. Additive and dominance effects were estimated by orthogonal contrasts. Genotype effects ($P<0.05$) were found for loin muscle area (LMA) at 10, 19 and 22 wk of age, ADG, carcass length, ham wt, loin wt, 10^{th} rib carcass LMA, 45 min pH, pH decline from 45 min to 24 h postmortem, CIE L*, CIE a*, subjective color score, Warner-Bratzler shear force, sensory panel muscle fiber tenderness and sensory panel overall tenderness. The IGFBP2 alleles exhibited additive effects ($P<0.05$) for LMA at 10, 19 and 22 wk of age, ADG, ham wt, loin wt, 10^{th} rib carcass LMA, pH decline, CIE L*, CIE a*, sensory panel muscle fiber tenderness and sensory panel overall tenderness. Pigs with the AA genotype had faster weight gain but smaller LMA than pigs with the BB genotype ($P<0.05$), and pigs with the BB genotype had darker meat color and improved tenderness but lower ham wt than pigs with the AA genotype ($P<0.05$). This study revealed associations of IGFBP2 genotype with growth, carcass and meat quality traits in pigs, and validation of these results in additional pig populations is warranted.

Key Words: IGFBP2, Growth, Pork quality

46 Genetic aspects of Residual Feed Intake in pigs. J. C. M. Dekkers*, W. Cai, S. Lkhagvadorj, O. Couture, C. K. Tuggle, D. Nettleton, and L. Anderson, *Iowa State University, Ames*.

Residual Feed Intake (RFI) is a measure of feed efficiency defined as the difference between observed feed intake and that predicted from average requirements for growth and maintenance. The objective of this presentation is to describe an ongoing research program to elucidate the biological and genetic basis of RFI in pigs, with the ultimate aim to develop genetic tests and indicator traits that can be used select for increased feed efficiency. The foundation of this work is a line of Yorkshire pigs that is under selection for reduced RFI. After 4 generations of selection, the low RFI line has a nearly 10% lower feed intake per d than its randomly selected control line and, after correcting for slightly lower growth rate and backfat, has reduced feed costs over the growing period by ~7%. To identify genes and genetic and metabolic pathways associated with feed intake, RFI, and feed efficiency, a series of microarray gene expression experiments were conducted, in which the expression of 20,000 genes in liver and fat tissue was investigated of pigs with high and low RFI, alternate genotypes for MC4R, and following ad libitum feeding, restricted feeding, or fasting. The impact of these contrasts on several blood parameters was also investigated. Currently planned research that aims to investigate differences between the lines in biological factors that can contribute to RFI in growing pigs, such as behavior, maintenance requirements, metabolic efficiency, immune response, etc., will also be described.

Key Words: Feed efficiency, Pigs, Residual Feed Intake

47 The role of rumen function in efficiency of feed utilization. V. Fellner*, *North Carolina State University, Raleigh*.

Feed costs are the single largest expense in feedlot and dairy production. With the increase in use of traditional grains (corn and soybean) for biofuels and the additional costs to comply with environmental guidelines the need to develop low-cost feeding strategies has never been greater. Efficiency of feed utilization is perhaps the single most important criteria affecting feasibility and profitability of an operation. Microbes in the rumen ferment dietary carbohydrates and protein into short chain fatty acids (SCFA) and ammonia to obtain energy (ATP) needed to support microbial growth. Cows use SCFA and microbial protein as the major source of metabolizable energy and metabolizable amino acids, respectively. The efficiency with which cows convert dietary energy and protein into nutrients is not high and tends to vary considerably. Much of this inefficiency occurs in the rumen and the variation appears to be due to several factors related to the ruminal environment. Methane, a major end product of ruminal fermentation is essential for the disposal of hydrogen and maintenance of normal rumen function. However, it also represents carbon energy loss to the animal. Although, there is considerable variation between measures of feed efficiency, data suggest a significant correlation between digestibility, methane production and animals that are more efficient at utilizing feed energy. A better understanding of microbial energetics of ruminal fermentation will help identify sources of variation and provide a basis for genetic manipulation of rumen microbes to enhance efficiency of nutrient use.

48 Genomic architecture of energy utilization and its role in beef cattle efficiency. M. Allan*, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE*.

Historically, academia revisits energy utilization every 10 to 15 years with each cycle providing some benefit to the producer. The lack of progress in factors limiting the understanding of the genetics of energy utilization include the difficulty and costs to accurately measure individual intakes, beef cattle's long generation interval, difficulty in definition, and a need for evaluation in the producing adult, as well as the growing/finishing juvenile. With 70 to 80% of the total variable costs in beef production associated with feed costs, any improvement in feed efficiency will have a significant impact in profitability in seg-

ments of beef production. Heritability estimates of feed efficiency range from 0.28 to 0.44 suggesting feed efficiency can be improved through genetic selection. Technology has developed to the point that we can better measure, record and analyze phenotypes, and implement selection for energetic efficiency. Application of marker-assisted selection is limited by a lack of information on quantitative trait loci (QTL) that are representative of U.S. beef cattle populations and understanding the correlated responses for many production traits. Identification of QTL is needed to devise an optimum sampling strategy to maximize genetic change and minimize costs of phenotyping and genotyping of animals. Feed efficiency projects at USMARC are structured to provide information to map QTL in the producing female at two life stages (growing and mature) and during the finishing phase in castrate males. Genetic correlations for a wide variety of traits, including multiple components of energy utilization, will be evaluated looking at all segments of the beef cattle production cycle. Genetical genomics will be applied to further define the functional biology underlying the genetic regulation by merging the use of transcript abundance and products of metabolism with over 50,000 SNP markers per animal.

Key Words: Feed efficiency, Cattle

49 Residual feed intake of heifers sired by high or low residual feed intake EBV Angus bulls. J. Minick Bormann*, D. W. Moser, and T. T. Marston, *Kansas State University, Manhattan.*

The objective of this study was to determine differences in performance of progeny of bulls with divergent genetic merit for residual feed intake. Angus bulls with high and low residual feed intake (RFI) EBV were selected from the Australian Angus Association sire summary. The average EBV of the three low RFI (efficient) bulls was -0.48 kg, and the average EBV of the two high RFI (inefficient) bulls was 0.33 kg. These sires were mated to Angus cross commercial cows from the Kansas State University Cow-Calf Unit in spring of 2005. The resulting heifer calves (n=50) were blocked by sire into two groups, and feed intake data was collected on each group using the Calan® gate feed intake measuring system for 42 days. After the feed intake test was completed, the gain test was continued so that the heifers were on gain test for 58 days. Heifers were allowed ad libitum consumption of a high-roughage, complete diet. Biweekly body weights were used to calculate a regression to determine mid-test body weight and average daily gain. Actual feed intake was regressed on mid-test metabolic body weight and average daily gain for the test group to calculate a predicted feed intake for each heifer. RFI was calculated by subtracting the actual intake from the predicted intake. Test group was used as a fixed effect in all analyses. LSMeans for heifer RFI were -0.24 kg for heifers sired by low RFI EBV bulls, and 0.29 kg for heifers sired by high RFI EBV bulls ($P = 0.1799$). LSMeans for heifer feed to gain ratio were 12.14 kg/kg for heifers sired by low RFI EBV bulls, and 12.52 kg/kg for heifers sired by high RFI EBV bulls ($P = 0.8668$). Average daily gain of heifers sired by low RFI bulls (1.19 kg/day) was similar to that of heifers sired by high RFI bulls (1.23 kg/day) ($P = 0.47$). The regression of heifer RFI on sire RFI EBV was 0.63 kg of heifer RFI per kg of sire RFI EBV, which is similar to the 0.50 kg of heifer RFI per kg of sire RFI EBV that would be expected. Preliminary results show that differences in daughter RFI were similar to what was predicted by the sire RFI EBV.

Key Words: Residual feed intake, Breeding value

50 Relationships among measures of feed utilization, ADG, and ultrasonic measures. K. A. Gray*, G. B. Huntington, M. H. Poore, C. S. Whisnant, and J. P. Cassady, *North Carolina State University, Raleigh.*

The objective was to estimate phenotypic relationships among measures of feed utilization and economically important traits in beef cattle. Data were from 121 registered Angus bulls from the NCSU Historic Angus Herd which is maintained at the Upper Piedmont Research Station in Reidsville, NC. Means and standard deviations for BW and age were 263 ± 37.8 kg and 267 ± 19.5 d, respectively. Bulls were blocked based on BW and sire into groups of 12, adapted to a corn silage-based diet (140g CP, 1.73 Mcal NEm and 1.22 Mcal NEg per kg DM), and trained to use Calen gates. Feed offered was recorded daily and used to calculate DMI. Bulls were weighed every 14 d for 84 d and ADG was determined by linear regression of weight on time. Means and standard deviations for ADG and DMI were 1.52 ± 0.23 DMI/d and 7.25 ± 1.12 kg/d, respectively. Feed conversion ratio (FCR) was calculated by taking average DMI of each bull divided by ADG. Residual feed intake (RFI) was calculated based on NRC equations (NRFI). Alternatively, RFI was also calculated with a model including the dependent variable DMI, fixed effects of year and age of dam, and regression covariates 42-d mid weight and ADG (RRFI). Partial correlations were calculated using a model including fixed effects of year, pen, and sire nested within year. Fixed effects of year and aged of dam and covariates 42-d mid weight and ADG effected RRFI ($P < 0.05$). Phenotypic correlations between NRFI with RRFI, FCR, BW, and ADG were 0.91, 0.73, 0.40, and -0.27 ($P < 0.01$), respectively. The phenotypic correlation between RRFI and FCR was 0.85 ($P < 0.01$). Relationships between feed utilization calculations and ultrasonic measurements of i.m. fat, LM area, rump fat and rib fat were not statistically different from zero. As expected, NRFI and RRFI were highly correlated. Both NRFI and RRFI were highly correlated with FCR. It was concluded that FCR is a good predictor of RFI. While alternative methods of calculating RFI were found to be nearly identical, RRFI was, by design, phenotypically independent of ADG and BW, and NRFI was phenotypically correlated with ADG and BW.

Key Words: Beef cattle, Residual feed intake, Efficiency

51 Recent developments in human amino acid nutrition. P. Pencharz*[1], [1]*Hosptial for Sick Children, Toronto, ON, Canada*, [2]*University of Toronto, Toronto, ON, Canada*.

The requirements for dietary amino acids are determined by the response of an outcome variable to graded levels of the test amino acid ranging from well below to well above the requirement level. Due to the high variability between subjects in humans it is important that subjects be fed across the range of test amino acid intakes, ideally a minimum of 3 below requirement and 3 above requirement. Next non-linear regression techniques need to be applied to analyze the data to define the mean requirement. We have extensively applied two-phase linear regression cross-over analysis to define a break-point which is a measurement of mean requirement. In addition by determining the confidence interval of the break-point we obtain an estimate of the mean plus 2 SD. Until recently amino acid requirements were based on studies which used nitrogen balance as the end-point. However in adults and children, nitrogen balance is an insensitive parameter. Further only two, of the many studies in the field, conducted serial intakes of the test amino acid, within the same subject. The late Dr Vernon Young introduced direct oxidation as a technique to determine essential amino acid requirements and his results suggested that dietary essential amino acid requirements had been significantly underestimated by the nitrogen balance studies. In hind sight the problem was the lack of sensitivity of nitrogen balance. Our group introduced the indicator amino acid oxidation (IAAO) technique as a novel method of determining amino acid requirements in humans based on earlier studies in piglets, lead by Dr Henry Bayley. This method is based on the assumption that since there is no storage of essential amino acids when one is limiting all the other essential amino acids are oxidized. So, when an essential amino acid (phenylalanine, lysine and leucine have been used) is used as an indicator, the indicator is either oxidized or is incorporated into protein (protein synthesis). Hence oxidation which is measured as the appearance of the tracer in breath as 13CO2 is inversely proportional to whole body protein synthesis. IAAO has become recognized as the "gold standard method" to determine amino acid requirements.

52 Cyst(e)ine imbalance and its effect on methionine precursor utilization in chicks. R. N. Dilger* and D. H. Baker, *University of Illinois, Urbana*.

Four 9 or 12-d chick growth bioassays were done in batteries using 2 different Met-deficient diets: a purified amino acid-based diet containing (by analysis) 20.3% CP, 0.12% Met, and 0.05% cyst(e)ine, and an AA fortified corn-peanut meal diet containing 19.6% CP, 0.23% Met, and 0.27% cyst(e)ine. Feed-grade DL-Met (99%) was compared to feed-grade DL-OH-Met, Ca (84%). When the purified diet was modified to contain 0.12% Met and 0.20% or greater cyst(e)ine, slope-ratio assays involving graded dosing of DL-Met (M) (0, 404, 808, and 1212 mg DL-Met/kg) or isosulfurous levels of DL-OH-Met, Ca (OH-M) resulted in linear ($P < 0.01$) weight gain and gain:feed responses. Multiple linear regression analysis (gain vs. supplemental sulfur intake, R2 = 0.98) resulted in an average bioefficacy estimate of 78.1% for OH-M vs. M (equivalent to 65.6% on a supplemental compound basis). In assay 3, the purified diet was modified to be equally deficient in Met and cyst(e)ine (i.e., 0.12% Met, 0.12% cyst(e)ine). When this diet was supplemented with either 404 mg M/kg or 476 mg OH-M/kg, weight gain and gain:feed responded ($P < 0.01$) markedly to either compound, and differences between M and OH-M were not significant ($P > 0.10$). Assay 4 employed the corn-peanut meal basal diet that contained the same level of bioavailable Met and cyst(e)ine (0.23%). Addition of either 465 mg M/kg or 554 mg OH-M/kg resulted in increased ($P < 0.01$) weight gain and gain:feed, regardless of supplemental L-cystine level. With no added cystine, responses to M and OH-M were similar, but with 0.10% added cyst(e)ine from either L-cystine or feather meal, M responses greatly exceeded ($P < 0.01$) those of OH-M. The small excess of cyst(e)ine, regardless of source, depressed ($P < 0.01$) feed intake and weight gain when added to the basal diet or the diet with added OH-M, but not when added to the diet with added M. These results suggest that excess dietary cyst(e)ine in Met-deficient diets is both anorexigenic and pernicious to OH-M utilization.

Key Words: Bioefficacy, Cysteine, Methionine

53 Amino acid idiosyncrasies of the cat. Q. Rogers*, *University of California, Davis*.

Some key idiosyncrasies related to amino acid (AA) nutrition of the cat include: 1) high nitrogen requirement for maintenance, explained by lack of down regulation of the nitrogen and urea cycle enzymes; 2) arginine deficiency causes severe hyperammonemia, explained by the very low activity of P5C synthase in the small intestine; 3) threonine deficiency causes neurological problems, cause unknown; 4) phenylalanine-tyrosine deficiency causes fading of colored hair, explained by a higher metabolic concentration of tyrosine required for melanin synthesis; 5) neither dietary AA imbalances nor excess AAs, e.g., leucine (except methionine), depresses growth rate, explained by the lack of food intake depression caused by AA deficiencies; 6) dietary essential AA deficiencies or excesses are neither selected or avoided, explained by lack of neuro-sensing of AAs to maintain homeostasis; 7) excess protein is avoided if it causes metabolic acidosis, the neuro-cause of decreasing food intake not known; 8) taurine is a dietary essential, quantitatively it may be large as a result of low synthesis and small intestinal bacterial overgrowth, hydrolyzing taurocholic acid and further destroying taurine. 9) urinary excretion of felinine, a territorial marker. After 30 years of studying the nutrition and metabolism of the cat, we have become convinced that the first 8 idiosyncrasies listed above are generally true for all "strict carnivores". There are various behavioral and metabolic reasons for this nutritional uniqueness. Cats will hunt and catch prey, even when not hungry. They are sensitive to texture, indifferent to sweetness, less aversive to bitter, aversive to medium chain triglycerides, attracted to certain amino acids, peptides and acid phosphates and have a weak thirst drive. Metabolically, they are adapted to effectively utilize animal tissue. Thus, the results of our research at first appears unique, but we conclude that the requirements of this desert animal are fully met and explained by the evolution of the domestic cat eating and adapting to the nutrient composition of small prey.

Key Words: Cat, Amino acids, Protein

54 The valine requirement of the young pig and its significance in practical feed formulation. A. M. Gaines*[1] and D. C. Kendall[2], [1]*The Maschhoffs Inc., Carlyle, IL*, [2]*Murphy Brown LLC, Rose Hill, NC*.

Much of the past amino acid research in young pigs has focused on lysine, threonine, and sulfur amino acid requirements, all of which

have economically viable synthetic amino acid sources. Although their levels are critical to maintain pig performance, the maximal inclusion of the aforementioned crystalline amino acids is determined by the requirement for valine, isoleucine, and tryptophan. In recent years we have conducted numerous studies defining the pig′s requirement for these latter amino acids in varying diet types. To determine the limiting order of valine, isoleucine, and tryptophan in corn-soybean meal based diets for young pigs we conducted an amino acid deletion study. This study was conducted in 11 kg pigs (TR-4 × C-22) and utilized a basal diet containing 0.625% L-lysine HCl with the addition of L-valine, L-isoleucine, and L-tryptophan. To validate the basal diet a practical diet containing 0.275% L-lysine HCl was also included. The deletion study indicated that valine was more limiting than either isoleucine or tryptophan. Because valine was found to be more limiting than either isoleucine or tryptophan subsequent studies focused on the valine requirement of the young pig in corn-soybean meal based nursery diet formulations. The TID valine requirement from 8 to 12 and 12 to 20 kg was determined to be 0.92 and 0.78%, respectively. Based on the lysine requirement needs for pigs of this weight range and genotype this corresponds to a TID valine:lysine ratio of approximately 65%. This estimate is consistent with our previous ratio estimates in 13 to 32 kg pigs. The practical implication of this research is that valine limits the aggressive use of crystalline amino acids in corn-soybean meal based nursery diets. However, with L-valine becoming more economically feasible, it allows nutritionists to utilize more aggressive amounts of crystalline amino acids in nursery diets replacing more expensive specialty protein sources.

Key Words: Valine, Swine, Growth

55 Determination of the lysine requirement and the order of limiting amino acids in diets for 20- to 40-kilogram pigs. M. Roux[1], A. Donsbough*[1], A. Waguespack[1], T. Bidner[1], L. Southern[1], and R. Payne[2], [1]*LSU Agricultural Center, Baton Rouge, LA,* [2]*Degussa Corporation, Kennesaw, GA.*

Experiments (Exp.) were conducted for 27 or 28 d to determine the Lys requirement and order of limiting AA in diets for grower pigs. Treatments had 4 to 6 reps with 4 to 6 crossbred barrows or gilts per pen. Plasma urea nitrogen (PUN) was determined at the start and end of each Exp. Experiment 1 had 4 treatments: 0.830, 0.872, 0.913, and 0.955% standardized ileal digestible (sid) Lys (by adding supplemental Lys, Thr, Met, and Trp). There was a quadratic effect ($P < 0.08$) in ADFI (1,737, 1,641, 1,663, and 1,717 g/d) and GF (0.42, 0.44, 0.47, and 0.42). Experiment 2 had 5 treatments: 0.747, 0.788, 0.830, 0.872, and 0.913% sid Lys. There were linear increases ($P < 0.04$) in ADG (678, 698, 741, 741, and 744 g/d) and GF (0.42, 0.41, 0.44, 0.45, and 0.44). Broken-line analysis of ADG and PUN indicated the sid Lys requirement was 0.84 and 0.82%, respectively. Experiment 3 had 5 treatments containing 0.830% sid Lys by adding 0, 0.12, 0.19, 0.26, and 0.34% supplemental Lys (with Thr, Met, and Trp) but no other AA. Gain (739, 714, 740, 708, and 663 g/d), GF (0.46, 0.44, 0.46, 0.44, and 0.39), and PUN (11, 9, 7, 5, and 3 mg/dL) were linearly decreased ($P < 0.01$) as AA supplementation increased. However, only pigs fed the diet with 0.34% Lys had reduced ADG and GF compared with pigs fed the control diet. Experiment 4 had 5 treatments: 1) 0.83% sid Lys, 0% supplemental Lys, 2) 0.83% sid Lys with 0.34% Lys, 3) Diet 2 + 0.046% Val, 4) Diet 2 + 0.022% Ile, 5) Diet 2 + 0.046% Val + 0.022% Ile. The ADG (738 vs. 708 g/d) of pigs fed Diet 5 was not different ($P > 0.10$) from that of pigs fed Diet 1, but ADFI (1,507 vs. 1,626 g/d) was increased ($P < 0.03$) and GF (0.49 vs. 0.44) was decreased ($P < 0.01$). The results of Exp. 4 indicate that the diet with 0.34% supplemental Lys is deficient in Ile and Val, but these two AA do not correct the deficiencies in this diet. The results of these Exp. indicate that 0.26% supplemental Lys (with added Thr, Met, and Trp) can be included into diets of 20- to 40-kg pigs, which potentially reduces dietary CP by 3.5%, without negatively affecting growth performance.

Key Words: Pigs, Amino acids

56 Regulatory science and the use of amino acids, proteins and related compounds in animal feed. G. Graber*, *AFSS Consulting, Gaithersburg, MD.*

The objective is to describe the scientific regulatory processes employed by the Food and Drug Administration (FDA) in the regulation of amino acids, proteins and related compounds used in animal feed. Under The Federal Food, Drug, and Cosmetic Act, the basic federal food (and feed) and drug law in our country, non-drug additives added to animal feed are placed in two categories: generally recognized as safe (GRAS) or food additive. The underlying scientific basis for each category is the same theoretically: i.e., there is reasonable certainty no harm will occur to animals and to people consuming food derived from animals when the GRAS substance or food additive is used at levels necessary to provide the technical effect sought. The FDA is responsible for deciding on the safety of food additives. GRAS status for an additive's intended use is attained either by showing a long history of safe use or through scientific procedures as judged by expert scientists for the intended purpose. Most nutrients, including amino acids and proteins, have been added into animal diets on the basis that they are GRAS for nutritional purposes. A few additives are permitted by regulation because sponsors of food additive petitions submitted to the FDA that provided data showing the additives were safe. A larger number of additives although considered food additives by the FDA are defined in the Official Publication of the Association of American Feed Control Officials (AAFCO) and thus are being used in animal feed as a matter of enforcement discretion by the FDA. Unsafe events have occurred with amino acids as well as other nitrogenous compounds. Economic adulteration of pet food with melamine and cynauric acid led recently to the deaths of many dogs and cats. To prevent the spread and amplification of Bovine Spongiform Encephalopathy (BSE) in the US cattle herd the FDA prohibited in 1997 the use of certain mammalian-derived proteins in the feed of ruminants.

Key Words: Regulatory science, Amino acids, Safety

57 Characterizing the ensiling properties of sugar beets with dry feedstuffs. T. C. Gilbery*, G. P. Lardy, B. W. Neville, B. A. Stoltenow, and M. L. Bauer, *North Dakota State University, Fargo.*

A study was conducted to evaluate the ensiling characteristics of chopped sugar beets with dry feedstuffs. Pre-calculated amounts of each feedstuff were weighed individually to achieve desired proportions of each silage product and thoroughly mixed for 5 minutes. After mixing, the silage was distributed evenly into three 19L buckets and sealed to provide an anaerobic environment. The treatments for this study were arranged in a 4 × 4 + 1 factorial design to determine the effects of DM level and source of dry feedstuff on the ensiling properties of sugar beets following a 42-d fermentation period. Treatments were ensiled sugar beets alone (25% DM) or based on 1) formulated silage DM concentrations of 27.5, 35, 42.5, and 50% and 2) the inclusion of dry feedstuffs (alfalfa hay, dry-rolled corn, wheat middlings, and wheat straw). Fermentation and nutritive characteristics of ensiled sugar beets were influenced with the addition of dry substrates. A linear increase ($P < 0.001$) in silage pH was observed with the addition of alfalfa, dry-rolled corn, and wheat middlings. There was a cubic tendency for pH to increase ($P = 0.08$) with the addition of wheat straw to sugar beets. Lactic acid decreased ($P < 0.001$) with the addition of wheat middlings. Percentage of lactate was not influenced ($P \geq 0.21$) with the addition of alfalfa (4.02 ± 0.24), dry-rolled corn (3.68 ± 0.75), or wheat straw (4.22 ± 0.45). A contrast was used to compare ensiling characteristics of sugar beets alone (25% DM) to 35% DM (sugar beets with dry substrates). Results indicated fermentative parameters were altered; pH increased ($P < 0.001$) for all dry substrates while lactate was lower ($P = 0.003$) for the sugarbeets ensiled with dry-rolled corn compared with sugarbeets ensiled alone. Alfalfa, wheat straw, and wheat middlings decreased ($P < 0.001$) while dry-rolled corn did not affect ($P = 0.54$) in vitro DM digestion. These results indicate the inclusion of dry feedstuffs with sugarbeets altered fermentation and with the exception of corn, decreased in vitro DM digestion.

Key Words: Dry-substrate, Ensiling, Sugarbeets

58 Impact of growing rate of gain on subsequent feedlot performance, carcass characteristics, and Warner-Bratzler shear force. B. A. Stoltenow*[1], G. P. Lardy[1], M. M. Stamm[2], and R. J. Maddock[1], [1]*North Dakota State University, Fargo,* [2]*Hettinger Research Extension Center, NDSU, Hettinger, ND.*

Seventy-nine Angus and Angus × Simmental steer calves were used in a completely random design to determine the effect rate of gain during the growing period on health status, feedlot performance, cost of gain, and carcass characteristics. Animals were stratified by body weight and allotted randomly to 1 of 10 pens (5 pens/treatment). Dietary treatments were formulated to have an ADG of 0.91 kg/d (LG) diets and 1.25 kg/d (HG). Steers were fed 70 d during the growing period. The LG diet consisted of 52.5% barley silage, 39.0% whole shell corn, and 8.5 % supplement, while the HG diet contained 43.9% barley silage, 47.4% whole shell corn, and 8.7% supplement on a DM basis. Initial body weight was not different ($P = 0.70$) between treatments. Steers fed the HG diet had increased ($P < 0.001$) ADG compared to steers fed LG diet (1.67 vs. 1.40 kg/d). Dry matter intake was greater ($P < 0.001$) for steers fed HG diets compared with those fed LG diets. Total cost was lower ($P < 0.001$) for those steers fed LG diet compared to HG diet ($105.00 vs. 120.09, respectively); however, total cost per kg of gain was not different ($P = 0.24$, $0.485/kg gain). Following the growing period, steers were fed a common diet for 135 d. During the finishing period, LG steers had greater ($P = 0.01$) DMI compared with those fed HG diets; however, ADG was not different ($P = 0.68$) among treatments. Hot carcass weight, marbling score, 12th rib fat, LM area, and USDA yield grade (363 kg, Sm^{30}, 1.33 cm, 83.8 cm^2, and 2.7, respectively) were not different ($P > 0.12$) between treatments. There were no differences ($P = 0.77$) in Warner-Bratzler shear force tenderness of ribeye steaks (3.63 kg). These data suggest that feeding steers to gain between 1.4 and 1.7 kg/d during the growing period does not affect meat quality.

Key Words: Growing, Finishing, Rate of gain

59 Read distance performance of low frequency radio frequency identification (RFID) panel transceivers varies across transponder manufacturer. S. E. Ryan*[1], D. A. Blasi[1], K. E. Fike[1], C. O. Anglin[1], A. M. Bryant[1], and B. A. Rickard[2], [1]*Kansas State University, Manhattan, KS,* [2]*Kansas Animal Health Department, Topeka, KS.*

The use of electronic animal identification technologies by livestock managers is increasing. However, the performance of these technologies in livestock production environments can be quite variable. This study was conducted to 1) determine if read distances of low frequency radio frequency identification (RFID) transceivers is affected by manufacturer of the transponder being interrogated and 2) determine if read distance of various transponder and transceiver manufacturer combinations meet the 2004 United States Animal Identification Plan (USAIP) bovine standards subcommittee minimum read distance recommendation of 61 cm. Twenty-four transceivers (transceiver manufacturers identified by # 1 to 5; n=5 transceivers/manufacturer for #1,2,4,5; n=4 transceivers for #3) were tested using 60 transponders (transponder manufacturer identified by letters A to G; n=10 transponders/manufacturer for A,B,C,D, and G; n=6 for E and n=4 for F) presented in the parallel orientation. Transceivers and transponders used all met ISO standards 11784 and 11785. Transponders represented both half-duplex and full duplex low frequency air interface technologies. The use of a mechanical tag trolley enabled the transponders to be presented to the center of each transceiver at a constant rate thereby reducing human error. Transponder and transceiver manufacturer interacted (P<.0001) to affect read distance indicating that transceiver performance was greatly dependent upon the transponder manufacturer being interrogated. Twenty-three of 30 combinations of transceivers and transponders evaluated met the minimum recommended USAIP read distance. The range in mean read distance across all 30 combinations was 37.5 cm to 121.7 cm. Maximum read distance performance of low frequency RFID technologies can be achieved by selection of specific transponder and transceiver combinations.

Key Words: Electronic identification, Cattle, Radio frequency identification

60 Factors influencing Certified Angus Beef® acceptance rates. G. D. Fike* and M. E. King, *Certified Angus Beef LLC, Wooster, OH.*

A multiple regression model quantifying the effects of independent factors affecting lot Certified Angus Beef® acceptance rate was developed

using a backwards selection procedure on two hundred forty-eight lots of beef cattle (21,350 head) from the 2005 and 2006 CAB® Feedlot Licensing Program database. Only cattle that were sired by bulls classified as solely Angus or predominantly Angus and out of straight Angus or Angus-based cows were included in this analysis. Lot CAB® acceptance rate was significantly (P<0.05) affected by gender, number of times implanted, number of harvest groups, feedlot in-weight, feed efficiency, and cost of gain. Lots consisting of heifers had a higher CAB® acceptance rate than lots of steers (33.6% vs 24.7%). Cattle that were not implanted had an acceptance rate of 38.2%, which was greater than cattle in lots implanted once (24.1%) or implanted two or more times (24.4%). Cattle implanted once had a similar acceptance rate to those implanted two or three times. Lot CAB® acceptance rate was enhanced by the number of harvest groups per lot. Lots with three or more harvest groups had a CAB® acceptance rate of 33.8% compared with rates of 23.3% and 29.6% for lots with one or two harvest groups, respectively. Calves with lighter feedlot arrival weights had higher CAB® acceptance rates than heavier cattle (–0.04072). Lots of cattle that were less efficient in converting feed into gain had higher CAB® acceptance rates (5.058). Lot CAB® acceptance rate increased as cost of gain decreased (–0.2048). Factors not having a significant effect on lot CAB® rate in this study were: year of harvest, location of the feedlot, age (calves vs yearlings), season of the year at harvest, harvest weight, days on feed, average daily gain, lot size, mortality rate, percent realizers, and medicine cost on a per head basis. These data would indicate that lot CAB® acceptance rate of beef cattle is influenced by feedlot in-weight, implant use, gender, feed efficiency, cost of gain, and number of harvest groups.

Key Words: Certified, Angus, Acceptance

61 Factors affecting lot CAB® acceptance rate of beef calves in the Iowa Tri-County Steer Carcass Futurity. G. D. Fike[1], M. E. King[1], and W. D. Busby*[2], [1]*Certified Angus Beef LLC, Wooster, OH*, [2]*Iowa State University, Ames.*

A multiple regression model quantifying the effects of independent factors affecting lot Certified Angus Beef ® acceptance rate was implemented on two hundred twenty lots of beef calves in the Iowa State University Tri-County Steer Carcass Futurity from 2003-2007. Lot CAB® acceptance rate was based on the new CAB® requirements and calculated by dividing the number of CAB® carcasses in the lot by the number of calves in the lot that were CAB®-eligible based on hide color. Lot CAB® acceptance rate was influenced (P<.05) by the following factors describing the lot: year of harvest, gender of calves, season of harvest, percent Angus, feedlot delivery weight, feed efficiency, and average daily gain. Lot CAB® acceptance rate was similar in each year from 2003-2006 but was significantly lower in 2007 than in all previous years. Heifers had a higher CAB® acceptance rate (31.7%) when compared with steers (16.9%) or mixed gender lots (18.1%). Cattle that were harvested from October through December had a lower CAB® acceptance rate (13.6%) than those harvested from January through March, April through June, or July through September (27.0%, 25.7%, and 22.6%, respectively). As the percentage of Angus genetics in the lot increased, the lot CAB® acceptance rate increased (0.093). Cattle that arrived at the feedlot at lighter weights had higher CAB® acceptance rates than heavier cattle (–0.1452). Lots of calves that were less efficient in converting feed to gain had higher CAB® acceptance rates (4.770). Lot CAB® acceptance rate increased as average daily gain increased (31.907). Factors that did not have a significant effect on lot CAB® acceptance rate in this study were: mud score at final sort, individual treatment cost per head, number of harvest groups within each lot, days on feed, cost of gain, lot size, geographic region of origin, average disposition score, adjusted final weight, and lot mortality rate. These data indicate that CAB® acceptance rate in beef calves is significantly affected by year of harvest, gender, season of the year at harvest, percent Angus, feedlot arrival weight, feed efficiency, and average daily gain.

Key Words: Certified, Angus, Tri-County

62 Effect of health on feedlot performance and carcass traits in beef calves. W. D. Busby[1], D. Strohbehn[1], L. R. Corah*[2], and M. E. King[2], [1]*Iowa State University, Ames,* [2]*Certified Angus Beef LLC, Wooster, OH.*

Calves (n=27,538) from 15 states fed at ten Iowa feedlots in the Iowa Tri-County Futurity (2002-07) were used to evaluate effect of health on feedlot performance and carcass traits. A common diet and similar implant and health programs were administered to all calves. Calf health was classified by treatment as No (NT; n=22,830), Single (ST; n=3,080), or Two or More (2T; n=1,628). Predominant cause of treatment was respiratory problems. At harvest, presence of trimable adhesions from rib cage was classified as yes (Y; n=1,105) or no adhesion (N; n=25,861). Calves were sorted and harvested when visually evaluated to have one centimeter fat cover. Effect of independent factors on continuous outcomes was performed using analysis of variance with means separated by Tukey-Kramer test. Percentages were analyzed using the Mantel-Haenszel chi-square analysis. Feedlot final weight (kg), ADG (kg/day), and days on feed for NT, ST, and 2T calves were 537, 1.46, and 170; 525, 1.39, and 179; and 519, 1.34, and 183, respectively (P<0.001). The percentage of Prime, Choice, Select, and Standard carcasses for NT, ST, and 2T were 1.2, 70.3, 26.6, and 2.0; 0.6, 61.1, 34.5, and 3.9; and 0.7, 52.7, 37.7, and 8.8, respectively (P<0.05). Treatment cost ($/head) and mortality rate (%) for NT, ST, and 2T were 0 and 0.1; 23.40 and 5.49; and 54.07 and 14.13, respectively (P<0.001). Feedlot ADG; percent Prime, Choice, Select, and Standard for carcasses with lung adhesions N or Y were 1.45, 1.1, 68.7, 27.8, and 2.5; and 1.36, 0.6, 59.9, 34.7, and 4.8, respectively (P<0.05). Morbidity rate (%) and treatment costs ($/head) for N and Y carcasses were 15.2 and 4.63; and 26.9 and 9.90, respectively (P<0.001). *Certified Angus Beef* ® acceptance rate of eligible black-hided calves for NT, ST, and 2T carcasses was 21.4, 17.2, and 14.8, respectively (P<0.001) and for N and Y carcasses was 20.9 and 14.8, respectively (P<0.001). Cattle treatment and presence of lung adhesions negatively impacted feedlot performance and carcass quality.

Key Words: Health, Lung adesions, Feedlot and carcass performance

63 Effect of varying corn price on the economics of two cattle production systems. W. A. Griffin*, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraksa, Lincoln.*

Data from the University of Nebraska calf-feeding and long yearling production systems were used to determine the effect of varying corn price on production cost and profitability of each system. The assumption that calf-feeding is a breakeven opportunity was used to determine steer purchase price at corn prices of $2.50, $3.50, and $4.50/25.6 kg. Steers entering the calf-feeding system were heavier than steer calves entering the yearling production system (292 vs. 239 kg; P < 0.01). Because calf-

feds were heavier at receiving initial steer cost was always higher for calf-feds ($P < 0.01$). Because of increased length of ownership, interest for yearlings was \$31.10 ($P < 0.01$), \$28.22 ($P < 0.01$), and \$25.46 ($P < 0.01$) higher when compared to calf-feds, at corn prices of \$2.50, \$3.50, and \$4.50/25.6 kg, respectively. Feed cost increased with increasing corn price and was \$45.73 ($P < 0.01$), \$61.31 ($P < 0.01$), and \$76.88 ($P < 0.01$) higher for calf-feds compared to yearlings at \$2.50, \$3.50, and \$4.50/25.6 kg, respectively. Total costs were \$29.09 ($P < 0.01$), \$27.04 ($P = 0.03$), and \$25.49 ($P = 0.06$) higher for yearlings compared to calf-feds when corn price was \$2.50, \$3.50, and \$4.50/25.6 kg, respectively. Cost of gain for the entire production system was similar for yearlings and calf-feds ($P > 0.10$) in all corn price scenarios. Profitability was calculated using \$90.00/45.5 kg live price. Final value of yearlings was \$73.64 ($P = 0.02$) greater than calf-feds because of greater final BW for yearlings compared to calf-feds (583 vs. 520 kg; $P < 0.01$). Profitability was \$43.66 ($P = 0.05$), \$46.53 ($P = 0.04$), and \$47.90 ($P = 0.02$) greater for yearlings compared with calf-feds at corn prices of \$2.50, \$3.50, and \$4.50/25.6 kg, respectively. In conclusion, as corn price increases steer cost decreases. Additionally, interest costs decrease and feed costs increase. In all corn prices scenarios yearlings were more profitable than calf-feds because of BW gain prior to feedlot entry utilizing less expensive forage resources and byproducts.

Key Words: Corn price, Production system, Steers

64 Metabolism of sulfur in the rumen. L. Kung, Jr.*, *University of Delaware, Newark.*

Sulfate reducing bacteria in the rumen, obtain energy via oxidation of various organic susbstrates and use sulfate as an external electron acceptor. Sulfate is reduced to sulfides in this process. Because the rumen pH is generally acidic, hydrogen sulfide is the predominate sulfide in the rumen. Consumption of excess sulfur or sulfate in feed or water, leading to excessive hydrogen sulfide production, has been implicated as the cause of some cases of polioencephalomalacia (PEM). Whether this effect is directly due to the toxicity of sulfides or to the destruction of thiamine by hydrogen sulfide is controversial. Although cases of PEM are not common, the effects of high levels of sulfides on the host animal are not well documented and this compound has deleterious effects on many tissues and functions. Identification of feeds and water high in sulfur and proper balancing of rations can reduce the chance of excess sulfur consumption. Including compounds in the diet that inhibit sulfate-reducing bacteria and reduces sulfide production may be another useful strategy to minimize sulfide production in the rumen. However, most biocides used to control sulfide reducing bacteria in the environment do not appear to be feasible candidates because of their potential toxicity toward other rumen bacteria and the host animal. For example the ability of molybdenum to inhibit sulfide production in ruminal fermentations has been reported but the potential for molybdenum toxicity is high. Clay minerals have inhibited sulfate reduction in sediments and this action may be associated with aluminum. Several feed additives approved for use in the US, for example oxytetracycline and chlortetracycline, appear to have some ability to decrease sulfide production in in vitro fermentations. The compound 9,10 anthraquinone, an experimental compound, has also been shown to be a potent inhibitor of sulfate reduction.

Key Words: Sulfate reducing bacteria, Hydrogen sulfide, Rumen

Extension - Dairy

65 Novel techniques to improve the measurement of neutral detergent fiber digestibility. D. K. Combs*, G. P. Goeser, and P. C. Hoffman, *University of Wisconsin, Madison.*

An accurate and precise estimate of neutral detergent fiber digestibility (NDFD) is critical because the fiber component can account for as much as 30% of the energy value of forage. Forage NDFD is positively correlated with intake and milk production in dairy cattle, and provides information regarding intake and performance that are not necessarily predicted by analysis of total fiber. Commercial forage testing laboratories report that up to half of all forage samples submitted are analyzed for NDF digestibility. Many procedures are used to measure neutral detergent fiber digestibility and methods are not standardized among labs. Most NDFD assays are based upon the *in vitro* method of Goering and Van Soest (1970) which was originally intended to measure apparent and true dry matter digestibility of forage after extensive fermentation times (48 hr). Currently, laboratories determine fiber disappearance after *in vitro* fermentations of 20, 24, 30, 36 or 48 hours. There is controversy as to which endpoint most accurately represents the forage energy value for lactating cows and there is little *in vivo* data to support the various procedures. There also is little consistency in NDFD results between labs and NDFD assays are not very repeatable from run to run within labs. This presentation will summarize the results of research that has focused on improving the precision of an *in vitro* method for determination of forage NDF degradation. Factors that contribute to the errors in precision and accuracy of fiber degradation estimates will be summarized.

66 The interaction of starch particle size and storage proteins on corn silage starch hydrolysis potential. A. E. Dorshorst and P. C. Hoffman*, *University of Wisconsin, Madison.*

Principal components affecting in vivo starch digestion of corn in lactating dairy cows are starch particle size, moisture content and endosperm type. These principal components have also been demonstrated to be related to lactation performance of dairy cows. Despite abundant research linking performance of dairy cows to particle size, moisture content and endosperm type of corn fed the principal components of starch digestion have been challenging to measure. Recent research from the University of Wisconsin has identified the potential to use NIRS to directly predict starch particle size in corn silage. Maturity and genetic influences on corn endosperm type are not directly measured and corn genetics are often referred to by non-quantifiable names such as floury, flint, opaque, translucent, vitreous, etc. Chemical composition of corn endosperm as influenced by maturity and genetics is however well defined in the literature. Maturation of genetically different corn results in different storage proteins in the endosperm. Seed physiological function of endosperm storage proteins is in part to protect endosperm starch stores until imbibition mediates metabolic up-regulation. Endosperm storage proteins can be differentiated by solubility. Water and dilute salt solutions solvate albumin-globulins, 70 % aqueous ethanol solubilizes prolamins and dilute alkali solutions release glutelins. The prolamin (zein) in corn is important because zein comprises 50-60 % of endosperm protein. Zein encapsulates starch granules in a protein

matrix that is insoluble in the rumen environment. Ironically, 100 year old laboratory techniques can be still be used to define maturity × genetic interactions on corn endosperm storage proteins. The concentration of ethanol soluble protein (zein) in corn increases with advancing maturity, is higher in flint corn vs. floury corn and is negatively correlated to starch hydrolysis potential. Routine evaluation of corn silage for starch particle size, moisture content and ethanol soluble protein (grain) has the potential to account for significant amounts of variance in in vivo corn starch digestion.

Key Words: Corn silage, Starch digestion, Zein

67 CornPicker: a partial budget approach to choosing corn hybrids for silage. M. S. Allen*, *Michigan State University, East Lansing.*

Genetic differences in corn hybrids allow the opportunity to increase farm profits by selecting hybrids with the optimal combination of yield and quality traits. Determining this optimum combination is complex because hybrids vary in several different economically important traits that affect the amount of land required, supplemental feeds, and milk yield. Selection indices simplify ranking corn hybrids for silage by combining yield and quality differences among hybrids into a single number. However, selection indices fail to consider many important biological and cost differences and cannot accurately rank hybrids according to farm profitability across farms. CornPicker is a spreadsheet developed to calculate a partial budget for evaluating effects on farm profits among different corn hybrids for silage. Calculations include only those costs and returns that change in response to the hybrids being compared and ignore those not affected. Input variables include data about specific hybrids related to yield and quality, relevant farm practices, and prices (e.g. for milk, corn grain, and soybean meal). Forage NDF concentration is used to calculate the corn silage concentration in diets because it limits feed intake and diets normally are formulated to the same or similar forage NDF concentrations. The cost of producing the required amount of corn silage is calculated as the total costs for seed, land, and other production costs, as well as the costs and DM losses for harvesting, storing, and feeding the corn silage. Cost adjustments are then made for differences in supplemental feed and milk yield. Differences in concentrations of NDF and CP between hybrids affect the amount of corn grain and soybean meal fed per year, and in vitro NDF digestibility differences affect milk yield and feed intake of lactating cows. CornPicker output is an estimate of the land required and production costs of hybrids being compared. Corn hybrids for silage should be selected using this partial budget approach because it accounts for economically important factors related to hybrid selection that vary from farm to farm and over time.

Key Words: Corn silage hybrids, Selection, Profitability

68 Fermentation – Beyond the basics. L. Kung*, *University of Delaware, Newark.*

The two major goals of fermenting feeds are to maximize the preservation of DM, nutrients and energy and to produce an end product that is stable when it is exposed to air during storage and feedout. Harvest and storage management (e.g. moisture content, speed of packing, packing density, plastic coverings, etc.) obviously affect these goals but the use of various additives can also have profound effects on these processes. There are numerous types of silage additives, but this presentation will focus only on bacterial inoculants. Traditional bacterial inoculants have been based on lactic acid bacteria that primarily produce lactic acid during anaerobic conditions. These inoculants have their major effects on the first goal of making silage. Other inoculants have been designed to help stabilize silages when they are exposed to air. The most successful organism in this category is *Lactobacillus buchneri*. This bacterium is able to anaerobically convert small amounts of lactic to acetic acid, the later being an effective antifungal agent. Recently, certain strains of this organism have been identified that produce an enzyme ferulic acid esterase, which has the potential to increase the digestibility of fiber. This presentation will discuss the supportive data for using bacterial inoculants and ways to ensure their effectiveness through correct handling and applications procedures.

Key Words: Silage, Inoculant, Aerobic stability

69 The fawlty towers of corn silage. F. Owens* and B. Mahanna, *Pioneer Hi-Bred, A DuPont Business, Johnston, IA.*

Numerous myths have hindered progress in selection, management, and utilization of corn silage. Such erroneous assumptions include: a single sample of corn silage represents the total silage mass; feeding value of corn silage is not influenced by plant growth conditions;

to detect a genetic yield advantage, trials across multiple years and locations are not needed; a trial with two silos (hybrids) in one year but hundreds of cows or multiple analyses has more than one degree of freedom to compare hybrids; NDF content increases with corn silage maturity; NDF digestibility decreases with corn silage maturity; kinetically, NDF is a single chemical entity; independent of NDF content, NDF digestibility is a meaningful index of feeding value; in vitro NDF digestibility accurately predicts in vivo NDF digestibility; 90% of total tract digestion of corn silage NDF consistently occurs within the rumen; for corn plants, yields of NDF and starch are inversely proportional; because corn silage is a forage, grain content is irrelevant; starch provides less than half of the digested energy from corn silage; corn silage can contain too much starch for high producing cows; kernel processing will not increase starch digestibility of more mature corn silage; grain content and extent of kernel processing are difficult to measure; starch digestibility is not increased by fermentation; starch digestibility does not increase with longer storage of corn silage; delayed harvest and more vitreous grain markedly reduce starch digestibility; whole or part kernels of corn in feces have been digested; starch digestibility can be appraised by visually observing feces; starch digestibility cannot be easily measured with a herd of cows; fecal starch all comes from the corn silage in the diet; spoiled silage should not be discarded; heating of silage does not represent a loss of digestible energy; silage inoculants cannot reduce energy loss during and after fermentation or improve the feeding value of corn silage; milk per acre harvested is not directly proportional to tons per acre. Wisdom: Logic tempered by experience.

Key Words: Corn silage, Nutritive value, Fermentation

70 Changes in live performance and carcass composition associated with feeding diets formulated with fats and/or oils. J. K. Apple*, *University of Arkansas, Fayetteville*.

Dietary inclusion of fats and/or oils in the finishing diets of cattle and swine increases the energy density of the diet, which, in turn, results in reductions in feed intake and improvements in feed conversion efficiency. Furthermore, carcass dressing percentages, fat thicknesses/depths, and trimmable fat yields are generally increased, and lean meat yields are reduced, by including fat/oil in the finishing diet; however, the effects of dietary fat on LM area, marbling, color, and water-holding capacity are variable. In swine diets, research has shown that fats/oils can be included at levels of 10 to 15% without negatively impacting performance; however, fat is generally limited to less than 5% in cattle finishing diets to minimize the negative impact of elevated fat levels on cellulytic bacteria and protozoa and fiber digestion. The fatty acid composition of pork fat and lean is a reflection of the fatty acid composition of the diet; thus, it is possible to manipulate the proportions of PUFA, especially the health-promoting, long-chain *n*-3 fatty acids. On the other hand, the rumen microflora of cattle hydrolyze triglycerides and a large percentage of the unsaturated fatty acids are hydrogenated into SFA and MUFA, but increasing the proportion of *n*-3 PUFA in finishing diets can modify the fatty acid composition of beef, indicating that these dietary PUFA were either not completely hydrogenated or bypass rumen-hydrogenation altogether. Conversely, varying the fatty acid composition via dietary means can alter: 1) the firmness of lean and fat tissues; 2) shelf-life of fresh meats; 3) flavor and aroma of cooked meats and meat products; and 4) exportability of fresh beef and pork. Lastly, the impact of dietary fats on growth performance, carcass composition, and meat quality varies with species of animal being fed, phase of production, and the quality (moisture content, iodine value, peroxide value, free fatty acid concentration, and impurities) of the fat source.

Key Words: Dietary fat, Growth performance, Carcass composition

71 Influence of fatty acids on muscle and adipose tissue development. J. P. Schoonmaker* and D. C. Beitz, *Iowa State University, Ames*.

There is a delicate balance among the nutritional value of beef and pork, palatability, and their share of the market for meat. Designing beef and pork to meet the nutritional demands of consumers without compromising other nutritional attributes or palatability (i.e., marbling and tenderness) is essential for them to compete in a market where consumers demand a product that is healthful. Fatty acids, in addition to their role as components of meat, may play an active role in determining carcass composition. Fatty acids and their derivatives have been shown to regulate fundamental adipose cell and liver functions through modulation of the activity and abundance of key transcription factors including PPAR (α,δ,γ) and SREBP (1a, 1c, 2). The prevalent point of view today is that transcription factors act as nutrient sensors that translate changes in lipid/fatty acid concentrations from the diet into metabolic activity, leading to either fatty acid catabolism or lipid storage. The specific actions of different fatty acids are to a large extent determined by their metabolic properties. Chain-length and position and number of double bonds determine both physical and chemical properties of the fatty acids as well as their metabolic destinies. The fatty acids presented for absorption in the small intestine of pigs can be easily changed by changing the fatty acid composition of the diet. In contrast, the nature of the ruminant digestive tract results in most dietary unsaturated fatty acids being biohydrogenated in the rumen, which results in a relatively higher concentration of saturated fatty acids reaching the small intestine of ruminants compared with non-ruminants. Incomplete biohydrogenation of 18:2 in the rumen, however, results in formation of CLA, of which the *trans*-10, *cis*-12 isomer is a potent activator of lipolysis. It is possible that alterations in adipose can affect muscle (or vice versa) through metabolic cross-talk that is finely regulated. Which factors are actually responsible for this mutual cross-talk is still unclear, but fatty acids are likely candidates and manipulation of circulating fatty acids may be able to effectively alter carcass composition.

Key Words: Fatty acid, Transcription factor, CLA

72 Fresh pork quality and lipid content: Exploring the linkages. S. M. Lonergan*, R. M. Smith, and E. Huff-Lonergan, *Iowa State University, Ames*.

The contribution of lipid content to variation in technical quality, sensory quality and nutritional quality of fresh pork is a significant, unresolved issue in the pork industry. Recognition of all factors that affect fat composition is critical given recent market forces. Consumer demand and focus on human nutrition has increased efforts to alter the fatty acid profile (for example decreasing the n-6:n-3 fatty acid ratio). In other cases, introduction of new feedstuffs has the potential to produce the unintended consequences of altering lipid profile. The antagonistic relationships between carcass leanness and fat quality are fairly well documented. Leaner carcasses and leaner muscle typically contain a greater proportion of unsaturated lipids. This is of concern because the proportion of the saturated fatty acids myristic acid and palmitic acid have been demonstrated to be positively correlated with pork tenderness, while the proportion of linoleic acid is negatively correlated with pork tenderness. A high concentration of unsaturated fatty acids in fresh pork results in softer pork that is also more susceptible to lipid oxidation. Processed pork made with products with more unsaturated fatty acids is similarly compromised. Experimental evidence supports the hypothesis that greater proportions of unsaturated fatty acids result in a greater production of volatiles that may have a negative impact on consumer perception of the product. It is well understood that diet has a direct effect on lipid profile of lean pork and pork adipose tissue. Other factors, including rearing, environmental temperature, and genetics should be considered when defining how lipid profile influences pork quality.

Key Words: Fatty acids profile, Lipid content, Pork

73 Industry perspective: How does changing the fatty acid profile of the carcass alter meat characteristics and subsequent consumer acceptance? M. E. England* and A. T. Waylan Brackenridge, *Cargill, Inc., Wichita, KS.*

Fat in food has experienced a great degree of scrutiny by consumers and within the meat industry, academia, and media. Pork fat quality has previously been impacted with the use of poultry fat, high oil corn and

vegetable blend oils in feed rations. Increased utilization of DDGS in both the number of producers utilizing the by-product and the levels being fed have also raised awareness on the potential impact to the meat processing characteristics. The ruminant digestive process reduces the level of susceptibility to unsaturated fatty acids and the subsequent softening that occurs in the fat; however feeding high levels of unsaturated fats can reduce the degree of saturation level within the carcass. Evaluation of feeding regimens in cattle has met little success in the attempt to elevate the levels of PUFA levels in beef. These trials also had a negative impact on cooked flavor and shelf life traits. Higher percentages of PUFA in swine diets may not only impact the shelf life of fresh products, but also processing attributes. Fatty acids are on the forefront not only for feeding concerns and their impact fat quality, but also the perceptions that consumers have about different types of fatty acids. Furthermore, fatty acids have entered the political arena with local governments forcing restrictions around the usage of trans-fats. A number of issues are at hand with today′s average consumer, as more than half of shoppers looked for health claims when making purchases at the supermarket in 2006. Therefore, supermarkets are focused on making meals easier, fresher, and healthier to meet the demands of the multiple generations of today′s consumers. Consumers expect convenience, ready to cook and pre-prepared fresh foods are popular with 75% of shoppers that are currently dining at home for at least three nights per week. Ready to eat meals top the strategy list of retailers with health claims and concerns being in the top five. Despite the demand for convenience, new product flavors and health claims, the base product has to be functional for both processing characteristics and sensory attributes.

Key Words: Fat, Consumers

74 Impact of growth-promoting antibiotics on development and persistence of antibiotic resistance in nursery and finishing pigs. J. P. Holt*, E. van Heugten, A. K. Graves, M. T. See, and W. E. M. Morrow, *North Carolina State University, Raleigh.*

A total of 200 gilts (initial BW = 6.2 ± 0.003 kg), were allotted by BW and to one of four treatments (trt) in a 2 × 2 randomized complete factorial block design. Pigs were fed diets consisting of: control in nursery and finishing (CC), antibiotic (chlortetracycline, CTC, 55 mg/kg diet) in nursery, control in finishing (AC), control in nursery, antibiotic (virginiamycin, VIR, 11 mg/kg diet) in finishing (CA), or antibiotics throughout (AA). Fecal samples were collected at week 0, 1, 3, 5, 7, 9, 13, 17, and 19. Fecal coliforms and *enterococcus* (ENT) were isolated and tested for resistance to CTC and VIR. At week 0, coliform resistance to CTC and VIR, respectively, were 68 and 73%, decreased to 35 and 41% at week 1, increased to 68 and 74% at week 5, decreased to 62 and 62% at week 7, then increased to 90 and 96% at week 19 (time effect, $P < 0.001$). At week 7, coliform resistance to CTC and VIR, respectively, was greater for CC (72 and 73%) compared to AA (54 and 49%, time × trt effect, $P < 0.004$). At week 9, coliform resistance to CTC and VIR, respectively, was greater for AC (85 and 88%) compared to AA (64 and 70%, time × trt effect, $P < 0.004$). At week 17, coliform resistance to CTC was greater for CA (98%) than AC (86%, time × trt effect, $P < 0.004$). ENT resistance to CTC and VIR, respectively, was 75 and 71% at week 0, increased to 88 and 90% at week 5, decreased to 31 and 34% at week 9, then increased to 62 and 64% at week 19 (time effect, $P < 0.001$). ENT resistance to CTC at week 7 was lower for CC (55%) compared to AA (76%), AC (74%) and CA (83%, time × trt effect, $P < 0.001$). At week 9, ENT resistant to CTC and VIR, respectively, was lower for CC (15 and 18%) than AA (31 and 40%), AC (35 and 35%), and CA (44 and 43%, time × trt effect, $P < 0.001$). Antibiotic resistant bacteria fluctuate over time and persist regardless of the use of antibiotic growth promoters. Funding for this research was provided by the National Pork Board.

Key Words: Antibiotics, Resistance, Swine

75 Survey of swine nutrition and feed industry practices in the United States for development of a national swine nutrition guide. M. S. Carlson*[1], S. D. Carter[2], J. M. DeRouchey[3], D. J. Meisinger[4], D. E. Reese[5], B. T. Richert[6], K. J. Stalder[7], H. H. Stein[8], E. van Heugten[9], and M. H. Whitney[10], [1]*University of Missouri, Columbia*, [2]*Oklahoma State University, Stillwater*, [3]*Kansas State University, Manhattan*, [4]*US Pork Center of Excellence, Ames, IA*, [5]*University of Nebraska, Lincoln*, [6]*Purdue University, West Lafayette, IN*, [7]*Iowa State University, Ames*, [8]*University of Illinois, Urbana*, [9]*North Carolina State University, Raleigh*, [10]*University of Minnesota, Mankato.*

Historically, 60 to 65% of the total production costs for a farrow-to-finish swine operation were feed costs. However, with the prospect of higher long-term feed prices, that percentage will likely increase. The National Swine Nutrition Guide (NSNG) will include nutritional recommendations by production phase and a simple least-cost diet balancing program to assist those responsible for developing and managing swine feeding programs. In order to ensure that the NSNG is current and relevant to the pork industry, a 16-question survey was conducted. There were 21 respondents (66% response rate) that represented commercial feed manufacturing companies, integrated production operations, genetic companies, independent feed manufacturers, and nutritional consultants (representing over 75% of U.S. pig production). Results showed 71% recommend or use a four-phase nursery feeding program with a range from 2 to 6. Reported average weaning wt for the nursery program was 5.4 kg with a range from 4.5 to 6.8 kg. The average ending wt of pigs leaving the nursery was 22.7 kg with a range from 20.5 to 31.8 kg. For the growing and finishing period, 86% recommend or use a five-phase feeding program plus a ractopamine phase from 22.7 kg to 123.8 kg (118.2 to 129.5 kg market wt). Half of those surveyed recommend feeding gilts a separate diet during gestation. To establish amino acid requirements, 76% use the 1998 NRC plus current literature or internal data. When formulating diets, 95% use ME, 33% use total amino acids, and 86% use percent of the diet for expressing nutrient requirements. When working with clients, 100% use ME, 86% use total amino acids, and 76% use percent of the diet for expressing nutrient requirements. Survey results suggest that the majority of the swine nutrition and feeding recommendations are similar across the industry. These survey results will support the development of the NSNG by including information that is most relevant to the swine industry.

Key Words: Swine, Nutrition, Feeding

76 A production barrow show that focuses on lean gain and pork quality at the Missouri state fair. M. S. Carlson*[1], C. L. Lorenzen[1], R. Disselhorst[1], and L. Wilson[2], [1]*University of Missouri, Columbia*, [2]*Missouri Department of Agriculture, Jefferson City, MO.*

The MO State Fair Growth and Quality Barrow Classic (MOGQBC) is an alternative to the traditional barrow show where pigs are judged

only on visual appraisal. The MOGQBC show is open to 4-H, FFA or adults and combines visual appraisal with fat-free lean gain (FFLG) and pork quality [color (L*), pH (24 hr), loin muscle tenderness (Warner-Bratzler shear force, WBSF) and marbling (1 to 6 scale)]. The visual score accounts for 20%, FFLG accounts for 40% and each of the four pork quality attribute accounts for 10% of the total score. MOGQBC is designed for swine exhibitors that want to show industry style pigs and involved more than 50 youth and adult producers. Exhibitors weighed pigs on test in April with a limit of 10 pigs/person. At the state fair, exhibitors can only show 4 pigs/person. From 2003 to 2007, the number of pigs exhibited at the state fair has increased from 42 hd to 107 hd and FFLG has improved from 0.31 kg/d in 2003 to 0.35 kg/d with no change in percent lean (55.5 %). In 2007, loin muscle tenderness was evaluated. The average WBSF was 3.65 kg ranging from 2.49 to 4.97 kg. There were eight breeds represented in MOGQBC which were Berkshire (n=3), Chester White (n=8), Duroc (n=18), Hampshire (n=2), Landrace (n=2), Spot (n=1), Yorkshire (n=9) and crossbred (n=61). Duroc and Yorkshire barrows had greater ADG during the 122 day test period compared to Berkshire, Chester White, and crossbred ($P < 0.05$). The highest FFLG was observed in the Duroc and Yorkshire at 0.364 and 0.365 kg/d, respectively ($P < 0.05$) compared to Berkshire. Berkshire had smaller loin eye area than Yorkshire, Duroc and crossbred ($P < 0.05$). Duroc had the highest 24 hr loin pH compared to all other breeds ($P < 0.05$). Berkshire had the lowest WBSF at 3.18 kg ($P < 0.05$). There were no growth performance measurements viable for determination of shear force with R2 less than 0.06. Production barrow shows are an excellent tool to educate youth and adults about the pork they produced and allow them to make management decisions that are most relevant to the swine industry.

Key Words: Barrow, Lean gain, Pork quality

77 Impact of weaning weight and early postweaning growth of pigs to late finishing growth when fed either corn-soybean meal based diets or low nutrient excretion diets. A. Schinckel*, B. Richert, D. Sholly, J. Radcliffe, and M. Einstein, *Purdue University, West Lafayette, IN*.

The BW growth of 1385 barrows and gilts was evaluated from 21 d weaning to 130 kg BW. The pigs were assigned to a 2 × 2 factorial arrangement of treatments. The pigs were fed a series of either standard corn-soybean meal based control diets (CON) or low nutrient excretion (LNE) diets from one week postweaning to 130 kg BW and assigned to either deep pit or pull-plug manure storage treatments. The pigs were weighed at weaning, 7 and 14 d postweaning, and biweekly intervals after 28 d postweaning. Mixed model nonlinear equations including pig specific random effects were evaluated for the Generalized Michaelis-Menten (GMM) function ($R^2 = 0.998$, RSD = 1.71 kg). The serial postweaning BW data for each sex-treatment group was fit to the GMM equation. The relationships of weaning BW to late finishing BW′s and days to 125 kg BW were different for each dietary treatment ($P < 0.05$). Late finishing BW′s and days to 125 kg BW had nonlinear relationships with weaning BW for pigs fed the LNE diets, and linear relationships for the CON pigs ($P < 0.05$). A one kg change in BW for CON pigs at weaning, 7, 14 and 28 d postweaning ($P < 0.01$) was predicted to reduce days to 125 kg BW by 3.71, 3.99, 3.30 and 2.26 d, respectively. Increasing the weaning BW of the lightest pigs fed the LNE diets had a greater impact on subsequent BW′s than increasing the BW of pigs with average to above average weaning BW ($P < 0.05$). Pigs with greater weaning BW′s and greater early postweaning ADG′s required less days to achieve target market BW′s.

Key Words: Mixed effects model, Nonlinear growth functions, Pig growth

78 Effect of birth weight on growth, composition, mortality and endpoint value. J. S. Fix* and M. T. See, *North Carolina State University, Raleigh*.

Piglets (n = 1472) were individually identified and weighed within 24 h of birth to examine the effect of birth wt on growth, composition, mortality and endpoint value. Sows (n = 217) mated via pooled semen from 3 sire lines, resulted in 163 litters. The commercial sow farm experienced a clinical PRRS outbreak during the trial and used a high level of crossfostering which may have contributed to the severity. Pigs were weaned at approximately 18 d of age. At weaning 421 pigs were transported to the NCSU Swine Evaluation Station (SES) and BW was measured. The remaining pigs were transferred to three commercial nurseries. At approximately 66 d of age all pigs at SES were weighed and placed in pens of 4. All pigs in commercial nurseries were placed in pens of 20 at a commercial finisher (COMF). Mortality was evaluated for all pigs born upon finisher placement. At both facilities pigs were grouped by sex and sire line and fed the same diets. At the beginning of finish phase BW was recorded on all pigs at SES and ten randomly selected pigs from each pen at COMF. At 178 d of age BW was collected on pigs previously weighed. Also, 10th rib fat depth (BF) and longissimus dorsi area (LMA) were measured with real-time ultrasound and adjusted to 113.4 kg BW. At time of final BW a value was given to all pigs (2 = dead; 1 = BW < [mean BW - one SD]; 0 = BW > [mean BW - one SD]). This was done to simulate levels where price discounts based on wt occur at local packing plants. Birth wt ranged from 0.45 to 2.45 kg, with a mean of 1.28 kg. A 1 kg increase in birth wt resulted in increases of 0.53 kg ($P < 0.01$) BW at weaning, 2.33 kg ($P < 0.01$) BW at finisher placement and 6.25 kg ($P < 0.01$) at final BW. Neither BF nor LMA were affected ($P > 0.05$) by changes in birth wt. A 1 kg increase in BW resulted in an increase in the odds of survival at finisher placement (9.77; $P < 0.01$) and of a pig being full value at harvest (5.19; $P < 0.01$). These findings indicate that increases in piglet birth wt resulted in increased BW at weaning, entering the finisher, and marketing. The odds of survival to finisher placement and odds of being full value at harvest were greater for heavier birth wt piglets.

Key Words: Pig, Birth weight

79 Validation of flank-to-flank allometric equations in predicting weight of lactating sows and lactation weight change. R. C. Sulabo*, M. D. Tokach, S. S. Dritz, E. J. Wiedemann, R. D. Goodband, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University, Manhattan*.

Objectives of this study were to validate the use of flank-to-flank measurement in predicting weight of lactating sows and to determine if the allometric model developed for growing pigs, gestating sows, and boars can be used to accurately estimate weights of lactating sows and lactation weight change. A total of 70 lactating sows (PIC Line 1050) were weighed after farrowing and at weaning. A cloth tape was used to measure the distance from the base of the flank on one side over

the back to the base of the flank on the other side of the sow. Absolute residuals were used to estimate the accuracy of the allometric model developed on growing pigs, gestating sows and boars ($BW^{0.33}$, kg = 0.0511 × Flank-to-flank, cm + 0.5687). The mean absolute residual for post-farrowing and weaning weights of sows were 17 and 21 kg, respectively. The predicted weight of sows post-farrowing (213 kg) and at weaning (195 kg) were lower (P<0.03) than their actual weights (224 and 213 kg, respectively). The underestimation of weights may be partially explained by the unaccounted contribution of mammary gland growth throughout lactation. The predicted weight loss was also greater (18.1 vs. 11.1 kg; P<0.01) than the actual average weight loss. As an alternative, a separate lactating sow model was developed using PROC REG of SAS. Flank-to-flank measurement and BW of lactating sows was positively correlated (R^2 = 0.61; P<0.01) with the following equation: $BW^{0.33}$, kg = 0.0371 × Flank-to-flank (cm) + 2.161. In conclusion, the previously developed allometric model for predicting pig weights using flank-to-flank measurements from growing pigs, gestating sows and boars was less accurate when used in lactating sows. A separate lactating sow model developed in this experiment, may be more appropriate in estimating weights and weight loss of lactating sows, but requires further validation.

Key Words: Lactating sows, Prediction equations, Weight

Graduate Student Competitive Research Papers, M.S. Oral Division

80 Copper supplementation promotes growth of piglets in the presence of dietary ZnO and antibiotic (carbadox). V. Perez-Mendoza*[1], M. Steidinger[2], T. Ward[3], and J. Pettigrew[1], [1]*University of Illinois, Urbana*, [2]*Swine Nutrition Services Inc., Anchor, IL*, [3]*Zinpro Corporation, Eden Prairie, MN.*

Two previous experiments showed dietary Cu and Zn have additive effects. This experiment tests whether dietary Cu from organic or inorganic sources promotes pigs performance in the presence of both ZnO and antibiotic in commercial conditions of production. A total of 1008 newly weaned pigs (about 21 days old; 5.7±0.3 kg BW) were used in a RCBD; blocks were BW categories within nursery rooms. The experimental unit (n=16/treatment) was a pen with a feeder and 21 pigs; gender was balanced within blocks. All diets contained 3000 ppm Zn from ZnO (first 2 weeks only), 55 ppm carbadox, and 8 ppm Cu from $CuSO_4$ in the mineral premix. Treatments were no added Cu; 315 ppm Cu from $CuSO_4$ (25.2% Cu); or 100 ppm Cu from a Cu-amino acid-complex (CuAA; 10% Cu). Data were analyzed by 2 orthogonal contrasts to test 1) the effect of Cu supplementation, and 2) differences between Cu sources. Copper supplementation increased (P<0.01) growth rate throughout the 6 weeks (Table), and $CuSO_4$ was superior (P<0.01) to CuAA during the first 2 weeks only. Feed intake was increased (P<0.01) by Cu during the first 2 weeks but not overall; in consequence, feed efficiency was improved (P<0.001) by Cu supplementation, with $CuSO_4$ superior (P<0.001) to CuAA. These results confirm that dietary Cu supplementation, at least from $CuSO_4$, promotes pig growth in the presence of ZnO and antibiotic.

Table 1. Dietary Cu effect on productive performance after weaning [a]

Cu source =	None	$CuSO_4$	CuAA		P-value Cu	P-value Cu
Cu supp., ppm =	0	315	100	SEM	supp.	source
ADG, to wk 2, g/d	167	193	173	8	0.01	0.01
ADG, to wk 6, g/d	363	386	379	11	0.01	0.32
FI, to wk 2, g/d	197	216	204	8	0.01	0.04
FI, to wk 6, g/d	564	565	576	16	0.46	0.28
G:F, to wk 6, g/kg	645	684	660	4	0.001	0.001

[a]All treatments had 3000 ppm Zn from ZnO (during the first 2 weeks only), carbadox at 55 ppm, and 8 ppm Cu from a premix.

Key Words: Copper supplementation, Zinc oxide, Weaned pigs

81 Effects of maternal selenium (Se) and dietary restriction on glucose concentrations and placental endothelial nitric oxide synthase (eNOS) expression in the pregnant ewe. L. A. Lekatz*[1], J. J. Reed[1], R. M. Weigl[1], T. L. Neville[1], J. S. Caton[1], J. B. Taylor[2], D. A. Redmer[1], L. P. Reynolds[1], and K. A. Vonnahme[1], [1]*North Dakota State University, Fargo*, [2]*USDA-ARS, Sheep Experiment Station, Dubois, ID.*

We hypothesize the reported reduction in fetal wt, without a reduction in placental wt (JAS 85 Suppl 2: Abstr. 245, 2007), was achieved by a decrease in nutrient transport and/or vascularity during placental development. Objectives were to determine effects of maternal diet on maternal and amnionic fluid (AF) [glucose] and placental expression of eNOS and soluble guanylate cyclase (sGC). Pregnant ewe lambs (n = 64) were allotted randomly to one of 8 treatments in a 2 × 2 × 2 factorial design. Factors were Se level (initiated at breeding; ASe or HSe, 0.3 or 3.0 ppm Se), and nutritional level (100 or 60, fed to meet 100% or 60% of NRC recommendations) at different times of gestation [Mid (d 50 to 90) or Late (d 90 to 130)]. Prior to slaughter (d 130) maternal blood was obtained. At slaughter, AF samples and placentomes were obtained. Caruncular (CAR) and cotyledonary (COT) tissues were separated and frozen. Glucose was analyzed in maternal serum and AF. Multiplex real time-PCR was used to determine expression of eNOS, sGC, and 18S in CAR and COT, with eNOS/18S and sGC/18S analyzed. Maternal [glucose] was decreased (P < 0.05) in Late-60 compared with Late-100 ewes (43.05 vs. 49.32 ± 1.89 mg/dL). In AF, a Se x Mid interaction was present (P = 0.03). While Mid did not impact [glucose] in HSe ewes by d 130, AF from ASe-Mid-60 ewes had greater [glucose] compared to ASe-Mid-100 ewes (21.33 vs.14.61 ± 2.71 mg/dL). HSe-Mid-60 had less AF [glucose] compared to ASe-Mid-60 ewes (15.28 vs. 21.33 ± 2.71 mg/dL). A Se x Late interaction on CAR eNOS expression (P = 0.04) showed ASe-Late-100 had an increase in eNOS expression compared to the ASe-Late-60, HSe-Late-100, and HSe-Late-60 groups (1.19 vs. 0.83, 0.60, 0.63 ± 0.80). Expression of COT eNOS was reduced (P = 0.04) in HSe-Mid-100 compared to the ASe-Mid-100 ewes (0.71 vs. 1.15 ± 0.09) and in HSe-Late-100 compared to the ASe-Late-100 ewes (0.73 vs. 1.17 ± 0.09). Maternal diet did not affect CAR or COT sGC expression. Reductions in fetal wt may be due to altered placental function including glucose transport and/or blood flow.

Key Words: Placenta, eNOS, Sheep

82 Effect of the grains to solubles ratio in diets containing wet distillers grains fed to feedlot steers. C. M. Godsey*, M. K. Luebbe, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska, Lincoln.*

The fat content of distillers grains plus solubles is an important factor in determining the feeding value for cattle, which can be impacted by the amount of solubles added back to wet distillers grains (WDG). The objective of this study was to determine if the grains to solubles ratio in feedlot finishing diets containing WDG plus solubles affect cattle performance and carcass characteristics. WDG and solubles contained 10.0% and 27.8% ether extract, respectively. Three-hundred thirty-six yearling steers (389 ± 14 kg) were blocked by initial BW and assigned randomly to 1 of 7 treatments (6 pens/treatment). Diets were formulated to contain 20 or 40% WDG with or without solubles, with grains to solubles ratios equal to 100:0, 85:15, and 70:30 of byproduct. The balance of diets contained equal amounts of (DM basis) dry rolled corn (DRC) and high moisture corn (HMC), 7.5% alfalfa, and 5.0% supplement. Treatments were 1) corn-based diet with no WDG (CON), 2) 20% WDG (LOW20), 3) 17% WDG, 3% solubles (MID20), 4) 14% WDG, 6% solubles (HIGH20), 5) 40% WDG (LOW40), 6) 34% WDG, 6% solubles (MID40), and 7) 28% WDG, 12% solubles (HIGH40). Total dietary fat was 3.1%, 4.6%, 5.1%, 5.7%, 5.9%, 6.9%, and 8.0%, for CON, LOW20, MID20, HIGH20, LOW40, MID40, and HIGH40, respectively. No significant WDG by solubles level interaction or solubles level response (P>0.05) were observed. There were no significant differences (P>0.05) for DMI. A linear response (P<0.02) to WDG inclusion was observed for final BW, HCW, ADG, and G:F. Cattle fed increasing amounts of WDG, regardless of solubles level, had 5.5 to 6.0% greater ADG and 5.5 to 8.3% greater G:F compared to CON. G:F was 0.144, 0.152, and 0.156 for CON, 20% WDG inclusion, and 40% WDG inclusion, respectively. Fat thickness increased linearly (P<0.05) with WDG inclusion, with no effect (P>0.3) on marbling scores. Results of this study indicate a positive response can be observed for ADG and G:F as WDG inclusion (regardless of solubles level) increased.

Key Words: Distillers solubles, Finishing cattle, Wet distillers grains

83 Effects of temperature stress on growth performance and bacon quality of grow-finish pigs housed at two housing densities. H. M. White*, M. A. Latour, and S. S. Donkin, *Purdue University, West Lafayette, IN.*

Managing temperature and other housing stressors is essential to optimizing pig growth. To determine the effects of temperature and space allocation on growth performance and carcass characteristics, pigs were housed either within their thermoneutral zone, 23.9°C (TNZ), or above their thermoneutral zone, 32.2°C (TNZ+), and provided either 0.93 m^2 /pig (high spatial allocation; HSA) or 0.66 m^2/pig (low spatial allocation; LSA) for the final 35 d of the grow-finish period. Body weights were recorded on days 1, 10, 20, and 30. At exsanguination, carcass measurements were taken, and samples of backfat and belly fat were collected for fatty acid profiles. Final body weight was decreased (P ≤ 0.05) from 113 kg to 103 kg for pigs housed at TNZ+. Housing at TNZ+ decreased (P ≤ 0.05) average daily gain (ADG) compared with TNZ (0.89 vs. 0.54 kg/d) and decreased (P ≤ 0.05) average daily feed intake (ADFI) from 3.1 to 2.1 kg/d, while decreasing (P ≤ 0.05) gain to feed ratio (G:F) from 0.28 to 0.24. Housing at LSA resulted in pigs that were lighter (106 vs. 110 kg; P ≤ 0.05), decreased (P ≤ 0.05) ADG (0.78 vs. 0.65) and decreased (P ≤ 0.05) G:F (0.27 vs. 0.25) compared with HSA pigs. Housing at TNZ+ and LSA independently increased (P ≤ 0.05) iodine value (IV) and the interaction effect increased (P ≤ 0.05) IV from 66.8 to 70.4. Temperature and spatial allocation synergistically decreased (P ≤ 0.05) ratio of saturated to unsaturated fatty acids and increased (P ≤ 0.05) omega-6 to -3 ratio. The TNZ+ pigs had increased (P ≤ 0.05) percent lean of bacon, and increased (P ≤ 0.05) raw slice scores. Housing at HSA tended to reduce (P = 0.09) fatty acid synthase (FAS) mRNA expression in adipose tissue of TNZ+ pigs. The interaction of TNZ+ and LSA increased (P ≤ 0.05) FAS and tended to increase (P = 0.08) stearoyl CoA desaturase 1 mRNA. The results from this study implicate increased housing allocation as a possible production practice to ameliorate the negative impacts of temperature stress on belly weight, carcass quality, and growth performance.

Key Words: Temperature stress, Housing, Carcass quality

84 Nutritional value of flaxseed meal and its effects on pig growth and carcass composition. L. Eastwood*, P. Kish, J. F. Patience, and P. Leterme, *Prairie Swine Centre Inc., Saskatoon, SK, Canada.*

The nutritional value of flaxseed meal (FSM, containing 12% oil) was measured via digestibility studies in both growing pigs (70 kg) and adult gestating sows. The effect of FSM inclusion on the growth performance of pigs, and the fatty acid profile of their carcasses was also tested. The energy values of the FSM were 3526 kcal DE/kg DM and 2448 kcal NE/kg DM in growing pigs and 3517 kcal DE/kg DM and 2441 kcal NE/kg DM in sows. A growth study was performed on a total of 200 pigs (gilts and barrows) with initial weights of 32 kg through to market (115 kg). Pigs were blocked by gender and assigned to one of four treatment groups receiving 0, 5, 10 or 15% FSM. Diets consisted of barley, wheat, peas, and soybean meal. FSM was included at the expense of wheat and soybean meal. Diets were balanced for both digestible energy and essential digestible amino acids. The overall average daily gains of pigs were 950, 940, 910 and 920 g/d for 0, 5, 10 and 15% FSM inclusion respectively. No effect of treatment was observed for daily gains (P = 0.60), feed intakes (P = 0.43) and feed conversion ratios (P = 0.23). As expected, an effect of gender was found for average daily gain (P < 0.0001) but not for feed intakes (P = 0.19) or feed conversion ratios (P = 0.09). A total of 6 pigs per treatment group (3 barrows and 3 gilts) were randomly selected for carcass fatty acid analysis. This analysis revealed that inclusion of FSM in the diets of finishing pigs would significantly (P < 0.0001) increase the content of α-linolenic acid in backfat (2.5 mg/g tissue per additional % FSM in the diet) and in the loin (0.33 mg/g tissue). No increases in total fat in the loins were detected (P = 0.29) indicating that the increase in omega-3 is due to carcass enrichment and not due to increases in carcass fat. In conclusion, diets containing up to 15% FSM do not affect the growth performance of pigs but can increase the omega-3 fatty acid content of their carcasses.

Key Words: Pig, Flaxseed meal, Omega-3 fatty acid

85 Candidate gene association studies for hernia and cryptorchidism in commercial lines of pigs. X. Zhao*[1], Z.-Q. Du[1], N. V. Vukasinovic[2], F. Rodriguez[2], A. C. Clutter[2], and M. F. Rothschild[1], [1]*Iowa State University, Ames,* [2]*Monsanto Company, St. Louis, MO.*

Cryptorchidism and hernias (inguinal and scrotal) in pigs are complex diseases affected by genetic and environmental factors, as well as interactions between them. Several putative genomic regions contributing

to incidence of scrotal hernia were reported in a previous genome-wide scan in several commercial lines of pigs. The ensuing fine mapping work has narrowed down the areas of interest to three locations on *Sus scrofa* chromosome (SSC) 2 and one location on SSC12. We selected 64 positional candidate genes within these locations on SSC2 and SSC12, and 11 biological candidate genes on other chromosomes, respectively. All of those genes are implied in collagen metabolism, smooth muscle breakdown, cell death pathway and/or sex hormone regulation. To date we have discovered 298 SNPs, 118 of which were genotyped by Sequenom MassArray™ technology on 1,998 and 274 animals for hernia and cryptorchidism studies, respectively. A transmission disequilibrium test (TDT) was applied to a subset of 1,488 Pietrain-originated animals to test the association between allele transmission and hernia incidence (chi-square test, 1 d.f.). SNPs with a sufficient number of heterozygous parents (range from 15 to 226, each having 2.3 offspring on average) were tested independently. Six genes were found to be significantly associated with hernia incidence ($P<0.05$), with one allele being transmitted to affected animals two to four times more often than to healthy animals. Seven genes showed suggestive association ($P<0.10$) with cryptorchidism. Further statistical and experimental analyses are being conducted to confirm those associations.

Key Words: Candidate genes, Cryptorchidism, Hernia

86 Site and extent of nutrient digestion in lambs fed high-linoleate safflower fat as whole seeds, cracked seeds, or oil extracted from seeds. P. L. Price*, V. Nayigihugu, D. C. Rule, and B. W. Hess, *University of Wyoming, Laramie*.

Four wether lambs (45.5 ± 3.4 kg BW) fitted with ruminal, duodenal, and ileal canulae were used in 4 × 4 Latin square design experiment to determine effects of feeding safflower fat as whole or cracked seeds or oil extracted from seeds on site and extent of nutrient digestion. The (Control) diet (% of DM) consisted of 33.4% ground (2.54 cm) bromegrass hay, 45.2% cracked corn, 15.4% safflower seed meal, 4.0% soybean meal, 2% limestone, and < 0.1% urea. Safflower fat from high-linoleate (75.4 to 77.2% 18:2n-6) whole or cracked seeds or oil extracted from the seeds replaced safflower seed meal to provide 3% added dietary fat. Isonitrogenous diets were achieved by including additional urea to the fat-supplemented treatments. A 10-d adaptation period was followed by 4 d of duodenal, ileal, and ruminal sampling. Intake of NDF ($P = 0.53$), OM, ($P = 0.67$) and N ($P = 0.23$) did not differ among dietary treatments. Ruminal digestibility of NDF ($P = 0.55$) and OM ($P = 0.73$) were not affected by dietary treatment. Lambs fed oil extracted from safflower seeds tended ($P = 0.06$) to have greater duodenal flow of bacterial N than lambs fed Control or cracked safflower seeds with duodenal flow of bacterial N for lambs fed whole safflower seeds being intermediate. Microbial efficiency was less ($P = 0.03$) for lambs fed cracked safflower seeds compared with lambs fed the oil or whole seeds, and microbial efficiency for Control lambs was intermediate. Percentage of OM ($P = 0.59$) and N ($P = 0.77$) digested in the small intestine did not differ among dietary treatments. We conclude that nutrient digestibility was not affected by adding 3% fat to diets of growing lambs. Furthermore, whole safflower seeds do not need to be processed to improve diet digestibility.

Key Words: Lambs, Fat supplementation, Digestion

87 Effect of standing estrus on LH pulses and subsequent progesterone following a fixed-time AI protocol. S. D. Fields*, B. L. Perry, and G. A. Perry, *South Dakota State University, Brookings*.

Research has reported cows detected in estrus around the time of fixed-time AI had increased pregnancy rates compared to cows not detected in estrus. Furthermore, research has indicated that LH pulses play a critical role in CL formation/function, and an injection of GnRH following onset of estrus influenced LH pulse frequency. Therefore our objectives were to determine the effect of standing estrus on LH pulse frequency, total LH release, and subsequent concentrations of progesterone following a fixed-time AI protocol. Cows (n = 32) were synchronized with the CO-Synch protocol (d -9 100 μg GnRH; d -2 25 mg $PGF_{2\alpha}$; d 0 100 μg GnRH). Estrus was detected by visual detection with the aid of EstroTect estrus detection patches. Prior to the second GnRH injection jugular catheters were inserted in each cow (n = 5 detected in standing estrus and n = 5 not detected in standing estrus). Blood samples were collected at 15-min intervals from 0 to 6 h (bleed 1), 12 to 20 h (bleed 2), 26 to 34 h (bleed 3), and 40 to 48 h (bleed 4) after the second GnRH injection. Blood samples were also collected daily for 17 d. There was an effect of bleed on area under the curve ($P < 0.001$) as well as average concentration ($P < 0.001$) with bleed 1 having greater LH release than bleeds 2, 3, or 4. Bleed 1 had decreased ($P = 0.03$) pulse frequency compared to 2, but did not differ ($P = 0.09$, $P = 0.82$) from 3 or 4. Bleed 2 did not differ ($P = 0.55$) from 3, but had greater ($P = 0.04$) frequency than 4. Bleeds 3 and 4 did not differ ($P = 0.13$). There were no effects of treatment or treatment x time for area under the LH curve ($P = 0.50$; $P = 0.97$), average concentration of LH ($P = 0.63$; $P = 0.83$), or LH pulse frequency ($P = 0.22$; $P = 0.92$). Cows that showed estrus had greater ($P = 0.002$) subsequent concentrations of progesterone than those that did not show estrus. In summary, GnRH increased the release of LH during bleed 1 but decreased pulse frequency. Estrus did not have an effect on LH pulses, but increased subsequent concentrations of progesterone.

Key Words: LH, Estrus, Progesterone

88 Use of 20% dried distillers grains with solubles (DDGS) and high amounts of synthetic amino acids to replace soybean meal in grower-finisher swine diets. A.J. Drescher*[1], L. J. Johnston[1], G. C. Shurson[1], and J. Goihl[2], [1]*University of Minnesota, St. Paul*, [2]*Agri-Nutrition Services, Inc., Shakopee, MN*.

This study was conducted to determine the effects of feeding diets containing 20% DDGS with increasing levels of synthetic amino acids (AA) on growth performance and carcass composition of grow-finish pigs. A total of 216 crossbred pigs (BW = 39.2 ± 0.19 kg) were blocked by BW and assigned to 24 pens (9 pigs/pen). Pens within block were assigned randomly to one of 4 dietary treatments in a 3-phase feeding program. Diets were formulated on a standardized ileal digestible AA basis using AA ratios published in NRC (1998). Control diets (Trt A) were corn and soybean meal (SBM) based, and contained 0.15% L-lysine HCl (L-lys). Treatment B diets contained 20% DDGS and maximal levels of L-lys to replace SBM without Trp becoming limiting. Treatment C diets contained 20% DDGS, higher amounts of L-lys, plus synthetic Trp to replace a greater amount of SBM compared to Trt B diets. Treatment D diets contained the least amount of SBM and the highest amounts of synthetic Lys, Trp, and Thr. Pigs were weighed and feed disappearance was determined bi-weekly. All pigs were harvested when average BW reached 114 ± 1.04 kg. Pigs fed Trt D had reduced ADG and ADFI (0.88

and 2.68 kg/d, respectively; P < 0.05), and pigs fed Trt C tended to have reduced ADG and ADFI (0.90 and 2.70 kg/d, respectively; P < 0.08) compared to those fed Trt A (0.95 and 2.86 kg/d, respectively). There was no difference in ADG and ADFI between pigs fed Trt B and Trt A. Dietary treatments did not affect G:F. Final BW was lower for pigs fed Trt D (P < 0.05), and there was a trend for lower final BW for pigs fed Trt C (P = 0.09) compared to those fed Trt A diets. There were no differences in dressing %, loin depth, backfat thickness, and % carcass lean among treatments. These results suggest that adding 20% DDGS and > 0.15% L-lys to grower-finisher diets can result in acceptable growth performance, but replacing greater amounts of SBM with 20% DDGS, L-lys (>.30%), and synthetic Thr and Trp may cause reduced ADG and ADFI. Carcass characteristics appear to be unaffected by feeding diets containing 20% DDGS and high levels of synthetic AA.

Key Words: Pigs, DDGS, Growth

89 Effect of diet and sire on the rates of back fat and marbling deposition in feedlot cattle. C. O. Trejo*, L. L. Berger, and T. G. Nash, *University of Illinois, Urbana*.

Carcass value is a major factor affecting the profitability of feedlot cattle. Both diet and genetics impact quality and yield grade. The objective of this trial was to determine the impact of diet and sire on the rates of back fat and marbling deposition in feedlot cattle. Six hundred and thirty six Simmental, Angus or Simmental x Angus steers from two different experiments (experiment 1, n= 230 and experiment 2, n= 436), with known sires (n=41) from three different ranches were used in a combined data set. Six dietary treatments were used that were composed primarily of corn, wet or dry distillers grains and/or soy hulls. Ultrasonic measurements of back fat thickness, marbling score, and longissimus muscle area were recorded every 28 d and 42 d throughout the feeding period for year 1 and year 2, respectively. Individual animal was used as the experimental unit and a simple linear regression model using the REG procedure of SAS was included in the analysis. Steers were on test for an average of 168 days and gained 1.70 kg/day. Rates of back fat and marbling were not affected by diet (P>0.05). Sire affected the deposition rate of back fat deposition (P<0.05) with a range from 0.0028 to 0.0077 cm per day. Progeny of Angus sires tended to have the three highest rates of back fat deposition, while progeny of Simmental and Simmental-Angus sires had overlapping rates of back fat deposition. The range of marbling deposition was wide (0.42–1.69 1/100 quality grade per day, P<0.05) within the progeny of all the sires included. There was nearly a ten-fold difference in rates of marbling deposition per cm back fat among sires (27.79 vs. 272.18, p<0.05). Progeny of Simmental sire, HC Hummer 12M, had the highest rate (p<0.05) of marbling per cm of back fat for the finishing feeding period (272.18 unit marbling/cm BF). Selection for high rates of marbling deposition relative to back fat offers the opportunity to maintain acceptable quality while allowing a high retail yield.

Key Words: Back fat, Marbling, Rates

90 Phosphorylation of Perilipin is associated with lipolytic activity in dairy cow. D. Elkins*, H. Park, and D. Spurlock, *Iowa State University, Ames*.

Postpartum dairy cows undergo lipolysis to mobilize body energy stores in support of the energy demands of lactation. The rapid depletion of these energy stores can compromise non-production traits such as health and fertility. A greater understanding of the regulation of postpartum lipolysis is needed to better define the relationship between production and non-production traits. Perilipin (PLIN) is an adipose specific protein that coats the lipid droplet, protecting lipids from lipolysis. However, PLIN is phosphorylated by cyclic AMP protein kinase (PKA) to facilitate lipolysis. The objective of this study was to determine if expression and/or phosphorylation of PLIN is associated with lipolysis. Adipose tissue biopsies were taken from the tailhead region of early (n=11) and mid (n=10) lactation cows. All cows were multiparous with similar body condition scores. Adipose tissue was frozen in liquid nitrogen and stored at -80°C. Semi-quantitative western blotting was used to quantify protein expression and phosphorylation of PLIN using commercially available antibodies. Blood samples were collected via jugular venipuncture at the time of biopsy. Serum was separated and frozen at -80°C pending analysis of glycerol and non-esterified fatty acids (NEFA) as indicators of *in vivo* lipolysis. Glycerol and NEFA were significantly greater in early compared to mid lactation (P < 0.0001). These results confirmed an increase in lipolysis during early lactation. Expression of PLIN did not differ between early and mid lactation cows (P = .40). However, phosphorylation of PLIN was significantly greater in early lactation (P = 0.0075). Additionally, phosphorylated PLIN was highly correlated with serum glycerol (r =.72; P < 0.0001) and NEFA (r = .69; P = 0.0003), demonstrating a strong association between phosphorylation of PLIN and lipolytic activity. In conclusion, phosphorylation but not expression of PLIN was strongly associated with lipolysis in dairy cows, suggesting phosphorylation of PLIN could be an important regulator of lipolysis.

Key Words: Perilipin, Lipolysis, Dairy

91 Determining the optimum ratio of dietary tryptophan to lysine in growing pigs fed non-U.S.-type ingredients. A. D. Quant*[1], M. D. Lindemann[1], G. L. Cromwell[1], B. J. Kerr[2], and R. L. Payne[3], [1]*University of Kentucky, Lexington,* [2]*USDA, Ames, IA,* [3]*Degussa Corporation, Kennesaw, GA.*

Formulating swine diets based on an ideal protein pattern is an effective way of minimizing total dietary protein content while meeting amino acid requirements. However, the wide range of feedstuffs used in diet formulation has provoked debate regarding the optimum AA ratios. The objective of this study was to determine the optimum standardized ileal digestible (SID) Trp:Lys ratio based on growth performance and plasma urea N (PUN) concentrations in growing pigs fed diets other than the typical U.S. corn-soybean meal diet. Crossbred pigs (n=120; initial BW: 28.49 ± 2.92 kg) were blocked by BW and gender and allotted to 5 treatments with 5 pigs/pen for a 21-d study. The base diet consisted primarily of barley (30%), Canadian field peas (30%), corn (17.35%) and wheat (8%). The treatment diets were formulated by the addition of supplemental Trp to create various Trp:Lys ratios (SID/total basis; 13.05/14.36%, 14.32/15.30%, 15.58/16.24%, 16.85/17.17%, 18.11/18.50%) with a constant SID Lys level of 0.70% (total basis, 0.84% Lys). Pigs were allowed ad-libitum access to feed and water throughout the entire experimental period. Following evaluation of the linear and quadratic nature of the responses by ANOVA, broken-line regression analysis was used to determine the optimum Trp:Lys ratio. As the SID Trp:Lys increased from 13.05% to 18.11%, ADG increased linearly (0.723, 0.784, 0.835, 0.850, and 0.848 kg/d; P = 0.007). The optimum SID Trp:Lys for ADG was estimated at 15.99 using broken-line regression analysis. Plasma urea N concentrations decreased (6.81, 6.22, 5.52, 5.60, and 5.93 mg/dL) linearly (P = 0.056) and quadratically

(P = 0.067) with an optimum SID Trp:Lys estimate of 15.29. The mean optimum SID Trp:Lys ratio, then, based on ADG and PUN concentrations was calculated to be 15.64% which equates to 16.48% on a total amino acid basis for these ingredients. The SID Trp:Lys estimate is similar to a previously determined optimum of 15.67%, but the total Trp:Lys estimate is lower (16.48 vs. 17.02%) for growing pigs fed diets containing typical U.S.-type ingredients.

Key Words: Tryptophan, Lysine, Pigs

92 Exercise can improve bone quality in confined gilts. J. M. Mapes*, C. I. O'Connor-Robison, G. M. Hill, J. E. Link, D. S. Rosenstein, and M. W. Orth, *Michigan State University, East Lansing.*

Locomotor problems are second only to reproductive failure as reason for premature culling of sows. Housed in gestation crates, sows spend much of their reproductive lives with limited mobility. Inferior bone development or weakening due to inactivity can increase susceptibility to injury; however, there is little information available on bone quality of sows. The purpose of this study was to determine if exercise improves bone quality of confined gilts. Objectives were to measure bone diameter, density, and markers of bone turnover. Eighteen Yorkshire x Landrace gilts, with an average BW of 114 kg, were housed in gestation crates, which measured 0.6 m x 2.0 m. Crates limited movement to a few steps and prevented gilts from turning around. For eight weeks, nine gilts ran 217 meters five days a week (E), while the remaining nine gilts remained in their crates without exercise (C). Blood samples were collected at weeks 0, 1, 2, 4, and 8, and were analyzed for osteocalcin and pyridinoline, which are markers of systemic bone turnover. Gilts were slaughtered, and both front legs were collected. The radius, ulna, and third metacarpal bones were scanned using computed tomography for determination of cross-sectional geometry and bone mineral density (BMD). Bones were ashed and analyzed for mineral content (Ca, Mg, and P). Exercise increased serum osteocalcin concentration when normalized to day 0, indicating an increase in bone formation (P=0.027). However, exercise did not decrease serum pyridinoline concentrations when normalized to day 0, thus exercise did not decrease bone resorption relative to control serum concentration. Exercised gilts had greater radial trabecular BMD (P=0.028) and medial lateral diameter of the third metacarpal bone (P=0.026). Mineral content did not differ between treatments. In comparison with confinement alone, exercising gilts led to greater bone formation, radial trabecular BMD, and bone diameter. Greater bone formation contributes to a denser bone with greater diameter, increasing stability and structural support. Thus, even a short bout of exercise can improve bone quality in confined gilts.

Key Words: Gilts, Exercise, Bone quality

93 Performance of lactating dairy cows to increasing concentrations of dried distillers grains with solubles on milk production and composition. K. A. Christen*, K. F. Kalscheur, B. W. Pamp, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University, Brookings.*

The purpose of this study was to determine a practical upper level of dried distillers grains with solubles (DDGS) in a dairy diet. A lactation trial was designed with a 4 x 4 replicated Latin square design with 12 Holstein cows. Periods were 4 wk with samples and data collection during wk 3 and 4. Distillers grains were added to the diet at inclusion rates of 0, 12, 24, and 36% on a dry matter basis. The diets consisted of 49% forage and 51% concentrate and the forages were 33% corn silage and 16% alfalfa hay. Diets were balanced for 17.5% CP and 10.1% RDP with DDGS replacing a mixture of soybean meal, Soyplus, extruded soybeans, soybean hulls, and ground corn. Dry matter intake was similar across all treatments (24.8 kg/d). Cows fed an increasing concentration of DDGS had a quadratic response (P = 0.01) for milk yield (34.9, 31.6, 31.9, and 34.3 kg/d for 0, 12, 24, and 36% DDGS) with cows fed 0 and 36% producing the highest milk yield. Milk fat percentage (4.07, 4.25, 4.05, and 3.91%) and milk fat yield (1.38, 1.28, 1.29, and 1.33 kg/d) were not affected by dietary treatment. Increasing the concentration of DDGS had no effect on milk protein percentage (3.12, 3.12, 3.23, and 3.16%) while milk protein yield (1.07, 0.95, 0.99, and 1.06 kg/d) had a quadratic response (P = 0.003) resulting in changes in milk production. Milk urea nitrogen (14.1, 13.9, 14.4, and 13.8 mg/dL) and total solids percentage (12.9, 13.0, 12.9, and 12.8%) were similar across all treatments. Total solids yield (4.41, 3.97, 4.01, and 4.30 kg/d) resulted in a similar quadratic response (P = 0.009) as milk production. Increasing the concentration of DDGS in the diet did not affect either NPN (6.56, 6.60, 6.80, and 6.78% of total milk CP) or true CP (93.4, 93.4, 93.2, and 93.2% of total milk CP). Percentage of casein decreased linearly (P = 0.03) as DDGS increased in the diets (76.6, 76.9, 75.4, and 74.4% of total milk CP). Feeding an increasing concentration of DDGS had no effect on the concentration of protein and fat in the milk.

Key Words: Distillers grains

94 Comparison of dried whey permeate (DWP) and a carbohydrate product (CHO) in diets for nursery pigs. V. D. Naranjo*, T. D. Bidner, and L. L. Southern, *LSU Agricultural Center, Baton Rouge, LA.*

Two experiments were conducted to compare the feeding value of DWP (80% lactose) with CHO (40% lactose, 30% sucrose, and 10% glucose) in diets for nursery pigs. Weanling pigs (n = 80; initial BW of 7.29 kg and 23 ± 3 d of age [Exp. 1] or n = 150; initial BW of 7.57 kg and 26 ± 3 d of age [Exp. 2]) were blocked by sex, ancestry, and initial BW to 5 dietary treatments with 4 (Exp. 1) or 6 (Exp. 2) pens per treatment and 4 or 5 pigs per pen. In both Exp., diets were formulated to contain 1.60, 1.40, and 1.20% total Lys for Phase 1 (d 0 to 7), 2 (d 7 to 21), and 3 (d 21 to 28), respectively holding soybean meal, Na, and Cl levels constant across treatments for each phase. Dietary treatments included: 1) control (no lactose); 2 to 3) 2 levels of CHO; and 4 to 5) 2 levels of DWP. The levels of each source for each phase were: Phase 1 (Exp. 1, 12.5 and 25%; Exp. 2, 6 and 12%), Phase 2 (Exp. 1, 10 and 20%; Exp. 2, 3 and 6%), and Phase 3 (Exp. 1, 6 and 12%; Exp. 2, none, a common diet for all pigs). In Exp. 1, ADG (286, 333, and 325, g/d) and ADFI (316, 414, and 393, g/d) were improved ($P < 0.1$) when either CHO or DWP were added to the diet during Phase 1; however, there was no level effect ($P > 0.1$). Gain:feed was reduced ($P < 0.1$) for pigs fed CHO compared with pigs fed the control diet (0.87 vs. 0.81). Gain, ADFI and G:F were not affected ($P > 0.1$) by carbohydrate source or level during Phase 2, 3, and overall. In Exp. 2, ADG (g/d) and ADFI (g/d) were increased ($P < 0.1$) in pigs fed CHO during Phase 1 (296 vs. 327; 386 vs. 443), 2 (481 vs. 512; 755 vs. 826), and overall (461 vs. 488; 726 vs. 793), but there was no level effect ($P > 0.1$). During Phase 3, ADFI (955, 1,023, or 1,039 g/d) was increased ($P < 0.1$) in pigs that were fed either CHO or DWP during the previous phases, and G:F (0.60 vs. 0.57) was decreased

($P < 0.1$) for pigs fed CHO. In the overall data, ADFI was increased ($P < 0.1$) when pigs were fed either carbohydrate source. This study indicates that CHO can equally replace DWP without affecting growth performance of nursery pigs.

Key Words: Carbohydrate, Lactose, Nursery pig

Graduate Student Competitive Research Papers, Ph.D. Oral Division

95 Growth performance and the development of antibiotic resistant *E. coli* in pigs fed growth-promoting antimicrobials. J. P. Holt*, E. van Heugten, A. K. Graves, M. T. See, and W. E. M. Morrow, *North Carolina State University, Raleigh.*

A 5 week study with 232 barrows (BW 4.1 ± 1.1 kg) was conducted to determine growth performance and development of antibiotic resistance of pigs fed growth-promoting levels of antimicrobials. Pigs were blocked by BW and penned in groups of 4 or 5 (12 replicates per treatment). Pigs were fed a control (CON) diet without antimicrobials or growth-promoting levels of antibiotic (AB, tylosin/sulfmethazine, 110 mg/kg diet each), copper (CU, 240 ppm) or zinc (ZN, 3000 ppm for 2 weeks, 1500 ppm for 3 weeks). *E. coli* was isolated from fecal samples collected on d 0, 7, 21, 28, and 35 and tested for resistance to tylosin (TYL), sulfamethazine (SUL), erythromycin (ERY), neomycin (NEO) and copper (COP). Growth performance was unaffected by dietary treatment ($P > 0.05$). Resistance to ERY was lower ($P < 0.02$) for pigs fed CON (26%) than pigs fed AB (35%), CU (37%), and ZN (35%). Resistance to COP was higher ($P < 0.01$) for pigs fed AB (63%) and ZN (70%) compared to pigs fed CON (53%) and CU (54%). Resistance to TYL, ERY, and COP, respectively, was 64, 55, and 55% at d 0, increased to 75, 69, and 74% at d 7, then decreased to 60, 16, and 54% at d 35 (time effect, $P < 0.001$). Resistance to SUL and NEO, respectively, was 81 and 65% at d 0 and decreased to 45 and < 1% at d 35 (time effect, $P < 0.001$), but was unaffected by diet. At d 7, *E. coli* from pigs fed CON or CU had lower resistance to TYL (60 and 66%, respectively) compared to pigs fed AB (90%) and ZN (85%; time x trt, $P < 0.005$). At d 21, resistance to TYL was lower for CON (15%) compared to AB (54%), CU (50%), and ZN (60%; time x trt, $P < 0.005$) and resistance to SUL was lower for CON (32%) compared to pigs fed AB, CU, or ZN (68, 61, and 65%; respectively, time x trt, $P < 0.009$). However, at d 28, pigs fed CON had higher resistance (time × trt, $P < 0.009$) to SUL (61%) than pigs fed AB or ZN (36 and 24%, respectively). Antibiotic resistant *E. coli* may be increased by the use of antimicrobial growth-promoters but are present regardless of their use.

Key Words: Antimicrobials, Resistance, Swine

96 Digestibility and fermentation parameters of barleys and oats differing in β-glucan content in the pig intestines. R. Jha*[1], B. Rossnagel[2], R. Pieper[3], A. Van Kessel[2], and P. Leterme[1], [1]*Prairie Swine Centre Inc., Saskatoon, SK, Canada,* [2]*University of Saskatchewan, Saskatoon, Canada,* [3]*FBN-Ernahrüngsphysiologie, Dummerstorf, Germany.*

Isolated non-starch polysaccharides have been shown to influence the gut microflora in pigs. However, little information is available on the effects of cereals differing in NSP composition, namely in Î²-glucan. An experiment was carried out to compare the effects of hulled barleys, supplemented or not with isolated β- glucans, 4 hulless barleys with β-glucan contents ranging from 34 to 93 g/kg and 2 oat varieties. A total of 72 weaned pigs (12.8 ± 1.9 kg) were kept individually in metabolic cages and fed a diet composed of 81.5% cereal, 6% whey, 9% soy protein isolate and 3.5% minerals. Pigs were killed 4h after the last meal and intestinal contents were collected from last 1/4 of the small intestine and 30 cm of medial colon. The ileal and colon contents were analyzed for dry matter, pH and short-chain fatty acids (SCFA). Ileal and fecal dry matter digestibility were determined using acid insoluble ash as a marker. Feed intake and body weight were also recorded. SCFA concentration did not differ among hulled barleys, hulless barleys and oats ($P > 0.05$) in ileum whereas in colon, SCFA was markedly (>50%) lower ($P < 0.05$) in pigs fed oats. Ileal digestibility was higher ($P<0.05$) for diets based on hulless barleys (75% on average), as compared to hulled barleys (62%) and oats (55%). Similar trends were found for total tract digestibility, varying from 90% in hulless barley (varieties SB 94893 and SB 90300) to 68% in oats (variety Sol-Fi). In conclusion, low-NSP content hulless barleys demonstrated the expected increase in digestibility, however, marked differences in fermentation parameters were not observed among cereals with the exception of oats, for which colonic fermentation appeared low.

Key Words: Pig, NSP, Fermentation

97 Effects of corn processing and wet distiller's grains on metabolism in steers. M. E. Corrigan*, G. E. Erickson, T. J. Klopfenstein, N. F. Meyer, C. D. Buckner, and S. J. Vanness, *Unversity of Nebraska, Lincoln.*

Previously we have reported an interaction of corn processing method (CPM) and wet distiller's grains with solubles (WDGS) level on G:F in finishing steer diets. Therefore, 7 ruminally-fistulated steers were used in a 6 period cross-over design to determine effects of WDGS inclusion level and CPM on digestibility and ruminal fermentation characteristics. A 3 × 2 factorial arrangement of treatments was used. Diets were based on dry-rolled (DRC), high-moisture (HMC), or steam-flaked corn (SFC) and contained either 0 or 40% WDGS (DM basis). No CPM × WDGS level interaction was observed in this study ($P > 0.10$). Steers fed 0% WDGS had decreased ($P \leq 0.02$) intake of DM (8.3 vs. 10.1 kg), OM (8.2 vs. 9.7 kg), NDF (1.08 vs. 2.25 kg), and ether extract (0.27 vs. 0.68 kg) compared to steers fed 40% WDGS. Digestibilities of DM (81.8 vs 77.5%) and OM (84.0 vs. 79.3%) were greater ($P \leq 0.08$), and digestibility of ether extract (87.0 vs. 90.4%) tended ($P = 0.11$) to be decreased for steers fed 0% WDGS compared to steers fed 40% WDGS. Ruminal pH change (1.50 vs. 1.25), variance (0.140 vs. 0.087), and maximum (6.50 vs. 6.26) were greater ($P \leq 0.09$) for steers fed 0% WDGS compared to steers fed 40% WDGS. Steers fed 0% WDGS also had decreased ($P = 0.09$) DMI per meal (0.91 vs. 1.09 kg) and greater ($P = 0.09$) acetate:propionate (1.59 vs. 1.23) compared to steers fed 40% WDGS. The observations of greater maximum rumen pH and acetate:proprionate in steers fed 0% WDGS are interesting given that they consumed considerably less NDF than steers fed 40% WDGS. Starch digestibility was greater ($P = 0.04$) for steers fed SFC (99.1%) than for steers fed DRC (95.5%) or HMC (96.5%), and digestibility of ether extract was greater ($P = 0.02$) for steers fed SFC (88.7%) or HMC

(90.8%) than for steers fed DRC (86.5%). Processing also affected ruminal pH with SFC fed steers having greater ($P \leq 0.05$) ruminal pH change (1.56) and variance (0.161) compared to steers fed DRC (1.21 and 0.070, respectively) and HMC (1.34 and 0.109, respectively). Maximum ruminal pH was also greater ($P \leq 0.07$) for steers fed SFC (6.50) and HMC (6.41) compared to steers fed DRC (6.22).

Key Words: Corn processing, Distiller's grains, Digestibility

98 Assessment of the influence of proximate fractions in meat and bone meals on their apparent nitrogen-corrected metabolizable energy content. O. A. Olukosi* and O. Adeola, *Purdue University, West Lafayette, IN*.

Apparent nitrogen-corrected metabolizable energy (AMEn) of 7 meat and bone meal (MBM) samples were determined using 72 barrows. The 8 dietary treatments were 8 diets which comprised a standard corn-soybean meal (SBM) diet and 7 test diets in which each of the 7 MBM samples replaced equal quantities of corn and SBM in the standard diet such that the ratio of corn:SBM was the same in all the eight diets. Each treatment had 9 replicates. The barrows were allowed 5 d of adjustment to metabolism cage and diets and 5 d of feeding and total collection of feces and urine. The diets, urine and feces were analyzed for gross energy (GE) and N. Correlation, regression and model selection analyses were used to determine relationship among proximate fractions and AMEn as well as for choosing the optimum prediction equation for AMEn. The AMEn of the MBM was in the range of 2,684 to 3,913 kcal/kg. Most of the proximate fractions explained < 40% of the variations in AMEn of the MBM. Calcium and P were negatively correlated ($r^2 \leq -0.26$) with AMEn. Gross energy ($r^2 = 0.27$) had the highest positive correlation with AMEn, followed by protein ($r^2 = 0.17$). The ratio of fat:ash in the MBM had the highest correlation with AMEn ($r^2 = 0.31$). Most of the proximate fractions and their ratios had higher correlations ($r^2 > 0.50$) with GE than with AMEn suggesting that the influence of relationship among proximate fractions influenced energy metabolism and thus AMEn. The relatively high correlation ($r^2 = 0.17$) of MBM protein with its AMEn suggests possible role of protein quality on AMEn. Digestibility of MBM protein is highly correlated with its AMEn ($r^2 = 0.78$) indicative of possible influence of MBM protein utilization on its energy value. The optimum prediction equation of AMEn of the MBM samples was: AMEn = 39,826 - (730×Ash) - (464×Ca) + (2,890×P) - (369×Fat) - (381×Protein). In conclusion, the current study indicates that understanding energy utilization of MBM in pigs requires assessing the utilization of proximate fractions of MBM as well as interactions among the fractions.

Key Words: Meat and bone meal, Metabolizable energy, Proximate fractions

99 The effect of eicosapentaenoic acid on markers of cartilage degradation in porcine articular cartilage in vitro. C. I. O'Connor-Robison*, J. M. Mapes, and M. W. Orth, *Michigan State University, East Lansing*.

Clinical studies have demonstrated that omega-3 polyunsaturated fatty acids (PUFA) can modulate the inflammatory response that occurs with arthritis. The objective of this study was to characterize the effects of eicosapentaenoic acid (EPA) on indices of cartilage degradation in recombinant porcine IL-1 beta (rpIL-1) stimulated porcine articular cartilage explants. The explants were harvested from the humeral-ulnar joints of eight Yorkshire x Landrace gilts within 8 h of slaughter. Explants were allocated to culture plates and cultured in 1 mL of a commercial serum free medium for 24 h with 10% fetal bovine serum. Cartilage was then washed in 1% phosphate buffered saline and treated as follows: 100 ug/mL linolenic acid (control treatment), 75 ug/mL linolenic acid and 25 ug/mL EPA, 50 ug/mL linolenic acid and 50 ug/mL EPA, 25 ug/mL linolenic acid and 75 ug/mL EPA, and 0 ug/mL linolenic acid and 100 ug/mL EPA. At 24, 48 and 72 h after cartilage was allocated to wells, media were removed from each well and reserved for analysis. At 48 and 72 h, 1 mL of treatment media containing 15 ng/ml of rpIL-1 was added to each well. Media were analyzed for proteoglycan, nitric oxide (NO), interleukin-6 (IL-6), and prostaglandin E2 (PGE_2) concentrations. Proteoglycan release decreased as EPA concentration increased on day 1 ($P < 0.05$); however there were no differences on day 0 nor on day 2. Nitric oxide synthesis decreased linearly as EPA concentration increased ($P< 0.05$). Interleukin-6 release was not different between treatments. Prostaglandin E_2 release tended to be reduced ($P = 0.10$) by EPA treatments compared to the control. The EPA treatments all had similar levels of PGE_2 release suggesting that concentrations higher than 25 ug/mL did not provide any additional benefit. These results indicate that EPA is able to reduce proteoglycan breakdown and decrease markers of inflammation. The results from this study will be used to further elucidate the effect of EPA on porcine articular cartilage using concentrations between 0 and 25 ug/ml of EPA.

Key Words: Porcine, Eicosapentaenoic acid, Cartilage

100 Effect of dietary vitamin A on finishing beef cattle. C. L. Pickworth*, S. C. Loerch, and F. L. Fluharty, *The Ohio State University, Wooster*.

Two beef cattle finishing experiments were conducted to evaluate diets without supplemental vitamin A on growth and carcass characteristics. In experiment 1, 80 Angus-based steers (BW = 211 kg) were allotted to individual pens and assigned to one of four dietary treatments (20 steers each). Treatments were: 1) no supplemental vitamin A for 227 d, 2) no supplemental vitamin A for 112 d then 115 d of supplemental vitamin A at 2,200 IU/kg of DM, 3) 2,200 IU/kg of DM supplemental vitamin A for 112 d then no supplemental vitamin A for 115 d, and 4) 2,200 IU/kg of DM supplemental vitamin A for 227 d. The diets were primarily whole shelled corn (80% DM basis). The basal diet was calculated to provide 1,100 IU/kg of DM of vitamin A equivalents via beta-carotene which is half of the NRC recommendation for feedlot cattle. No treatment differences ($P > 0.05$) were observed for DMI, G:F, and ADG. There were no treatment differences ($P > 0.05$) in hot carcass weight (HCW), back fat thickness (BF), ribeye area (REA), KPH, marbling score (MS), quality grade (QG), or yield grade (YG). In experiment 2, 168 Angus-based steers (BW = 285 kg) were blocked by BW and allotted to 24 pens. The experiment had a 2 x 2 factorial arrangement of treatments. Main effects were: 1) no supplemental vitamin A (NA) vs 2,200 IU/kg of DM supplemental vitamin A (SA) and 2) program fed to gain 1.1 kg/d for 90 d then ad libitum fed vs ad libitum fed for 165 d. The diets were primarily high moisture corn (75% DM basis) and calculated to provide 1,300 IU/kg of DM of vitamin A equivalents. There were no interactions, therefore only the main effect of vitamin A will be reported. The DMI was lower ($P < 0.05$) for NA steers (8.0 and 8.3 kg/hd/d, NA and SA, respectively). Average daily gain and

G:F were not affected (P > 0.05) by the vitamin A treatment. Carcass characteristics (HCW, BF, REA, KPH, MS, QG, and YG) were not affected (P > 0.05) by the vitamin A treatment. These results confirm that feeding low vitamin A diets does not impede growth of finishing beef cattle. Contrary to previous reports, feeding low vitamin A diets did not improve carcass quality.

Key Words: Vitamin A, Beef, Carcass

101 Effect of wintering system, nutrition around breeding, and prostaglandin on gain and reproduction in beef heifers. D. M. Larson*[1], R. D. Richardson[2], and R. N. Funston[3], [1]*University of Nebraska, Lincoln,* [2]*Rex Ranch, Ashby, NE,* [3]*West Central Research and Extension Center, North Platte, NE.*

Three experiments evaluated heifer development system, level of nutrition around breeding, and PG on ADG and pregnancy rate. In Exp. 1, 89 heifers (267 ± 4 kg) grazed winter range (WR) or corn residue (CR) with supplement (29% CP; [0.45 kg/d, 78 d], [0.90 kg/d, 26 d]). Heifers were treated similarly until 7 d before AI (10 d), when half CR and WR received supplement (S vs. NS; 17% CP, 101 g/d Ca propionate; 1.4 kg/d) for 21 d and then exposed to bulls (45d). In Exp. 2, 83 heifers (232 ± 4 kg) grazed WR or CR with supplement (29% CP; [0.45 kg/d, 86 d]). Heifers were treated similarly until 7 d before bull exposure (45 d), when half of CR and WR received S (19% CP, 101 g/d Ca propionate; 1.4 kg/d) for 21 d. In Exp. 3, 1230 heifers (215 ± 1 kg) grazed WR after weaning. At breeding, heifers were exposed to bulls for 25 d and half S and NS received PG on d 5. Seven d before PG injection, half received S (19% CP, 101 g/d Ca propionate; 1.4 kg/d) for 21 d. The CR had lower ($P \leq 0.02$) ADG compared to WR while grazing (0.22 vs. 0.28 ± 0.02; 0.26 vs. 0.35 ± 0.02 kg; Exp. 1 and 2 respectively). The WR were heavier than CR at breeding (308 vs. 292 ± 4 kg; $P = 0.01$; Exp.2), but similar in Exp.1 (362 ± 5 kg). At pregnancy diagnosis, S were heavier ($P \leq 0.04$) than NS (415 vs. 400 ± 5; 345 vs. 343 ± 1 kg; Exp. 1 and 3 respectively), but similar ($P > 0.10$) in Exp. 2 (348 ± 5 kg). Percentage pubertal at breeding was similar ($P > 0.10$) among WR and CR (53 ± 5; 69 ± 8 %; Exp. 1 and 2 respectively). Neither WR/CR nor S/NS affected AI conception or pregnancy rate in Exp.1 (71 ± 8 %; 83 ± 6 %; $P > 0.10$) or Exp. 2 (82 ± 6%; $P > 0.10$). In Exp.3, S/NS did not affect pregnancy rate (71 ± 2%; $P = 0.27$), but PG had a lower pregnancy rate than non-PG heifers (68 vs. 74 ± 2%; $P = 0.03$). Development on CR reduces ADG prior to breeding, but development and supplementation do not affect pregnancy rate; however, PG injection in a short breeding season reduces pregnancy rate.

Key Words: Development, Supplement, System

102 Acute phase responses in piglets fed diets containing non-starch polysaccharide (NSP) hydrolysis products and egg yolk antibodies upon *Escherichia coli* K88 oral challenge. E. kiarie*, B. A. Slominski, D. O. Krause, and C. M. Nyachoti, *University of Manitoba, Winnipeg, MB, Canada.*

Acute phase responses in pigs fed NSP hydrolysis products (HP) and egg yolk antibodies against K88 fimbriae (EYA) alone or in combination upon oral challenge with enterotoxigenic *E. coli* K88 (ETEC) were evaluated. The HP were generated by incubating a mixture of ethanol-extracted wheat, soybean meal, canola meal and flax with a blend of carbohydrase enzymes. Forty, 21-d old pigs housed in pairs were assigned one of four diets: control (C; devoid of feedstuffs used to generate HP), C + 5 g of HP/kg (HP), C + 5 g of EYA/kg (EYA) or C + 5 g of EYA + 5 g of HP/kg (EYA+HP) in a completely randomized design to give 5 pens per diet. Following a 9-d adaptation period pigs were weighed on d 10 at 0800, bled and rectal temperature (RT) recorded to establish baseline values (0 h). Two h later, all pigs were orally challenged with ETEC and then bled and RT recorded at 1600 (6 h), 1000 of d 11 (24 h) and 1000 of d 12 (48 h). Feed intake was monitored at 24 and 48 h. Pigs fed the C diet ate less ($P = 0.04$) than pigs fed diets containing HP within 48 h post-challenge. There was a diet x time post-challenge interaction ($P < 0.08$) for packed cell volume (PCV), plasma osmolality, urea N (PUN), glucose, serum haptoglobin (Hp), interleukin-6 (IL6) and interleukin-1β (IL1β). Pigs fed C diet showed lower PCV at 6 h, higher PUN at 6 and 48 h, higher glucose at 24 h, higher Hp and IL6 at 6 and 24 h compared to pigs fed the other diets. Pigs fed EYA+HP diet showed higher circulating IL6 and IL1β at 48 h compared to pigs fed C diet whilst those fed the EYA and HP diets were intermediate. In conclusion, pigs fed diets with additives showed less severe ETEC-enteritis within 24 h post-infection, however, at 48 h pigs fed EYA+HP showed an upsurge of pro-inflammatory cytokines.

Key Words: Acute phase responses and piglet diarrhoea, Egg yolk antibodies, Non-starch polysaccharides hydrolysis products

Graduate Student Competitive Research Papers, M.S. Poster Division

103 Competition effects in a Large White/Landrace composite population of pigs. W. L. Hsu*[1], R. K. Johnson[1], and L. D. Van Vleck[1,2], [1]*University of Nebraska, Lincoln,* [2]*USMARC, ARS, USDA, Lincoln, NE.*

Records on final weights (kg) of pigs of a University of Nebraska Large White/Landrace composite population were analyzed to estimate effects of competition on growth. Data were weight at approximately 180 days of age of 3,524 pigs in 351 pens (9 - 11 pigs per pen) farrowed from 1999 - 2005. Area of each pen was 8.18 m2. The full model (M1) included fixed effects of contemporary group, sex and line, covariates of age and inbreeding coefficient, and random effects of direct additive genetic (g), competition genetic (cg) and permanent environmental (cp), pen, litter, and residual effects. A REML algorithm was used to estimate variance components. M1 and 7 reduced models were used to estimate Vg, Vcg, Vcp and Vpen components of variance. When cp was dropped from M1 (M2), Vpen increased slightly. When pen was dropped from M1 (M3), Vcp increased considerably. When cg was dropped from M1 (M4), Vpen increased considerably. When both pen and cp were dropped from M1 (M5), the estimates of other variances increased. When cg and cp were dropped from M1 (M6), Vpen increased as with M4. When cg and pen were dropped from M1 (M7), Vcp increased considerably. When cg, pen and cp were dropped from M1 (M8), estimates of direct genetic, litter and residual variances increased, especially the residual variance. Chi-square tests showed that M1 was significantly better than M5 and M8 but was not significantly different from M6. Differences between -2 logL of M5 ($P \leq 0.01$) and M8 ($P \leq 0.01$) compared with M1 were 9.94 and 45.72, respectively. M6 was significantly better than M8 (P ≤

0.005); difference in -2 logL was 41.6. Under management conditions for this experiment, the model for genetic evaluation should include litter effects, either pen effects or competition permanent environmental effects, and possibly competition genetic effects, a finding in agreement with results of studies with different populations and locations. Models with pen effects are much easier to compute than models with competition permanent environmental effects.

Key Words: Competition effects, Growth, Swine

104 The effect of the Kentucky Beef Cattle Genetics Improvement Program on real-time ultrasound carcass traits, performance and pelvic measurement of heifers enrolled in the Eastern Kentucky Heifer Development Program. B. Galbreath*, H. Nauman, P. Prater, K. Peterson, J. Willard, J. M. Phillips, and T. Wistuba, *Morehead State University, Morehead, KY.*

Young heifers were weighed, pelvic measured, and ultrasonically scanned to study breed differences for performance, pelvic area, 12th rib fat depth, longissimus muscle area, intramuscular fat, and rump fat in February of 2002 - 2006. Angus (AN), Angus cross (AC), Gelbvieh (G), Gelbvieh cross (GC), Limousin (L), Limousin cross (LC), Charolais (CH), Charolais cross (CC), and commercial (CM) heifers (n = 2072) were delivered to Hazard, KY for the Eastern Kentucky Heifer development program. Heifers were grazed for 135 d with minimal supplementation and then pelvic measurements were taken by an experienced veterinarian and carcass measurements were obtained by a CUP certified ultrasound technician. Measures of 12th rib fat depth, longissimus muscle area, intramuscular fat, and rump fat were taken with an ALOKA 500V ultrasound unit equipped with a 17.2 cm, 3.5 MHz linear transducer. Ultrasound images were then submitted to the ILIA lab (Gustine, TX) for determination of 12th rib fat depth, longissimus muscle area, intramuscular fat, and rump fat. Initial, mid test and end weights differed between years ($P < 0.09$) and by breed ($P < 0.01$). There were also differences in total gain and ADG between years ($P < 0.01$) and breeds ($P < 0.01$). There were no significant differences for pelvic area for the year by breed interaction or year or breed separately. However, there were differences for year ($P < 0.01$) and breed ($P < 0.01$) but not the interaction for the number of days bred. The L and CH heifers had the largest ($P < 0.05$) longissimus muscle area (63.5 cm2) and AN had the smallest (50.6 cm2) where as the AC, G, GC, LC, CC, and CM were intermediate, in addition, AN, AC and CM heifers had the greatest ($P < 0.05$) 12th rib fat depth, intramuscular fat, and rump fat of the heifers. These results support the knowledge that earlier developing breeds of cattle have increased intramuscular fat and subcutaneous fat depots whereas the continental breeds are leaner and have greater longissimus muscle area.

Key Words: Beef cattle, Ultrasound, Performance

106 Evaluation of milk components, fatty acid profile, and production of cows fed rolled flaxseed on two commercial dairies. N. R. Bork*[1], G. P. Lardy[1], J. W. Schroeder[1], K. A. Vonnahme[1], P. M. Fricke[3], K. B. Koch[1], K. G. Odde[2], R. D. Shaver[3], and S. J. Bertics[3], [1]*North Dakota State University, Fargo,* [2]*Kansas State University, Manhattan,* [3]*University of Wisconsin-Madison, Madison.*

The objective of this field trial was to study the effects of supplementing early lactation dairy cow diets with rolled flaxseed on milk composition, fatty acid profile, and yield. Conducted on 2 commercial dairies with cows naive to flaxseed, the treatments consisted of either their existing post-fresh ration (CON; n=408) or a similar diet re-formulated with rolled flaxseed (FLX; n=507; 0.85 kg DM/cow daily). Cows were assigned randomly to treatment upon leaving the fresh-cow pen (approximately 10 d postpartum) within parity (primiparous or multiparous). On both sites, cows remained in the study until confirmed pregnant or culled. Milk, TMR, and feedstuffs were collected monthly. Analyses included 915 cows. Milk production was collected and monitored using monthly DHIA records. Milk yield was analyzed as a split-plot with cow as the experimental unit and treatment by parity by farm as the whole-plot error term. Treatment did not interact with farm or parity. Milk from cows fed FLX had a greater ($P < 0.07$), compared to CON, proportion of C18:0 (11.17 vs. 10.42±0.24 g/100g), C18:1 (24.59 vs., 22.65±0.44 g/100g), and C18:3n3 (0.84 vs. 0.52±0.06 g/100g) fatty acids in the milk fat and a lesser ($P < 0.08$) proportion of C16:0 (26.95 vs. 29.33±0.53 g/100g) and C23:0 (0.0003 vs. 0.009 ± 0.003 g/100g). Treatment did not affect milk yield (36.49±1.11 kg/d), milk protein (2.77±0.02 %), protein yield (1.01±0.03 kg/d), milk fat (3.34±0.04%), and milk fat yield (1.22±0.05 kg/d). Feeding 0.85 kg DM of flaxseed daily can alter the fatty acid profile of milk while maintaining milk yield and composition in on-farm dairy applications.

Key Words: Flaxseed, Milk composition, Fatty acids

107 Effects of high dietary nitrate on feed intake, weight, and plasma parameters in sheep. R. Cockrum*, K. Austin, P. Ludden, and K. Cammack, *University of Wyoming, Laramie.*

Nitrate consumption has a significant impact on livestock production worldwide due to both chronic and acute effects. During periods of severe drought relief, plants absorb high amounts of nitrate. Consumed nitrate is converted to nitrite in the rumen, where it is reduced to ammonia. The initial conversion of nitrate to nitrite exceeds the reduction process when animals consume high nitrate forages. Nitrite is absorbed into the blood and binds with hemoglobin, reducing the ability of blood to carry oxygen to peripheral tissues. Impacts include decreased feed efficiency, reproductive complications, weight loss, and even death. The purpose of this study is to confirm individual variation in response to subacute levels of dietary nitrate and identify ewes more and less tolerant to elevated dietary nitrate. Purebred Suffolk sheep were administered a 300 mg NO_3^-/kg BW/d supplement (n = 47) or control supplement (n = 8) for 8 d. Six nitrate tolerant and six nitrate intolerant ewes were identified based on feed intake, weight change, and behavior traits, and will be used for future gene expression analyses. Supplement intake was lower ($P < 0.0001$) in nitrate-treated ewes than in control ewes, indicating that elevated dietary nitrate influences feed intake. The average % NO_3^- intake of tolerant and intolerant ewes was 84% and 24%, respectively. There was no difference in supplement intake ($P > 0.05$) between control ewes and tolerant ewes. However, intake was higher ($P < 0.0001$) in control and tolerant ewes than in intolerant ewes. Weight change was not different ($P > 0.05$) between nitrate-treated and control ewes. Plasma nitrite levels were not different between control, tolerant, and intolerant ewes; however, the binding of hemoglobin to nitrite may affect results, requiring further analyses. Results from this study confirm that individual animals differ in their response to subacute levels of dietary nitrate, suggesting it may be possible to select animals more and less tolerant to elevated dietary nitrate.

Key Words: Nitrate, Variation, Sheep

108 Effects of glycerol on cow and calf performance in creep rations. C. Fleenor*, S. Lake, M. Claeys, P. Gunn, and R. Lemenager, *Purdue University, West Lafayette, IN.*

Two-hundred and eleven cow-calf pairs (650.3 ± 80.1 kg initial BW, 5.3 ± 0.6 initial BCS and calves at 172.4 ± 25.6 kg initial BW) were randomly assigned based on calf weights to either a soybean hulls, corn and dried distillers grains with solubles (DDGS) based treatment (39%, 34%, 16%, respectively; control) or a soybean hulls, DDGS and glycerol based treatment (46%, 22%, 20%, respectively; glycerol) to determine the effects of glycerol as an energy source in a pelleted creep feed diet. Diets were balanced to be isocaloric (NEg = 1.19 Mcal/kg), isonitrogenous (14.1% CP) and were fed for 58 d. Body weight on cows and calves, as well as BCS for cows, was recorded on d 0 and 58. There were no treatment differences observed for initial ($P = 0.51$) or final cow BW ($P = 0.68$), however the control cows decreased ($P < 0.001$) BCS while the glycerol cows gained BCS (-0.157 vs + 0.075, respectively). Calf ADFI ($P = 0.38$) and final BW ($P = 0.18$) were not affected. Control calves had a greater ($P < 0.01$) ADG (1.35 kg vs. 1.23 kg) than glycerol calves. These data imply that glycerol added at 20% DM of a creep ration appears to be a viable energy substitute for corn.

Key Words: Calves, Creep, Glycerol

109 Comparison of two grain adaptation systems, one with forage and another using wet corn gluten feed, on ruminal pH, feed intake, and digestibility of feedlot cattle. T. J. Huls*, N. F. Meyer, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska, Lincoln.*

A metabolism trial was conducted using 8 ruminally fistulated steers (291 ± 19 kg) to compare decreasing the level of wet corn gluten feed (WCGF; Sweet Bran®, Cargill) for grain adaptation with a traditional grain adaptation system using forages (CON). Steers (4/treatment) were adapted to finishing diets across 5 periods consisting of 5, 7, 7, 7, and 7 d. The CON adaptation contained supplement and molasses at 5% each with decreasing alfalfa from 45 to 7.5% and increasing corn (DM basis). The WCGF adaptation had supplement and alfalfa hay at 5 and 7.5% of the diet, respectively, with WCGF decreasing from 87.5 to 35% while corn increased (DM basis). Continuous pH and intakes were recorded 4 of 7 d while steers were placed in stanchions. Dacron bags (50 μm pore size) containing both adaptation diets (8/steer) were incubated 24 h in each steer during each period to determine DM digestibility. One steer (CON) was removed due to acidosis after the third adaptation diet. No period by adaptation diet interactions occurred ($P > 0.60$) Ruminal pH was decreased ($P < 0.05$) and time and area below pH 5.6 was increased ($P < 0.05$) for WCGF compared to CON adaptation systems. Cattle adapted using WCGF had greater DMI than CON ($P < 0.01$). As steps were adapted to finishing diets, DMI increased ($P = 0.01$) and ruminal pH decreased while time and area below pH 5.6 were greater ($P < 0.05$). Ruminal pH for CON steers decreased as corn replaced alfalfa hay from 6.59 to 6.12 while pH decreased from 6.0 to 5.79 for WCGF steers. *In Situ* DM digestibility had no treatment by incubation diet interactions ($P > 0.18$) for adaptation period 1 and 2 although period 3, 4, and 5 did ($P < 0.01$). Steers adapted using WCGF had greater in situ digestion than steers adapted using CON. Diets containing WCGF were more digestible than diets containing forage. Decreasing WCGF inclusion instead of forage is a viable method for adapting feedlot cattle to high-concentrate diets.

Key Words: Feedlot cattle, Grain adaptation, Wet corn gluten feed

110 Canola meal replacing dried distillers grains with solubles in lactating dairy cow diets. C. N. Mulrooney*, D. J. Schingoethe, K. F. Kalscheur, and A. R. Hippen, *South Dakota State University, Brookings.*

The objective of the study was to determine the response to feeding diets containing canola meal as a protein supplement in place of all or portions of dried distillers grains with solubles (DDGS). Twelve lactating Holstein cows (four primiparous and eight multiparous) were fed in a 4 x 4 Latin square design with 4 wk periods. Data were collected wk 3 and 4 of each period. Diets were formulated with increasing amounts of canola meal at 0, 33, 66, and 100 % of the source of supplemental protein. All diets contained a forage to concentrate ratio of 55:45, with forage being 50% corn silage and 50% alfalfa hay. Diets were formulated to be similar in crude protein (16.0%) and ether extract (4.7%). No difference ($P > 0.05$) was found among treatments for dry matter intake (25.1, 25.9, 25.4, and 25.2 kg/d, respectively for 0 to 100% supplemental protein from canola meal). An increase in canola meal had no effect ($P > 0.05$) on the milk production (34.3, 34.5, 35.8, and 35.2 kg/d). Milk protein concentration (3.05, 3.06, 3.06, and 3.01%), protein yield (1.03, 1.05, 1.10, and 1.08 kg/d), fat concentration (3.87, 3.97, 4.05, and 3.81%) and fat yield (1.32, 1.37, 1.45, and 1.34 kg/d) were similar ($P > 0.05$) for all diets. Lactose concentrations (4.92, 4.87, 4.86, and 4.91%) tended ($P < 0.10$) to be lower with combination diets and tended ($P < 0.10$) to be higher with primiparous cows (4.95 and 4.83%). There was no effect ($P > 0.05$) of treatment on lactose yield (1.69, 1.68, 1.76, and 1.72 kg/d). Dietary treatments had no effect ($P > 0.05$) on feed efficiency (1.44, 1.42, 1.53, and 1.46 ECM/kg DMI). Increasing canola meal concentrations in the diet resulted in a quadratic response ($P < 0.05$) of milk urea nitrogen concentrations (7.25, 7.63, 7.56, and 7.10 mg/dL). Canola meal is a suitable replacement for DDGS in dairy cow diets.

Key Words: Canola meal, Distillers grains with solubles, Lactating dairy cows

Graduate Student Competitive Research Papers, Ph.D. Poster Division

111 Finishing diets containing wet distillers grains plus solubles affect shelf life of beef. A. S. de Mello Junior*, C. R. Calkins, B. E. Jenschke, L. S. Senaratne, and G. E. Erickson, *University of Nebraska-Lincoln, Lincoln.*

Yearling, crossbreed steers (n = 48) were allocated to three treatments (0%, 15% or 30% wet distillers grains plus solubles – WDGS; DM basis) to test the effects on shelf life and sensory attributes of beef. Tenderloins (m. *psoas major*), strip loins (m. *longissimus lumborum*) and top blades (m. *infraspinatus*) were obtained. Tenderloin steaks aged 7 d and strip loin and top blade steaks aged 7 d and 42 d were analyzed for degree of oxidation (thiobarbituric acid reactive substances – TBARS), objective color, shear force (WBSF), and sensory attributes. Ribeye samples (m. *longissimus throacis*) were analyzed for fatty acid profile. Trained sensory panelists (n = 8) rated juiciness, tenderness, connective tissue amount, and off-flavor intensity. Regardless of aging time, strip

steaks ($P = 0.008$) and top blade steaks ($P = 0.003$) from cattle fed 30% WDGS had more oxidation (greater TBARS) than steaks from cattle fed 0% WDGS (strips: 3.02^a, 3.52^a, and 4.10^b mg/kg and top blades: 2.68^a, 3.09^a, and 3.67^b mg/kg for 0, 15, and 30% WDGS, respectively). Values for steaks from cattle fed 15% WDGS were intermediate. The same was true for tenderloin steaks after 3 and 7 d ($P < 0.01$) of retail display. There were no differences in total saturated and unsaturated fatty acid content ($P > 0.15$). Meat from cattle fed 30% WDGS had significantly more polyunsaturated fatty acids than other treatments (4.23^b, 4.91^b, 6.15^a % for 0, 15, and 30% WDGS, respectively). No treatment influence was identified for WBSF of the three muscles ($P > 0.2$). Choice grade, top blade steaks aged 42 d from cattle fed 15% WDGS had lower tenderness ratings when compared to cattle fed 0% WDGS ($P = 0.04$). In addition, Choice grade, top blade steaks from cattle fed 15% WDGS had lower ($P < 0.05$) juiciness ratings than cattle fed 0 or 30%. When aged 42 d, strip steaks from cattle fed 15% WDGS were significantly lighter (higher values of L*) than steaks from cattle fed 0 or 30% WDGS. Results from this study demonstrate that cattle finished with WDGS may have compromised shelf life.

Key Words: Distillers grains, Beef palatability, Shelf life

112 Impact of birth weight on growth performance and carcass characteristics of pigs – a retrospective analysis. B. A. Peterson*[1], M. Ellis[1], R. Bowman[2], N. H. Williams[3], and B. F. Wolter[2], [1]*University of Illinois, Urbana*, [2]*The Maschhoffs, Inc., Carlyle, IL*, [3]*PIC USA, Franklin, KY*.

The objective of this research was to determine the relationship between birth weight and subsequent body weight and growth rate of pigs. Data was obtained from two studies conducted to evaluate a range of commercial genotypes that involved 5930 pigs (equal numbers of barrows and gilts) that were individually weighed at birth (1.6 kg BW), weaning (6.3 kg BW), and 8 (33.5 kg BW) and 20 weeks (113.7 kg BW) post-weaning. Carcass data was obtained for all pigs. Pigs were assigned to quartiles on the basis of birth weight and the data was analyzed as a CRD with 4 treatments (Quartile 1: 0.63–1.36 kg; Quartile 2: 1.36–1.59 kg; Quartile 3: 1.59–1.86 kg; Quartile 4: 1.86–3.15 kg) using the PROC MIXED procedure of SAS, and correlation analysis was conducted to determine relationships between birth weight and subsequent performance. Correlation coefficients between birth weight and the growth performance parameters were positive, but generally low. Birth weight quartile influenced ($P < 0.05$) all subsequent body weight and growth rate measures with the relationship being cubic ($P < 0.05$) for birth weight, weaning weight, and week 20 post-weaning weight (1.1, 1.5, 1.7, 2.1 kg, SEM = 0.01, $P<0.01$ for Quartile 1, 2, 3, 4, respectively; 5.7, 6.3, 6.7, 7.2 kg, SEM = 0.05, $P<0.01$, resp.; 107.3, 113.5, 116.3, 119.5 kg, SEM = 0.50, $P<0.01$, resp.). The relationship between birth weight quartile and average daily gain was also cubic in each weight period. Pigs in the first quartile had lower loin depth, however no difference ($P>0.05$) was observed between the quartiles for backfat depth or carcass lean content. When expressed as a percentage of hot carcass weight, there was no difference in loin percentage between the quartiles, however, pigs in the lightest quartile had the greatest ($P<0.05$) percentage ham, and lowest percentage belly. The results of this study indicate that pigs with lower birth weights grow slower, and have different primal-cut weight distribution at a fixed age compared to heavier birth weight pigs.

Key Words: Birth weight, Growth, Pigs

113 Use of transcriptional profiling to understand genetic mechanisms responding to fasting in pigs. S. Lkhagvadorj*[1], L. Qu[1], O. Couture[1], J. Dekkers[1], and C. Tuggle[1], [1]*Iowa State University, Ames*, [2]*USDA ARS, Athens, GA*, [3]*University of Georgia, Athens*.

Feed is the largest variable cost in pork production but the genetic mechanisms that control feed intake and feed efficiency are generally unknown. In this study, we used transcriptional profiling of liver and fat tissues to identify genetic mechanisms that respond to feed deprivation and to melanocortin-4 receptor (MC4R) genotype for a missense mutation in the MC4R (D298N), which has been associated with increased feed efficiency. Prepubertal Yorkshire gilts that were homozygous for MC4R D298N (n=4) or MC4R wildtype (n=4) were either fed ad libitum or fasted for 3 days in a complete 2×2 factorial design. Total RNA was isolated from liver and fat tissues and hybridized to the 24,123 probe set Affymetrix Porcine Genome Array. A mixed linear model was fit to each tissue and gene using SAS Proc Mixed and interested contrasts were tested. In response to feed deprivation, 7,029 genes in fat and 1,831 genes in liver were declared differentially expressed with q-value<0.05, but no genes satisfied this criterion for the MC4R genotype effect in either tissue. Gene Ontology clustering analysis showed that both liver and fat responded to fasting by modulating several energy pathways. Genes representing lipid biosynthesis such as sterol regulatory element binding transcription factor 1c, fatty acid synthase, aconitase-1, acetyl CoA carboxylase alpha, and acetyl CoA synthase were downregulated in fat tissue due to fasting, which were confirmed by qPCR. Along with blood hormone assays, confirmation of expression of additional candidate genes will be performed to determine key pathways that respond to fasting in pigs. Responses to MC4R genotype will be further investigated by analysis of groups of genes. (Supported by USDA-NRI-2005-3560415618)

Key Words: Fasting, MC4R, Microarray

114 Effects of replacement of corn with rice in weaned pig diets under commercial conditions. M. T. Che*[1], M. U. Steidinger[2], and J. E. Pettigrew[1], [1]*University of Illinois, Urbana*, [2]*Swine Nutrition Services Inc., Anchor, IL*.

An experiment was conducted to evaluate effects of complete replacement of corn with rice in diets on growth performance and health of weaned pigs on a commercial farm. A total of 1004 crossbred pigs were weaned at 21 d and 5.5 kg BW and allotted to 4 treatments in a randomized complete block design. Pigs were divided into 3 weight blocks in each of 4 rooms, resulting in 12 blocks. Each pen within a block had 21 pigs (except for only 1 block having 20 pigs/pen) and equal distribution of genders. The pigs were fed a 4-phase feeding program with declining diet complexity. The 4 treatments were (A) corn diet, (B) rice diet fed for 1 week (phase 1), (C) rice diet fed for 2 weeks (phases 1 & 2), and (D) rice diet fed for 4 weeks (phases 1, 2, & 3). All pigs received a common diet during weeks 5 & 6. The diets were formulated to meet the same levels of calculated ME and SID lysine within phase. Over a 6-week period, ADG of pigs fed diets B, C, and D was not different ($P>0.05$) from that of pigs fed diet A (Table 1). Similarly, there were no differences ($P>0.05$) in ADFI and G:F among the treatments. Pigs fed diets B, C, and D had a lower ($P<0.05$) removal rate (dead & sick) than those fed diet A by Chi-square analysis; however, no differences ($P>0.05$) were seen in the number of antibiotic treatments. In conclusion, this study suggests that rice can substitute for corn in diets for weaned

pigs without affecting ADFI, ADG, and G:F. More importantly, rice appears to improve pig health with evidence of reduced removal rate.

Table 1. Effects of feeding rice to weaned pigs on ADG, ADFI, gain:feed, removal rate, and antibiotic treatment over a 6-week period

	A	B	C	D	SEM	P-value
ADG, g	307	315	318	307	6.23	0.507
ADFI, g	455	459	468	446	9.07	0.374
Gain:feed	0.74	0.75	0.75	0.75	0.01	0.920
Removal rate, %	10.3	3.6	4.0	5.2		0.004
Antibiotic treatment, %/d	1.6	1.3	1.4	1.3		0.343

Key Words: Rice, Weaned pigs, Health

115 Autocrine signaling mechanism of vitamin D in the bovine innate immune response. C. D. Nelson*, D. C. Beitz, T. A. Reinhardt, and J. L. Lippolis, *Iowa State University, Ames, Periparturient Diseases of Cattle Research Unit, National Animal Disease Center, ARS, USDA, Ames, IA.*

Vitamin D is 25-hydroxylated in the liver to provide the precursor for renal production of the steroid hormone 1,25-dihydroxyvitamin D ($1,25(OH)_2D_3$) by 1α-hydroxylase. This highly regulated endocrine pathway is key to controlling many aspects of calcium homeostasis. In contrast to the hormone's well characterized endocrine role in regulation of calcium homeostasis, $1,25(OH)_2D_3$ has been found to be produced locally in activated macrophages. Activation of macrophages can occur through Toll-like receptor (TLR) recognition of pathogen associated molecular patterns (PAMP). Subsequently, the signal from TLR binding can increase local production of $1,25(OH)_2D_3$ by increasing expression of 1α-hydroxylase in human and mouse macrophages. Macrophage produced $1,25(OH)_2D_3$ has been shown to act locally to activate genes important for innate immune function in mice and humans. Thus, we hypothesized TLR recognition of PAMP can cause conversion of 25-hydroxyvitamin D_3 to $1,25(OH)_2D_3$ by 1α-hydroxylase in bovine macrophages. Therefore, we stimulated bovine monocyte derived macrophages (BMDM) with ligands for TLR2 and TLR4 and measured expression of 1α-hydroxylase mRNA using quantitative real-time PCR (qPCR). Stimulation with the TLR2 and TLR4 ligands resulted in a 26-fold and 130-fold increase in 1α-hydroxylase mRNA expression respectively. Increased production $1,25(OH)_2D_3$ in BMDM was then shown by 2.5 fold up-regulation of a VDRE dependent gene, 24-hydroxylase, in stimulated versus non-stimulated BMDM cultures. In conclusion, an autocrine signaling mechanism of vitamin D does occur in the bovine innate immune response. Future studies will need to examine the functional impact of $1,25(OH)_2D_3$ on the bovine immune system at the cellular and molecular level.

Key Words: Vitamin D, Bovine macrophage, Toll-like receptor

Growth, Development, Muscle Biology, and Meat Science

116 Genetic parameter estimates of fatty acid composition and meat quality traits in Duroc pigs selected for intramuscular fat content for six generations. J. L. Burkett*, T. J. Baas, D. C. Beitz, C. R. Schwab, N. L. Berry, and S. Zhang, *Iowa State University, Ames*.

The objective of this study was to estimate genetic parameters for fatty acid composition and meat quality traits in Duroc pigs selected for intramuscular fat (IMF) for 6 generations. Selection was based on EBV for IMF estimated by fitting a two-trait animal model and the full relationship matrix in MATVEC. In the select line (SL), the top 10 boars and top 50% of the gilts were used to produce each subsequent next generation. One boar from each sire family and 50 gilts representing all sire families were selected randomly to maintain the control line (CL). Longissimus muscle (LM) samples (n=321; 234 barrows, 87 gilts) collected from generations 5 and 6 pigs in the CL (n=178) and SL (n=143) were used to determine the fatty acid profiles of IMF. Total lipids were extracted from trimmed LM samples and methylated directly with acetyl chloride and methanol. Methyl esters were quantified by using gas chromatograph with a 100 m column and a flame ionization detector. Genetic parameters were calculated with the use of DMUAI software. The model included fixed effects of line, sex, and carcass contemporary group, and random effects of animal and litter. Hot carcass weight was included as a covariate in the model. Single trait heritability estimates for IMF (0.42), loin muscle area (0.51), tenth-rib backfat (BF10, 0.34) were moderate to high. Heritability estimates were low to moderate for saturated (SFA, 0.31), monounsaturated (MUFA, 0.09), and polyunsaturated fatty acids (PUFA, 0.32). Genetic correlations for PUFA with IMF and BF10 were high and negative. A low negative genetic correlation was observed between IMF and MUFA. Low positive correlations for MUFA and PUFA with off flavor score (OFS) were found; however, the correlation between OFS and SFA was low and negative. Results from this study suggest that the fatty acid composition of intramuscular fat is genetically correlated with meat production and eating quality traits. Therefore, when selection emphasis is placed on meat quality traits, attention must be placed on correlated changes in fatty acid composition.

Key Words: Fatty acid, Genetic parameter, Meat quality

117 Birth weight, but not litter size, impacts growth performance of pigs. J. F. Patience[1], A. D. Beaulieu*[1], P. Leterme[1], and J. L. Aalhus[2], [1]*Prairie Swine Centre, Inc., Saskatoon, SK, Canada*, [2]*Agriculture and Agri-Food Canada Lacombe Research Centre, Lacombe, AB, Canada*.

Sow herd productivity has a major impact on the profitability of pork production and producers have been successful in their efforts to increase litter size. Mean birth weight (BIRTH) decreases as litter size increases. This study was conducted to investigate: 1) the effect of BIRTH on growth performance to market, and 2) the effect of litter size (LS) on growth and the variability in growth. BIRTH, birth order, total born (n=1200) and born alive (n=1114) were recorded at farrowing for 98 litters. LS was divided into small, medium or large litters with 3 to 10, 11 to 13 and 14 to 19 pigs born alive, respectively. Management, including cross-fostering, was as per normal barn procedures. Prior to data analysis, BIRTH was divided into 4 quartiles (Q1, 0.8 to 1.2; Q2, 1.25 to 1.45; Q3, 1.50 to 1.70 and Q4, 1.75 to 2.50 kg). Pigs < 800 g BIRTH were excluded. Birth order and BIRTH were not correlated.

Mean BIRTH (kg) ranged from 1.04 (Q1) to 1.93 (Q4; P<0.01). Weight (kg) at weaning (5.48, 6.30, 7.04, 7.68; Q1 to Q4) and at 7 wk post-weaning (29.60, 31.78, 33.77, 34.74; Q1 to Q4) differed among BIRTH Q (P<0.01). ADG (kg/d) from birth to weaning and weaning to 5 wk post-weaning (0.23, 0.42; 0.26, 0.45; 0.29, 0.47; 0.30, 0.49; Q1 to Q4) differed among BIRTH Q (P<0.01). ADG from 5 to 7 wk post-weaning (0.68, 0.71, 0.73, 0.73; Q1 to Q4) differed among BIRTH Q (P<0.01); however, Q2, Q3 and Q4 were similar. Days to market (159.3, 154.9, 152.3 149.6; Q1 to Q4) differed among BIRTH Q. Mean BIRTH (1.58, 1.40, 1.32 kg) decreased (P<0.01) and total litter weight (12.90, 16.14, 19.30 kg) increased (P<0.01) as LS increased from small to large. Mean body weight (kg) was similar among LS at weaning (6.60), 5wks (22.57) and 7 wks (32.53) post-weaning and when the first pig per pen was shipped (97.59). LS did not affect days to market (155.3). The SD (kg) and the CV (%) of BIRTH (0.24, 17.1) and weight at weaning (1.16, 18.0), 5 wk (3.01, 13.6) and 7 wk (3.92, 12.2) post-weaning and at first pull (9.27, 9.6) were similar among LS. Within litter variability was not affected by LS. Low BIRTH but not increased LS, reduced growth performance and increased days to market.

Key Words: Litter size, Birth weight, Pigs

118 Piglet birth weight has very little impact on carcass quality, muscle composition, or eating quality of pork. A. D. Beaulieu*[1], J. L. Aalhus[2], J. F. Patience[1], and I. L. Larsen[2], [1]*Prairie Swine Centre, Inc., Saskatoon, SK, Canada*, [2]*Agriculture and Agri-Food Canada Lacombe Research Centre, Lacombe, AB, Canada*.

Improvements in sow productivity have resulted in an increased number of low birth weight (BW) pigs. Low BW may be associated with fewer primary muscle fibers; the impact of this on pork quality is unknown. The objective of this study was to determine if BW is a predictor of pork quality. BW, total born (n=1200) and born alive (n=1114) were recorded at farrowing for 98 litters. For analysis, BW was divided into 4 quartiles (Q1 to Q4; 0.8 to 1.2, 1.25 to 1.45, 1.50 to 1.70 and 1.75 to 2.50 kg). Pigs < 800 g BW were excluded. Pigs were shipped to market upon reaching 120 kg. Meat composition data were obtained from a subset of 24 litters; 1 pig per Q per litter. Animals were slaughtered and dressed in a simulated commercial manner. Full grade and carcass dissection data were collected 24 h post-mortem. Meat quality, muscle histochemistry, and sensory panel data were obtained. Remaining pigs were marketed commercially and carcass data acquired. Litter size ranged from 3 to 19 pigs born alive. Dressed weight (94.4 kg), lean yield (60.4 %), loin (66.7 mm) and fat (19.9 mm) thickness was unaffected by BW. Except for the tabulated variables below; BW Q did not affect the proportions of lean, bone or fat in the carcass or primal cuts, the sensory qualities of pork (tenderness, juiciness, flavor, and palatability), pH, temperature, color, chemical, or histological properties of pork.

In our study, pork quality from pigs with BW ranging from 800 to 2500 g was similar. BW does not predict pork quality.

Table 1.

Birthweight quartile	Q1	Q2	Q3	Q4	SEM	P value
Birthweight, kg	0.8-1.2	1.25-1.45	1.50-1.70	1.75-2.50		
Moisture, %	74.4[a]	74.6[ab]	75.0[b]	75.0[b]	0.14	0.01
Intramuscular fat,%	3.51[a]	3.01[b]	2.58[b]	2.91[b]	0.02	0.004
Intermuscular fat, % in butt	16.6[a]	15.3[a]	13.4[b]	15.5[a]	0.66	0.007
Flavor[1]	4.40[a]	4.09[b]	4.19[b]	4.26[ab]	0.07	0.02
Sarcomere length, μm	2.00[a]	1.97[a]	1.97[a]	2.06[b]	0.02	0.005
Area slow oxidative fibers, μm^2	3959[a]	3878[ab]	3420[c]	3470[bc]	154	0.05

[1]Eight point hedonic scale, 8=extremely desirable; 1=extremely undesirable

Key Words: Birth weight, Litter size, Pork quality

119 Effect of castration or raw potato starch supplementation prior to slaughter on growth performance, carcass characteristics, and meat quality of entire male pigs. C. Pauly[2,1], S. Ampuero[1], S. Dubois[1], J. Messadène[1], and G. Bee*[1], [1]*Agroscope Liebefeld Posieux, Posieux, Switzerland*, [2]*Swiss College of Agriculture, Zollikofen, Switzerland*.

In Switzerland, castration of piglets without anesthesia will be banned in 2009. In view of recent results from a large Swiss home use test study revealing a rather high acceptance of pork from boars, rearing entire males could be an alternative to castration. Regardless of these results, Swiss meat processors are reluctant to entire male production because they fear a high incidence of boar tainted pork and consequently unsatisfied customers. Thus, the objective of the study was to compare the growth performance, carcass characteristics, and meat quality traits as well as to evaluate by a trained sensory panel the incidence of boar taint in the neck and LM from boars and castrates. Furthermore, the effect of raw potato starch (**RPS**) fed for 7 d prior to slaughter on skatole levels in the backfat was determined. Thirty-six Swiss Large White pigs were blocked by BW into 12 blocks (3 littermates/block) and assigned to the experimental groups: **C**: castrates; **B**: boars; **B+**: boars offered 30 g RPS/100 g diet. The pigs were group-penned from 20 to 105 kg BW and had *ad libitum* access to the diets. Boars grew slower (774 vs. 830 g/d; $P < 0.01$), consumed less feed (1.88 vs. 2.23 kg/d; $P < 0.01$), were more efficient (gain to feed: 0.41 vs. 0.37 kg/kg; $P < 0.01$) and were leaner (56.9 vs. 52.6%; $P < 0.01$) than C. Meat quality traits did not ($P > 0.05$) differ among C, B, and B+. On a scale from 1 (weak) to 10 (strong), sensory scores for boar odor and flavor were lower ($P < 0.05$) in the loin than the neck and were lower ($P < 0.05$) in C than B and B+. Feeding RPS reduced ($P < 0.05$) the skatole level of B+ compared to B (0.22 vs. 0.85 μg/g) but that of indole and androstenone and sensory scores did not ($P > 0.05$) differ. The low ADFI of boars compared to C concurred with the low ADG and leaves the question open whether appetite was limited or ADFI was low because of increased physical activity. Despite that sensory scores were up to 2 points higher in B and B+ than C, the scores were on average lower than 5 indicating surprisingly high acceptance of pork from boars.

Key Words: Boar production, Growth performance, Sensory quality

120 Implant programs in the presence of a beta-agonist. K. J. Vander Pol*, M. S. Davis, W. C. Koers, and O. A. Turgeon, Jr., *Koers-Turgeon Consulting Services, Inc., Salina, KS.*

A 208 d finishing trial using 1434 crossbred Mexican steers (BW = 279 kg) was conducted at a commercial feedyard in Watonga, OK by Bos-Technica Research Services, Inc. The objectives were to evaluate the effects of implants in the presence or absence of a beta-agonist on performance, health, and carcass characteristics. Treatments were: 1) initial implant (Revalor–S) with a beta-agonist (IBA), 2) initial implant (Revalor–IS) and reimplant (Revalor–S; RI), and 3) initial implant (Revalor–IS) and reimplant (Revalor–S) with a beta-agonist (RIBA). A RCBD with 6 blocks in 18 pens, and 78 to 80 steers/pen was utilized with pen serving as the experimental unit. Steers were fed a 95% concentrate diet providing 33 g monensin/909 kg (DM basis) and 90 mg tylosin/(hd·d) until the last 28 d of the trial when IBA and RIBA steers were fed an additional 200 mg ractopamine hydrochloride/(hd·d). On d 48 (range = 46 to 49) RI and RIBA steers were re-implanted, whereas IBA steers were not removed from their home pen. No differences ($P > 0.05$) existed for morbidity (0.56%), mortality (2.51%), final BW (538 kg), ADG (1.25 kg·d), DMI (7.94 kg), G:F (0.157), HCW (348 kg), USDA yield grade, marbling score (394), 12th rib fat thickness (0.87 cm), or liver abscesses (8.27%). Dressing percent was higher ($P < 0.05$) for RIBA than RI steers (64.9 vs. 64.4%). Percentage of USDA Choice carcasses was greatest ($P < 0.05$) for IBA (38.0 vs. 29.5%), while percentage of USDA Standard carcasses was less ($P < 0.05$; 13.7 vs. 22.4%). Longissimus muscle area was largest ($P < 0.05$) for RIBA (86.1 vs. 83.6 cm^2). In summary, reimplanting in the presence or absence of a beta-agonist did not improve performance compared to a single implant used in conjunction with a beta-agonist. A system using a single implant combined with a beta-agonist 28 d prior to slaughter provided similar performance and health and improved carcass quality when compared to reimplant programs with or without a beta-agonist.

Key Words: Finishing steers, Implants, Beta-agonist

121 Effects of wet distillers grains plus solubles on marbling attributes and fat content of beef. A. S. de Mello Junior*, C. R. Calkins, B. E. Jenschke, L. S. Senaratne, and G. E. Erickson, *University of Nebraska, Lincoln.*

Marbling is an important attribute of beef quality. Some have suggested that feeding wet distillers grains plus solubles (WDGS) can alter marbling (or perception of marbling) in beef. In this study, yearling, crossbreed steers (n = 92) were randomly allocated to three treatments (0, 15 and 30% WDGS; DM basis) and fed for 115 d to determine the effects of WDGS on marbling attributes and fat content. Marbling score, marbling texture and marbling distribution were evaluated by a USDA grader 48 h *post mortem*. One ribeye slice (*m. longissimus thoracis*), about 7 mm thick, was excised from each carcass and vacuum packed until the fat analysis could be made. In addition, short loins (IMPS #174) and shoulder clods (IMPS #114) were obtained from the left side of each carcass and shipped to the University of NE Meat Laboratory. After 7 d of aging, tenderloins (m. *psoas major*) and top blades (m. *infraspinatus*) were removed from their respective primal cuts and one steak was cut to evaluate fat content. For the treatments 0, 15 and 30% WDGS, 80%, 81.3% and 73% of the carcasses were graded USDA Choice, respectively. No significant difference was observed on marbling score ($Small^{20}$, $Small^{22}$ and $Small^{30}$ for 0, 15 and 30%, respectively; $P = 0.89$) and marbling texture (1.67, 1.87 and 1.77 for 0, 15 and 30%, respectively; $P = 0.70$). Choice carcasses from cattle fed 30% had greater marbling distribution when compared to 0 and 15% (1.00^b, 1.00^b and 1.15^a for 0, 15 and 30%, respectively). Wet distillers grains plus solubles finishing diets did not alter fat content (%) of ribeye slices ($P = 0.22$), tenderloins ($P = 0.28$) and top blade steaks ($P = 0.85$). There were linear relationships between marbling and fat for all treatments ($P < 0.05$) and slopes were statistically equal ($P = 0.99$). Although minimal effects were identified in marbling distribution of choice carcasses, results of this work indicate that WDGS do not alter fat content and the relationship between fat and marbling in beef.

Key Words: Beef, Distillers grains, Marbling

122 Interactions of mammalian synemin with the costameric protein talin. N. Sun* and R. M. Robson, *Iowa State University, Ames.*

The mammalian striated muscle cell cytoskeleton consists primarily of the contractile myofibrils and the heteropolymeric intermediate filaments (IFs), which are formed by the major type III intermediate filament (IF) protein desmin together with a smaller amount of the type VI IF protein synemin. These IFs encircle all of the myofibrils at their Z-lines and thereby link all adjacent myofibrils together within developed striated muscle cells. The desmin/synemin heteropolymeric IFs also link the peripheral layer of the cellular myofibrils to the sarcolemma at sites called costameres, which are multi-protein assemblies located immediately subjacent to the sarcolemma and in register with the nearby myofibrillar Z-lines. The objective of this study was to determine the detailed mechanism by which the IF protein synemin interacts with the costameric protein talin. Synemin is a very large, highly unique member of the IF protein superfamily. The single mammalian synemin gene encodes two major splice variants that are expressed and named α-synemin and β-synemin. The larger α-synemin contains an additional 312 amino acid insert (SNTIII) that is present near the end of its long C-terminal tail domain. By using co-immunoprecipitation assays, we found that mammalian synemin co-precipitated with talin from human uterine smooth muscle cell extracts. Subsequent, additional protein-protein interaction assays demonstrated that SNTIII specifically binds to the rod domain of talin. EGFP-tagged SNTIII also co-localized with talin at the focal adhesion sites within transfected mammalian smooth muscle cells. Results of immunofluorescence confocal microscopy showed that mammalian synemin and talin co-localized within the costameric structures located periodically along, and subjacent to, the sarcolemma of mammalian skeletal muscle cells. In toto, our results support a model in which mammalian α-synemin helps to link the desmin/synemin heteropolymeric IFs to the muscle cell sarcolemma via its interaction with talin, and thereby helps provide overall integration of the muscle cell cytoskeleton. (Supported by USDA-CSREES-NRICGP Award 2003-35206-12823)

Key Words: Intermediate filaments, Synemin, Talin

123 Identification of chlortetracycline (CTC)-sensitive pathways in the liver and *longissimus dorsi* tissues in beef steers using microarray technology. K. R. Brown*, L. Huang, A. J. Stromberg, D. Wall, K. Chen, J. A. Boling, and J. C. Matthews, *University of Kentucky, Lexington.*

Chlortetracycline (CTC; AUREOMYCIN, Hoffman La Roche, Inc.), is an antibiotic commonly used at subtherapuetic levels to promote

growth and improvements of carcass quality in cattle. To determine cellular mechanisms and tissues potentially responsible for enhanced REA and hepatic function of CTC-fed cattle, we assessed potential shifts in mRNA expression in the liver and *longissimus dorsi* (LD) tissues of steers consuming a common finishing diet with or without CTC using the Affymetrix GeneChip® Bovine Genome Array. Experimental treatments were arranged as a 2 × 2 repeated measures factorial with main effects of added CTC (0 or 350 mg/d) fed for 112 d and tissue (liver and LD collected from the same steer) at harvest (n = 6; CTC (BW = 544 kg) > ($P = 0.07$) no CTC (BW = 514 kg). Approximately 77% of the probe sets representing 23,000 genes were detected in liver and 70% in LD tissue. CTC treatment altered ($P < 0.01$) the expression of 142 liver genes (53 up-regulated, 89 down-regulated) and 63 LD genes (36 up-regulated, 27 down-regulated). The genes affected by CTC consumption were subjected to metabolic pathway analysis (INGENUITY Pathways Analysis, Ingenuity Systems, Inc.). The expression of liver mRNA regulated by CTC included those which encode for proteins involved with xenobiotic, LPS/IL-1, alanine, aspartate, and tryptophan metabolism, such that the potential for cell survival, immune system response, and gluconeogenesis was increased. The expression of LD genes regulated by CTC included IGF-I, IL-6, and PI3K/AKT signaling, such that the potential for cell growth and proliferation was increased. These results suggest that the enhanced potential for LD tissue accretion in CTC-fed cattle was supported by an increased potential for glucose production by the liver.

Key Words: Chlortetracycline, Gene expression, Growth

124 Growth of protein, moisture, lipid and ash of two genetic lines of barrows and gilts from twenty to one hundred twenty-five kilograms body weight. A. Schinckel*[1], D. Mahan[2], T. Wiseman[2], and M. Einstein[1], [1]*Purdue University, West Lafayette, IN*, [2]*The Ohio State University, Columbus*.

The objective of this study was to evaluate dfferences in the chemical growth of pigs with different lean growth rates. Two genetic lines of barrows and gilts were used to determine chemical composition growth from 23 to 125 kg BW. The experiment was conducted in 2 replicates with 6 pigs from each gender and genetic line were killed at 25 kg intervals from 23 kg BW to 125 kg BW. Body components were analyzed for water, protein, lipid, and ash. The allometric function, component mass= aBW^b, provided the best fit to the body component data. The overall ADG of the genetic lines were not different ($P > 0.05$). Barrows had 0.052 kg/d greater ADG than the gilts ($P < 0.01$). The allometric coefficients for all four chemical components were different ($P < 0.01$) for each genetic line. The allometric coefficients and predicted relative growth (g/kg BW gain) for protein and moisture mass were greater ($P < 0.01$) for the high lean-gain (HLG) pigs than the low lean-gain (LLG) pigs. The allometric coefficients for lipid mass were lesser ($P = 0.001$) for the HLG pigs than the LLG pigs. The allometric coefficients and predicted relative growth rates for lipid mass were greater ($P < 0.01$) and for moisture and protein mass lesser ($P < 0.002$) for barrows than the gilts. In comparison to LLG pigs, HLG pigs had: (1) 32.8% lesser daily rates of lipid deposition, (2) 12.3% greater daily rates of protein deposition, and (3) 18.8% greater daily moisture accretion rates. Barrows had 21.3% greater lipid deposition (49 g/d) than gilts. In summary, the HLG pigs had greater rates of protein and moisture accretion and substantailly lesser rates of lipid accretion than LLG pigs.

Key Words: Chemical composition, Genotype, Pig growth

125 A rapid technique for predicting oxidation capacity of fresh beef. L. S. Senaratne*, C. R. Calkins, and T. P. Carr, *University of Nebraska, Lincoln*.

Oxidation is the primary cause of color deterioration in beef during storage, reducing shelf life and value. Lipid oxidation is influenced by total fat content, especially polyunsaturated fatty acids (PUFA), oxygen exposure, and the presence or absence of antioxidants. The objective of this research was to develop a technique to predict the oxidation capacity of fresh beef. Conjugated diene hydroperoxides are produced from PUFA during oxidation. Nine different solvents (n-propanol, hexane, dimethyl sulfoxide, ethanol, methanol, chloroform, 2-propanol, Tween 20, and Triton X 100) at different concentrations were checked for the lipid solubility and interference with the absorbance at 234 nm in phosphate buffered saline (PBS), pH 7.4. Twenty percent 2-proponol had the highest fat solubility and lowest interference with the absorbance at 234 nm and therefore it was selected as the solvent for the meat extraction. The time courses for oxidation of two different infraspinatus muscles isolated from two beef animals were continuously measured spectrophotometrically by monitoring the conjugated dienes formation catalyzed by $CuSO_4$ at 37°C. There were three consecutive phases, a lag phase (2 min) during which the dienes absorbance increased slowly, a propagation phase (14 min) where the dienes absorbance increased rapidly and finally a plateau or decomposition phase. All the replicates of the each muscle showed similar magnitude of absorbance throughout the diene formation period of 20 min. The mean rate of diene formation in the propagation period of each muscle was 0.136 ± 0.0018 and 0.091 ± 0.0055 absorbance/min with a coefficient of variance of 5.62% and 6.02%, respectively. The new technique was applied to monitor *in vitro* oxidation of different concentrations PUFA (0.2, 0.4, 0.6 and 0.8 g of linoleic acid/L). Diene formation increased with the increase of concentrations of linoleic acid (0.268, 0.429, 0.665, and 0.982 absorbance at 20 min for 0.2, 0.4, 0.6 and 0.8 g of linoleic acid/L, respectively). This technique is an easy and rapid way of predicting the oxidation capacity of beef.

Key Words: Beef, Conjugated dienes, Oxidation

126 Use of bioelectric impedance to predict dissected lean tissue of market weight lamb carcasses. J. Galbreath*, P. Berg, K. Carlin, J. Caton, D. Redmer, L. Reynolds, K. Vonnahme, and E. Berg, *North Dakota State University, Fargo*.

Sixty-five Rambouillet lamb carcasses, average weight 24.69 (SD 3.52) kg were used to evaluate bioelectric impedance (BEI) technology as a means of predicting dissected lean tissue. Live lambs were harvested under humane commercial procedures and carcasses chilled for 24 h. Chilled carcass wt was obtained and BEI measures of whole carcass resistance (Rs; ohms), reactance (Xc; ohms, carcass temperature (degrees C), and length (cm) between detector terminals were recorded. After BEI measurements were recorded, carcasses were ribbed between the 12th and 13th rib and ribeye area, subcutaneous backfat depth, and bodywall thickness were recorded. Carcasses were then split down the medial plane and the right halves were frozen until dissection. Carcasses sides were dissected and weights obtained for total knife-separable external fat, internal (seam) fat, peri-renal fat, bone, and lean tissues. Purge remaining in the vacuum bag after thawing was added to the weight of the lean soft tissue. Chilled carcass wt and ribeye area had the highest correlation with dissected lean tissue (r = 0.79 and 0.63, respectively; $P < 0.001$). The BEI measures of Rs and Xc were not

significantly correlated to dissected soft tissue ($P < 0.05$). Stepwise regression analysis was used to create a linear regression equation for the prediction of dissected lean tissue. The equation included chilled carcass wt, RS, Xc, and carcass length ($R^2 = 0.75$; RMSE = 377 g). The same variables used to predict total dissected fat tissue explained 75.6% of the variation with an RMSE of 551 g. In a separate test, BEI prediction equations developed at Purdue University for estimating chilled carcass dissected lean were evaluated for accuracy. Purdue predicted dissected lean was significantly ($P < 0.001$) correlated with actual dissected lean ($r = 0.848$). However, the Purdue BEI equation overestimated dissected lean tissue, on average, 2.80 kg.

Key Words: Lamb, Composition, Bioelectric impedance

127 Finishing diets containing wet distillers grains plus solubles increase the levels of polyunsaturated, omega 6 and C 18:2 fatty acids in yearling beef steers. A. S. de Mello Junior*, C. R. Calkins, B. E. Jenschke, L. S. Senaratne, and G. E. Erickson, *University of Nebraska, Lincoln*.

Ninety-two yearling, crossbreed steers were randomized in three groups and fed with three different finishing diets (0%, 15% or 30% - WDGS DM basis) to identify the effects of WDGS on fatty acid profile of beef. One ribeye slice (*m. longissimus thoracis*) about 7 mm thick was excised from each carcass and transferred to the University of NE under refrigeration where it was trimmed and analyzed for fatty acid profile (weight, %) and fat content (%). Beef from animals fed 30% WDGS had 45% more polyunsaturated fatty acids than controls (4.23^b, 4.91^b, 6.15^a for 0, 15 and 30%, respectively; $P < 0.01$). As amount of WDGS in the diet increased (0, 15 and 30%), there were higher values of omega 6 fatty acids (3.81^c, 4.53^b and 5.71^a, respectively; $P < 0.01$) and C 18:2 (2.19^c, 3.25^b and 4.15^a, respectively; $P < 0.01$). No treatment effects were observed for content of total lipid (5.00, 6.22, and 5.73% for 0, 15 and 30%, respectively; $P = 0.22$), total unsaturated fatty acids (52.08, 54.07, and 53.87% for 0, 15 and 30%, respectively; $P = 0.15$), total monounsaturated fatty acids (48.59, 49.94, and 48.70% for 0, 15 and 30%, respectively; $P = 0.42$), C 18:1 (36.89, 37.82, and 36.35% for 0, 15 and 30%, respectively; $P = 0.46$), and total saturated fatty acids (43.30, 43.86, and 43.79% for 0, 15 and 30%, respectively; $P = 0.63$). However, greater amounts of C 18:1 isomers, such as C 18:1Δ^{13}, C 18:1$\Delta^{6\text{-}8}$ and C 18:1Δ^{10}, were observed in beef from animals fed WDGS ($P \leq 0.01$). Conversely, increasing WDGS in the diet reduced concentrations of cis-vaccenic acid [C18:1, n7] (1.83^a, 1.56^b and 1.44^c, for 0, 15 and 30%, respectively; $P < 0.01$) and C 16:1 (3.46^a, 2.97^b and 2.81^b for 0, 15 and 30%, respectively; $P < 0.01$). Results of this work demonstrate that feeding up to 30% WDGS to yearling cattle elevates the content of polyunsaturated fatty acids. This may have negative implications to oxidation capacity, color and shelf-life.

Key Words: Beef, Distillers grains, Fatty acid

128 Predicting aged beef tenderness with hyperspectral imaging and the relationship to muscle properties. L. M. Grimes*, G. Konda Naganathan, J. Subbiah, and C. R. Calkins, *University of Nebraska, Lincoln*.

Hyperspectral imaging (**HSI**) captures multiple reflectance images from 900-1700 nm at 3 nm intervals. These images can be used to predict beef tenderness. Reflectance data are influenced by the muscle properties. The objectives of this research were to develop a HSI system that accurately predicts 14 d aged beef tenderness from scans of 2 d aged beef and to determine what muscle properties HSI is using to determine beef tenderness predictions. Longissimus steaks (n = 249) were scanned at 2 d postmortem, vacuum packaged, aged to 14 d and frozen. For 14 d tenderness determination, steaks were thawed overnight, cooked in an impingement oven and slice shear force (**SSF**) values were obtained. Matching steaks were aged 2 d or 14 d postmortem and frozen for biochemical and muscle structure analyses and trained taste panel evaluation (**TP**). For TP, 14 d steaks were broiled to 70°C. Using hyperspectral image features, canonical discriminant models were developed to predict 3 tenderness categories (tender, intermediate, and tough) based on SSF or TP measurements. A TP model with 22 variables was 71.8% accurate at predicting tenderness categories. The model correctly predicted 65 of 94 tender samples, 11 of 16 intermediates, and 26 of 32 tough samples. The first canonical variable was significantly correlated to 14 d troponin–t (**TNT**) proteolysis ($P < 0.05$), while the second canonical variable was related to moisture ($P = 0.07$). SSF categories were: tender ≤ 21.0 kg, intermediate 21.1 to 24.9 kg, and tough ≥ 25.0 kg. A SSF model with 30 variables was 77.4% accurate, correctly identifying 118 of 151 tender samples, 17 of 23 intermediate samples, and 19 of 25 tough samples. The first canonical variable was significantly correlated to pH ($P < 0.01$), 14 d TNT ($P < 0.01$), fat ($P < 0.01$), and moisture ($P < 0.01$), while the second canonical variable was significantly correlated to insoluble collagen ($P < 0.05$). Both models were successful in predicting 14 d aged beef tenderness and showed significant correlations with muscle properties.

Key Words: Hyperspectral imaging, Tenderness, Grading

129 Effects of vitamin A restriction on retail shelf-life and sensory attributes of Longissiumus and Triceps brachii steaks from traditionally and early-weaned calves. M. J. Daniel*, M. E. Dikeman, A. M. Arnett, and S. Hutchison, *Kansas State University, Manhattan*.

Vitamin A (VA) restriction during finishing has been shown to increase marbling in cattle. However, little work has been done to look at the effects that vitamin A restriction may have on sensory attributes and retail shelf-life of beef. This study involved calves (n=48) either early-weaned at 140 d or traditionally-weaned at 210 d and supplemented with 15,400 IU/kg of VA or restricted to only 1,100 IU/kg of VA during the finishing phase. Strip loins and shoulder clods were retrieved and cut into steaks after 14 d of aging. Visual and instrumental color scores for 7 d of retail display, thiobarbituric acid reactive substances values, trained sensory panel scores, and Warner-Bratzler shear force values were obtained. The only differences due to weaning group were that L* values were lower on d 1 to 3 for Triceps brachii steaks from early-weaned calves supplemented with high VA. Both Longissiumus and Triceps brachii steaks from calves supplemented with high VA had less ($p<0.05$) desirable color scores after 4 d of display in PVC packaging. Also, a*, b* and saturation index values were lower ($p<0.05$) for the high VA treatment. There was less lipid oxidation ($p<0.05$), as reported by TBARS, in both muscles from calves restricted in VA. There were no treatment effects on tenderness or flavor in either muscle. Vitamin A restriction not only poses potential for increasing marbling during finishing, but also possible positive effects on retail display and lipid stability.

Key Words: Vitamin A, Early-weaning, Retail display

105 Digestible and net energy contents of field peas in gestating sows. R. Premkumar*, A. Samaraweera, P. Kish, J.F. Patience, and P. Leterme, *Prairie Swine Centre Inc., Saskatoon, SK, Canada*.

The digestible (DE) and net energy (NE) contents of feed ingredients such as field peas, are higher in sows than in growing pigs, owing to the better capacity of sows to use fermentable carbohydrates. Therefore, specific energy values are required for sows. However, it is unclear whether the better digestive capacity also reduces the variability in DE and NE contents of ingredients produced in different conditions, which is the case of field peas. In order to answer to that question, pea samples grown in different parts of Western Canada were collected in 2006 and analyzed. The crude protein, starch and NDF contents ranged, respectively, from 21 to 26 %, 42 to 50 % and 12 to 18% of the dry matter. The DE and NE contents of 15 samples were measured in gestating sows. A basal diet composed of barley, soybean meal, minerals and Celite (source of insoluble ash, used as a marker) was formulated. Fifteen diets containing 40% peas, at the expense of barley and soybean meal, were then prepared. A total of 96 gestating sows were fed one of the 15 diets (6/diet) and a faecal sample was collected by grab sampling for 3 consecutive days after 10 days of adaptation to the diet. The average DE and NE content was, respectively, 3,699 kcal and 2,585 kcal/kg DM. The DE contents ranged from 3,440 to 4,052 kcal/kg DM and the NE from 2,402 to 2,835 kcal/kg DM. The range of variation was lower than that observed in growing pigs. No relationship ($P > 0.05$) could be established between the chemical composition of the peas, namely their dietary fibre content, and the energy content. It is concluded that the DE and NE contents of field peas collected on-farm are variable but the variability is not explained by their chemical composition.

Key Words: Sows, Peas, Digestible energy

130 The challenge of incorporating novel energy sources into practical swine diets. J. F. Patience*, A. D. Beaulieu, and P. Leterme, *Prairie Swine Centre, Inc., Saskatoon, SK, Canada*.

Energy is a very important component of practical swine diets. Not only is it the single most costly nutrient, it drives many metabolic processes and thus defines both the rate and composition of growth. Quantitatively, starch is the most common source of energy in today's diets. However, the growth of industrial users of starch, most notably the biofuel sector, will make starch increasingly expensive. Consequently, the landscape of swine nutrition is changing, and is expected to evolve in ways that reduces the use of raw grains and increases the use of co-products of various commercial or industrial processes. It is not surprising, then, that there is growing interest in using alternate sources of energy in pig diets. Unlike other nutrients, energy is not a unique chemical constituent of the diet. Rather, energy can be supplied by carbohydrates, fats, or protein. Moreover, even within each of these, there are sub-groups which differ in their ability to supply energy; qualitatively and/or quantitatively. The most common laboratory method for determining the energy content of a diet or an ingredient, the bomb calorimeter, cannot distinguish among energy sources and it provides no information pertaining to the efficiency of utilization of that energy. Digestibility will differ according to feed factors such as processing, and animal factors such as the age of the pig, and the method of feeding: restricted versus to appetite. Additionally, even when digestibility is accounted for, large differences in biological utilization exist. Dietary energy is used by the pig either for maintenance or for tissue growth (body weight gain, milk synthesis, foetal development). The efficiency with which energy is used for each function differs, and indeed, the composition of gain will affect the efficiency of utilization. Finally, the quantity of energy that the pig can derive from a given energy source may be influenced by processing methods and by the use of exogenous enzymes. All of this makes diet formulation as it relates to energy particularly challenging and the evaluation of novel ingredients as sources of energy a particularly daunting task.

Key Words: Energy, Growth, Pig

131 Prediction of energy digestibility of wheat in grower pigs using an *in vitro* digestibility procedure. P. R. Regmi*[1], N. S. Ferguson[2], A. Pharazyn[2], and R. T. Zijlstra[1], [1]*University of Alberta, Edmonton, AB, Canada,* [2]*Nutreco Canada, Guelph, ON, Canada*.

Wheat is an energy feedstuff for swine; however, the DE content of wheat can vary up to 28% due to changes in energy digestibility. Thus, prediction of energy digestibility is required to determine the DE and economic value of individual batches of wheat and to balance feed formulations. Previously, the energy digestibility of barley for grower pigs was accurately predicted using a cost effective and 3-day *in vitro* digestibility procedure; however, it is not known if the same procedure can be used to predict energy digestibility of wheat. The objective of this study was to evaluate the existing *in vitro* procedure to predict energy digestibility and DE content of wheat in grower pigs. Wheat samples ($n = 20$) with a wide range in physical and chemical characteristics (56.0 to 77.3 kg/hL test weight, 13.4 to 22.8% CP, 3.1 to 6.4% ADF, 10.3 to 19.7% NDF, and 1.8 to 2.9 % EE) were collected from Western Canada. Energy digestibility of the samples was analyzed using the *in vitro* procedure. Briefly, the samples were subsequently digested with pepsin (6 h), pancreatin (18 h), and cellulase (24 h), and DM and GE of the samples and residues were measured. *In vitro* energy digestibility ranged from 79.8 to 91.0 % (0.01 to 2.21% relative error), and the *in vitro* DE content ranged from 3.90 to 4.33 Mcal/kg DM. Total-tract energy digestibility of the samples, measured in 60 crossbred barrows, ranged from 72.7 to 83.7% (0.5 to 2.3% relative error), and *in vivo* DE content ranged from 3.55 to 4.06 Mcal/kg DM. *In vitro* energy digestibility had a linear relationship with *in vivo* energy digestibility ($R^2 = 0.65$). Curvilinear relationships did not improve the prediction, indicating that neither substrate nor enzymes limited the *in vitro* energy digestibility procedure. These results indicated that the DE content of wheat for grower pigs can be predicted using the *in vitro* digestibility procedure. The procedure might also be used as a screening procedure to calibrate rapid analytical equipments to predict *in vivo* energy digestibility.

Key Words: Energy digestibility, Wheat, Pig

132 Effects of fibrous ingredients on pig performance and body composition. L. L. Stewart*[1], D. Y. Kil[1], J. F. Patience[2], G. L. Allee[3], J. E. Pettigrew[1], and H. H. Stein[1], [1]*University of Illinois, Urbana,* [2]*Prarie Swine Centre, Saskatoon, SK, Canada,* [3]*University of Missouri, Columbia*.

An experiment was conducted to measure effects of including 30% soybean hulls (SBH) or 30% wheat middlings (WM) in corn soybean meal

diets. Forty growing (initial BW: 25.4±1.41 kg) and 40 finishing (initial BW: 84.8±3.47 kg,) barrows were randomly allotted to 5 treatment groups within each stage of growth with 8 pigs per group. Two groups (16 pigs) at each stage of growth served as the initial slaughter groups (ISG) and were harvested at the initiation of the trial. The remaining 3 groups were randomly assigned to 3 diets that were provided on an ad libitum basis for 28 d in the grower phase and for 35 d in the finisher phase. All pigs were harvested at the end of the feeding period. Results showed that during the grower phase, ADG and G:F were greater ($P \leq 0.05$) for pigs fed the control corn-soybean meal diet (1.15 kg and 0.56 kg/kg) than for pigs fed the SBH (0.97 kg and 0.47 kg/kg) or the WM (0.89 kg and 0.48 kg/kg) diets. However, during the finishing phase, no differences in ADG or G:F were observed among treatments. In growing pigs, hot and chilled carcass weights and the dressing percentage were lower ($P \leq 0.05$) for pigs fed the SBH and WM diets compared with pigs fed the control diet, but weights of blood and viscera did not differ among treatments. The percentage and the total amount of fat in the carcass was lower ($P \leq 0.05$) for pigs fed the SBH and WM diets than for pigs fed the control diet, but the concentration and amount of protein in the carcass was not different among treatments. The percentage and total amount of fat in the carcass was lower ($P \leq 0.05$) in ISG pigs than in pigs fed the treatment diets. In finishing pigs, no differences in carcass concentrations of fat or protein were observed among treatments, but the total concentration of fat was greater ($P \leq 0.05$) in pigs fed the control diet (41.45 kg) than in pigs fed the SBH or the WM diets (35.0 and 36.7 kg). The ISG pigs had a lower ($P \leq 0.05$) concentration of fat, but a greater concentration of protein ($P \leq 0.05$) than pigs fed the treatment diets. In conclusion, the inclusion of SBH and WM affects performance and body composition more in growing pigs than in finishing pigs.

Key Words: Pig, Soybean hulls, Wheat middlings

133 Digestible and net energy contents of field peas in growing pigs. P. Leterme*, P. Kish, A. Samaraweera, A. D. Beaulieu, and J. F. Patience, *Prairie Swine Centre Inc., Saskatoon, SK, Canada*.

Field peas express a high variability in composition, due to genetic differences and variation in growth conditions. This project aimed to study the consequences of that variability on the digestible (DE) and net energy (NE) contents in growing pigs. Pea samples grown in different parts of Western Canada were collected in 2005 and analyzed. The crude protein, starch and total dietary fiber (TDF) contents ranged, respectively, from 19 to 28 %, 39 to 51 % and 19 to 24% of the dry matter. Based on their composition, 23 samples were selected and their DE value was measured in growing pigs at 2 BW (20 to 25 kg and 50 to 60 kg). A basal diet composed of barley, wheat, soybean meal, minerals and Celite (source of insoluble ash, used as a marker; 0.4%) was formulated and 23 diets containing 30% peas, at the expense of the basal diet, were prepared. A total of 144 pigs were fed with one of the 24 diets (6/diet) and a fecal sample was collected by grab sampling for 3 consecutive days, after a 10d-adaptation period. Once the pigs had reached a 50 kg-bodyweight, the procedure was repeated. The DE content of the pea samples alone was calculated and their NE content estimated by means of prediction equations. The average DE and NE in 20kg- and 50kg-pigs were, respectively: 3,715 and 3,923 kg DE/kg DM and 2,577 and 2,715 kcal NE/kg DM. The range of variation was extremely high: from 3,185 to 4,555 kcal DE/kg DM and from 2,222 to 3,084 kcal NE/kg DM. The DE and NE content was higher in 50kg-pigs (+ 208 kcal DE and + 138 kcal ND/kg DM; $P < 0.001$) and there was a high correlation ($P < 0.001$) between the results obtained in small and large pigs. Attempts to establish a relationship between the composition of the peas and their energy contents failed: the correlation with ADF was 0.09 ($P > 0.05$) and that between NDF and DE was –0.22 ($P > 0.05$). It is concluded that the DE and NE content of peas in pigs are extremely variable between pea samples grown in different conditions but the variability is not explained by their chemical composition.

Key Words: Pig, Peas, Digestible energy

134 The interaction of dietary flaxseed and length of feeding on the fatty acid profile of subcutaneous fat in grower-finisher pigs. J. F. Patience[1], A. D. Beaulieu*[1], M. E. R. Dugan[2], J. L. Aalhus[2], P. Leterme[1], I. U. Haq[1], and R. T. Zijlstra[3], [1]*Prairie Swine Centre, Inc., Saskatoon, SK, Canada,* [2]*Agriculture and Agri-Food Canada Lacombe Research Centre, Lacombe, AB, Canada,* [3]*University of Alberta, Edmonton, AB, Canada*.

Successful production of pork enriched with omega-3 (n-3) fatty acids (FA) requires consistent attainment of the desired tissue concentration. Reports on the effect of length or level of flaxseed inclusion are limited, and the results contradictory. This study examined the impact of diet concentration and length of feeding of flaxseed on n-3 concentrations in the subcutaneous fat (SQF) of pigs. Eighty pigs (31.0 ± 2.9 kg) were fed a wheat, soybean meal control diet for 12 wk or diets containing 10, 20, or 30% LinPro® (50:50 flaxseed:peas co-extruded for optimal linolenic acid [18:3n-3] availability) for 12, 8 or 4 wk prior to sampling. SQF samples were obtained by biopsy at the 10th rib, 5 cm from the midline. Increasing dietary flaxseed level from 5 to 15% decreased ADFI (2.62 to 2.45 kg/d; linear, $P<0.05$), improved G:F (0.39 to 0.41; linear, $P<0.05$) while ADG did not change (mean 0.99 kg/d). Increasing the length of flaxseed feeding from 4 to 12 wk decreased ADG (1.01 vs. 0.97 kg/d) and ADFI (2.57 vs. 2.46 kg/d; $P<0.05$) while G:F was not affected. Linolenic acid in SQF, as a % of total FA, was increased by flaxseed level (1.22% control, 4.72 to 13.6%; 5 to 15% flaxseed) and length of feeding (5.74 to 9.75%; 4 to 12 wk). Pigs fed 15% flaxseed for 12 wk had the highest concentration of 18:3n-3 (18.6%; diet by wk, $P<0.001$). A similar pattern was observed for total n-3 and n-6 FA (diet by wk, $P<0.02$). Increases for 18:3n-3 were linear over time for all levels of flaxseed inclusion ($R2>0.99$). The SDs and CVs were lower when feeding for a longer period within flaxseed level. Increasing dietary flaxseed concentration or length of feeding decreased the n-6/n-3 ratio from 1.92 to 0.89 and 1.76 to 0.99, respectively (diet by wk, $P<0.001$). Saturated FA concentration decreased from 36 to 30% as dietary flaxseed level increased and from 31.8 to 30.3% with increased feeding time (diet by wk; $P<0.05$). Increasing either dietary flaxseed level or length of feeding increased n-3 FA in SQF. Maximal levels were obtained when feeding 15% flaxseed for 12 wk. Consistency of n-3 enrichment improved with length of feeding.

Key Words: Swine, Omega-3 FA, Flaxseed

135 Effects of increasing choice white grease in corn and sorghum-based diets on growth performance and fat quality characteristics of finishing pigs. J. M. Benz*, M. D. Tokach, S. S. Dritz, J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan*.

One hundred twenty barrows and gilts (TR4 × 1050; 54 kg) were used in an 83-d experiment to evaluate the effects of increasing added

fat to corn or sorghum-based diets on growth performance and fat quality characteristics. Treatments were arranged in a 2 × 2 × 3 factorial based on grain source (corn or sorghum), gender, and added fat (0, 2.5, or 5% choice white grease; CWG). At the end of the trial, jowl fat and backfat samples were collected. Pigs fed sorghum-based diets had increased (P < 0.01) ADG compared with pigs fed corn-based diets (0.98 vs 0.93 kg). There were no differences in G/F. Increasing CWG increased (linear, P < 0.01) ADG (0.92, 0.96, 0.99 kg) and increased (linear, P < 0.02) 10th rib backfat (17.3, 18.3, 19.8 mm). There was a fat level × grain source interaction (P < 0.03) for iodine value (IV) and percent C 18:2 fatty acids in jowl fat. The interaction was due to the greatest increase in IV and percent C 18:2 fatty acids occurring when CWG was increased from 2.5 to 5% for corn-based diets (69.2, 69.3, 72.2 g; 14.57, 14.13, 15.35%), while the greatest increase was from 0 to 2.5% CWG for sorghum-based diets (66.2, 69.6, 68.9 g; 11.97, 13.85, 13.04%). Despite this interaction, adding CWG increased (linear, P < 0.02) iodine value and percent C 18:2 fatty acids in jowl fat (68.0, 69.5, 70.5 g; 13.39, 13.99, 14.19%) and backfat (62.5, 66.2, 65.9 g; 12.50, 14.02, 13.49%). Adding CWG decreased (P < 0.01) percent saturated fats in jowl fat (36.4, 35.3, 34.3%) and backfat (41.4, 38.7, 38.5%). Pigs fed corn-based diets had increased (P < 0.01) iodine values in jowl fat (70.3 vs 68.3 g) and backfat (65.8 vs 63.0 g), and increased (P < 0.01) percentage C 18:2 fatty acids in backfat (14.4 vs 12.3 compared with pigs fed sorghum-based diets. In summary, substituting sorghum for corn in diets for finishing pigs reduced iodine value while adding CWG increased iodine value.

Key Words: Sorghum, Corn, Iodine value

136 Nutrient digestibility of lupin and air-classified protein and starch fractions of field pea and faba bean in grower pigs. C. K. Gunawardena*[1], R. T. Zijlstra[1], and E Beltranena[1,2], [1]*University of Alberta, Edmonton, Alberta, Canada*, [2]*Alberta Agriculture and Food, Edmonton , Alberta, Canada*.

Nine ileal cannulated barrows (25 kg) were used to establish the ileal AA and whole tract digestibility of energy, Ca, and P in lupin and the air-classified protein and starch fractions of field pea (Pea-P, Pea-S) and zero-tannin (<1%) faba bean (ZTFB-P, ZTFB-S), respectively, and compared to soy protein concentrate (SPC). A cornstarch-sucrose (CS) diet served as the N-free diet for the subtraction of basal endogenous losses. Test diets were formulated to provide 19% CP, 0.9% Ca, and 0.7% P; Cr2O3 was used as indigestible marker (0.375%). Pigs were randomized to diets as a 7 × 7 Latin square. Following a 5 d diet acclimation, feces and subsequently digesta were collected. Apparent ileal digestibility of Lys, Thr, and Met (Table 1) was higher (P < 0.05) for ZTFB and Pea fractions compared to lupin and SPC. Total tract digestibility of energy and DE content was higher (P < 0.05) in Pea-P, lupin and ZTFB-P than SPC. Total tract digestibility of P was higher (P < 0.05) in pea and faba fractions than SPC and of Ca was highest (P < 0.05) for Pea-P. In conclusion, air classification of pea and faba bean results in protein and starch fractions with a high nutritional value for swine.

Table 1. Apparent ileal and total tract nutrient digestibility values (%) for air-classified protein and starch fractions of field pea, zero-tannin faba bean and lupin compared to soy protein concentrate

	SPC	Lupin	ZTFB-P	Pea-P	ZTFB-S	Pea-S	SEM
Lys	85.5^{a}	82.3^{a}	91.3^{b}	89.1^{b}	91.1^{b}	85.4^{a}	1.3
Thr	73.9^{c}	78.0^{bc}	85.8^{a}	82.5^{ab}	82.3^{ab}	77.9^{bc}	2.1
Met	80.2^{b}	61.5^{a}	87.8^{c}	85.2^{bc}	82.8^{bc}	86.3^{bc}	2.8
GE,%	95^{a}	93^{c}	96^{a}	95^{ab}	92^{c}	94^{b}	0.4
DE,% Mcal/ kg DM	4.1^{c}	4.2^{d}	4.2^{d}	4.2^{e}	4.0^{b}	4.0^{b}	0.2
P,% DM	16^{c}	59^{ab}	55^{ab}	69^{a}	56^{ab}	60^{ab}	7.7
Ca,% DM	12^{a}	30^{ab}	7^{a}	46^{b}	41^{b}	31^{ab}	12

superscripts differ (P<0.05)

Key Words: Air classification, Digestibility, Pig

137 A comparative evaluation of a dried milk product (Nutri-Gold®) with other milk protein sources for weanling pigs. G. L. Cromwell*, B. G. Kim, Y. L. Ma, A. D. Quant, and M. D. Lindemann, *University of Kentucky, Lexington*.

Nutri-Gold® (International Ingredient Corp., St. Louis, MO) is a product resulting from the drum drying of fresh, chilled milk collected from grocery stores prior to, but approaching, the expiration date. This product consists of the full line of fresh dairy-case milk (skim milk and milk with 1%, 2%, and 4% fat). The milk is kept chilled throughout the handling process, de-packaged, and gently dried under tightly controlled temperatures. The dried product typically contains 25% CP, 17% fat, 35% lactose, and 41% total sugars. A 22-d experiment involving 90 pigs weaned at 21.1 d and averaging 7.5 kg BW was conducted to compare Nutri-Gold with 3 other sources of milk protein in phase I (8 d) and phase II (14 d) diets. There were 4 replications of 4 or 5 pigs/pen. Treatments were (1) basal diet with no milk protein, and 4 diets with 1.82% milk protein provided by (2) dried skim milk, (3) whey protein concentrate, (4) Nutri-Gold, or (5) casein. The 4 milk protein sources contained 34.9, 34.5, 26.0, and 80.9% CP, respectively. In addition, the Nutri-Gold analyzed 95.8% DM, 17.4% fat, 35.4% lactose, 2.1% glucose, 2.0% fructose, 2.1% sucrose, 0.71% Ca, 0.72% P, and 1.68% Lys. The milk products were substituted for starch (3.1% starch was in the basal diet), and lactose was equalized across diets at 20 and 15% during the 2 phases. Fat, Ca, and P also were equalized across diets. Lysine in the basal diet was 1.17 and 0.99% during the 2 phases and was equalized in diets 2-5 at 1.40 and 1.23%. The basal diet was purposely made slightly deficient in Lys so as to better assess the contribution of the milk protein sources. ADG, ADFI, and feed:gain for the 22-d study were, respectively (395, 421, 418, 444, 444 g/d; 574, 570, 558, 590, 589 g/d; 1.45, 1.35, 1.33, 1.33, 1.33). Pigs fed Nutri-Gold or casein gained faster than controls (P<0.006) and all groups receiving milk protein gained more efficiently (P<0.001) than controls. Feed intake was not affected by treatment. These results indicate that Nutri-Gold is as effective in improving performance in weanling pigs as other milk protein sources when fed in phase I and II nursery diets.

Key Words: Pigs, Milk protein

138 Faba bean and field pea protein concentrates as replacements for specialty proteins in nursery diets for weaned pigs. C. K. Gunawardena*[1], R. T. Zijlstra[1], L. A. Goonewardene[1,2], and E. Beltranena[1,2], [1]*University of Alberta, Edmonton, Alberta, Canada,* [2]*Alberta Agriculture and Food, Edmonton, Alberta, Canada*.

Specialty protein feedstuffs are an expensive component of diets for weaned pigs, and cost- effective alternatives should be developed to ensure that feed costs can be contained. The effect of replacing three specialty protein sources (5% soy protein concentrate, 5% corn gluten meal, 5% menhaden meal) with the air-classified protein fractions of zero-tannin (< 1%) hulled faba bean (16%), dehulled faba bean (16%), or field pea (17.5%) in nursery diets on daily feed disappearance, weight gain, and feed conversion in 3-week-old weaned pigs was tested in this experiment. In total, 192 crossbred Hypor pigs (7.5± 1.4 kg at 27d) were used to evaluate the four diets. The wheat-based test diets contained 10% SBM and 10% whey permeate and were formulated to provide 3.60 Mcal DE and 3.3 g SID Lys/Mcal DE. Two barrows and two gilts per pen had ad libitum access to the test diets from the pen self-feeder for 28 d starting one week post-weaning (20 d), for a total of 12 pen observations per diet. Pigs were individually weighed and pen feed disappearance was measured weekly. Measured for the entire study period, protein source did not affect daily feed disappearance, weight gain, or feed:gain, indicating that changes in specialty protein sources at the specific dietary inclusion levels did not affect growth performance. In conclusion, faba bean and field pea protein fractions are cost effective replacements for specialty protein sources in diets for weaned pigs.

Table 1. Effect of dietary protein source on daily feed disappearance, weight gain and gain:feed

	Hulled Fababean Protein Concentrate	De-hulled Fababean Protein Concentrate	Field Pea Protein Concentrate	Specialty Proteins	SEM
ADF, g/d	648	654	685	662	14
ADG, g/d	483	484	504	486	12
Gain:feed	0.758	0.758	0.755	0.740	0.01

Key Words: Air-classification, Fababeans, Weaned pigs

139 Full-fat oat groats for weaned pigs. P. Leterme*[1], B. Rossnagel[2], A. Samaraweera[1], and J. F. Patience[1], [1]*Prairie Swine Centre Inc., Saskatoon, SK, Canada,* [2]*University of Saskatchewan, Saskatoon, SK, Canada*.

High-fat oat groats (HFOG; 9.5% oil and 17% crude protein) could be an ingredient of interest for weaned pigs. Two experiments were carried out to determine their nutritional value and the growth performances of weaned pigs fed graded levels of HFOG. Eight pigs were fed with a diet composed of 95% HFOG and 5% of minerals, including an indigestible marker. After fecal sample collection, the pigs were killed, 4h after the last meal, and the ileum content was collected. The DE content was 3,724kcal/kg DM and oil digestibility was 0.6. The apparent ileal digestibilities of N and lysine were 0.80 and 0.78, respectively. For the growth study, a control diet was formulated with 63% wheat, 16% soybean meal, 2% fish meal, 3.5% blood cells, 7% whey, 4.5 % canola oil, minerals and amino acids. Three other diets were formulated to contain 15, 30 or 45% of the diet, at the expense of wheat and soybean meal. All the diets contained 2.35 Mcal NE/kg DM and 11 g SID Lysine/kg DM. The 192 pigs (6.8 kg, 1 week after weaning) were distributed in 48 pens of 4 pigs (2 males, 2 females) and the 4 treatments were randomly allocated to the pens. The pigs were weighed weekly for 4 weeks. No difference in daily gain, feed intake and feed conversion was observed between treatments (P > 0.05). The combined, average values of daily gains were 229, 427, 612 and 726 g/d, respectively, for the 4 consecutive weeks. In conclusion, HFOG can replace wheat in rations for nursery pigs.

Key Words: Pigs, Oat groats, Nutritional value

140 Impact of increasing levels of soybean hulls on nitrogen and energy digestibility in growing pigs. D. M. Sholly*[1], B. E. Aldridge[1], K. L. Saddoris[2], A. L. Sutton[1], and B. T. Richert[1], [1]*Purdue University, West Lafayette, IN,* [2]*Akey, Lewisburg, OH*.

Eight barrows (avg initial BW=19.7 kg) were surgically fitted with simple T cannulas to determine the N and energy digestibility of diets with soybean hulls (SH) in growing pigs. Pigs were allowed a 10 d recovery and acclimation period to metabolism crates. The experiment was designed as a replicated 4 × 4 Latin Square. Each 2 wk feeding period included a 9 d adjustment to experimental diet, 3 d total collection, and 2-12 hr ileal collections. The basal diet was formulated to meet or exceed dietary requirements (NRC, 1998), and contained 17.95% CP, 0.95% Lys, and 0.25% avail. P. The basal diet was fed at 9% BW.75 and divided into two equal meals (0700 and 1900 hr); SH was supplemented in addition to the basal diet feeding. The 4 dietary treatments were: 1) Basal-no added SH; 2) Basal + 3% SH; 3) Basal + 6% SH; and 4) Basal + 12% SH. Pigs were weighed at 2 wk intervals to adjust feed intake. Total collection of feces and urine were used to determine nitrogen and energy digestibility. A linear increase in pig ADG (0.57, 0.70, 0.62, and 0.73 kg/d; P<0.04) and ADFI (1.32, 1.32, 1.41, and 1.46 kg/d; P<0.001) were observed as pigs were fed 0-12% SH, respectively. Fecal N output linearly increased (9.1, 9.6, 10.5, 11.9 g/d; P<0.05), urinary N increased quadratically (12.0, 10.8, 10.5, 12.7 g/d; P<0.001) and N intake increased linearly (40.0, 42.4, 44.5, 49.9 g/d; P<0.001) as SH inclusion increased from 0-12%, respectively. No differences in N digestibility among diets (avg=76.5%; P>0.27) or periods were observed. However, the amount of N absorbed and retained increased linearly (P<0.004) with increasing SH. Gross energy intake increased over period (P<0.001) due to increased feed intake and among the diets due to dietary energy differences with additional SH. Energy digestibility was not different among diets (avg=76.9%; P>0.05). Results from this experiment suggest additional supplementation of 3-12% SH does not change overall dietary N or energy digestibilities and may reduce urinary N excretion with up to 6% SH addition.

Key Words: Soybean hulls, Diet digestibility, Pigs

141 Effect of glycerol and soy oil on pellet mill production efficiency and nursery pig performance. C. N. Groesbeck*, L. J. McKinney, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, J. L. Nelssen, S. S. Dritz, A. W. Duttlinger, and K. C. Behnke, *Kansas State University, Manhattan.*

A study was conducted evaluating the effects of glycerol, soy oil, and a 50:50 soy oil/glycerol blend on pellet mill production efficiency and nursery pig performance. The 7 treatments included a corn-soybean meal-based diet with no added soy oil or glycerol (control), the control diet with 3 or 6% added soy oil, 3 or 6% added glycerol, and 6 or 12% additions of a 50:50 soy oil/glycerol blend. Diets were steam

conditioned to 65.5C and pelleted using a CPM pellet mill equipped with a die that had an effective thickness of 31.8 mm and holes 3.96 mm in diameter. Each diet was replicated by manufacturing a new batch of feed 3 times. Glycerol lowered (P < 0. 01) delta temperature, amperage, motor load, and production efficiency (kWh/t) and increased (P < 0.01) pellet quality. The diets were fed to 182 pigs (initial BW 10.9 kg) in a 26-d growth assay. Pigs were blocked by initial BW and randomly allotted to treatment, with 5 or 6 pigs/pen and 5 pens/treatment. Pigs fed increasing glycerol had increased (linear, P < 0.03) ADG. Gain:feed increased with increasing soy oil (quadratic, P < 0.05) or the soy oil/glycerol blend (linear, P < 0.01). Adding glycerol to the diet did not influence G:F compared to the control. These data indicate that glycerol can be included in a diet up to 6% either alone or in combination with soy oil. Adding glycerol prior to pelleting improved pellet quality and decreased energy cost in processing. The addition of soy oil, glycerol, or the soy oil/glycerol blend resulted in similar final BW.

Table 1. Effects of glycerol on pellet mill production and nursery pig performance

	Control	3% soy	6% soy	3% gly	6% gly	6% blend	12% blend	SE
Pellet mill data								
Amperage	28.2	23.0	19.6	23.7	22.8	20.9	16.0	0.52
Delta temp, C	11.3	7.7	5.5	7.6	7.3	4.7	3.3	0.71
Motor load, %	53.6	45.9	34.6	42.9	41.6	36.2	26.9	2.22
Total energy, kWh/t	7.8	6.1	5.2	6.5	6.2	5.5	4.3	0.14
PDI,%	93.0	81.6	58.3	94.7	95.5	85.4	80.3	1.84
D 0 to 26								
ADG, g	528	571	554	568	570	555	564	18.2
ADFI, g	782	782	761	809	814	758	763	33.9
G:F	0.68	0.73	0.73	0.70	0.70	0.73	0.74	0.01
Final wt, kg	24.7	25.8	25.4	25.8	25.8	25.4	25.7	0.98

Key Words: Pig, Glycerol, Pelleting

142 Use of glycerol in nursery pig diets. R. Hinson*, L. Ma, and G. Allee, *University of Missouri, Columbia*.

Two experiments were conducted in order to determine the effect of glycerol addition in nursery pig diets. In Exp. 1, 477 newly weaned pigs (TR-4 × C22; 6.98 kg) were randomly allotted by sex and weight to one of three treatments: negative control (0% lactose), positive control (20, 15, 10, and 0% lactose in ph 1-4), or 6% glycerol (0% lactose) with 7 replicate pens/trt and 21 or 23 pigs/pen. Growth performance was evaluated during four dietary phases: Phase 1 (d 0-7), Phase 2 (d 7-14), Phase 3 (d 14-21), and Phase 4 (d 21-42). Diets were formulated to contain 1.53, 1.51, and 1.45% total lysine in phases 1-3, respectively, and 1.25% TID lysine in phase 4. During phase 4, the negative and positive control treatments received a common diet. In Exp 2, 817 nursery pigs (TR-4 × C22; 9.8 kg) were randomly allotted by sex and weight to one of two treatments: 0 or 6% glycerol addition. Diets were formulated to contain 1.25% TID lysine. In Exp. 1, d 0 - 7 ADFI was reduced (P < 0.008) when the glycerol diet was compared to the negative and positive control diets at 159, 186, 191 g/d, respectively. Day 14-21 and d 0-21 ADG were reduced (P < 0.05) when the negative control and glycerol diets were compared to the positive control diet at 386, 386, and 449 g/d from d 14 - 21, respectively and 259, 259, and 291 g/d from d 0-21, respectively. These differences resulted in the d 21 weights of the positive control pigs being heavier (P < 0.038) than that of the negative control and glycerol pigs at 13.23, 12.49, and 12.54 kg, respectively. No other differences (P > 0.05) in performance were observed. In Exp. 2, ADG (599 vs. 590 g), ADFI (881 vs. 881 g), F:G (1.47 vs. 1.49) and final BW (22.4 vs. 22.2 kg) did not differ (P > 0.05) between the 0 and 6% glycerol diets, respectively. In the present studies, glycerol did not appear to be a lactose replacement source from d 0-21, but can be utilized as an energy source at 6% addition without any detrimental effects on growth performance of nursery pigs.

Key Words: Nursery pigs, Lactose, Glycerol

143 Preference of weanling pigs for different sources of supplemental methionine. M. Wang*[1,2], M. D. Lindemann[1], G. L. Cromwell[1], H. J. Monegue[1], and R. L. Payne[3], [1]*University of Kentucky, Lexington,* [2]*Zhejiang University, Hangzhou, P.R. China,* [3]*Degussa Corporation, Kennesaw, GA.*

Feed intake is critical to growth and overall performance of weanling pigs. Thus, there is interest in how different nutrient sources affect dietary preferences. The objective of this study was to investigate the preference of weanling pigs for diets supplemented with either DL-Met (DLM, 99%) or methionine hydroxyl analogue (MHA-Ca, 84%). A total of three 4-wk studies (276 barrows/gilts; initial BW = 7.09 kg) were conducted with a basal diet (0.24% Met and 1.37% Lys) slightly deficient in Met (requirement of 0.35% for 5-10 kg BW and 0.30% for 10-20 kg BW; NRC, 1998). Within each study, pigs were blocked by BW within gender and randomly allotted to one of 3 treatment comparisons: 1) choice of basal or basal plus 0.07% DLM; 2) choice of basal or basal plus 0.0825% MHA-Ca, and 3) choice of basal plus either 0.07% DLM or 0.0825% MHA-Ca. Pigs were housed 4/pen for a total of 23 replicates (12 barrow and 11 gilt replicates). Pigs were provided ad libitum access to feeders with each of the diets; feeder location was switched 3 times/wk. Pigs consumed a higher percentage (55 vs. 45%; P=0.008) of their total feed intake from the diet supplemented with DLM in Trt 1, but a lower percentage (45 vs. 55%; P=0.003) of their total feed intake from the diet supplemented with MHA-Ca in Trt 2. These differences were established by Wk 1 for Trt 2 and Wk 3 for Trt 1. However, while these differences existed, there was no preference for DLM or MHA-Ca in Trt 3 (51 vs. 49%; P=0.46). Further, with regard to the preference differences for Trt 1 and 2, the differences were observed in the barrow replicates but not in the gilt replicates (Trt 1: barrows – 43 vs 57%, P=0.017; gilts – 48 vs. 52%, P=0.285, and Trt 2: barrows – 60 vs. 40%, P=0.001; gilts – 50 vs 50%, P=0.834). Pigs fed Trt 3, which would have had a higher mean Met equivalence level, had greater ADG (P<0.001), ADFI (P=0.011),and lower feed:gain (P<0.001) than pigs on the other comparisons. These results demonstrate no preference for a source of methionine but do indicate that weanling barrows have a stronger preference than gilts for a diet with adequate Met, and that this preference differs based on the source of Met.

Key Words: Pigs, Methionine, Preference

144 Determining the fourth-limiting amino acid in swine diets containing NutriDense® corn. A. W. Duttlinger*[1], J. R. Bergstrom[1], M. D. Tokach[1], J. L. Nelssen[1], S. S. Dritz[1], R. D. Goodband[1], J. M. DeRouchey[1], and J. Snow[2], [1]*Kansas State University, Manhattan,* [2]*BASF Plant Science, Research Triangle Park, NC.*

Two, 28-d studies were conducted to determine the fourth-limiting amino acid in finishing diets containing NutriDense® corn. A total of 1,134 (37.2 kg) and 1,090 (77.3 kg) PIC pigs were used in Exp. 1 and 2, respectively. Pigs were blocked by BW and randomly allotted to one of six diets with 7 replications in each experiment. Dietary TID lysine was 0.91% in Exp 1 and 0.72% in Exp. 2. Treatments were 1) positive control containing 0.15% L-Lys HCl; 2) negative control with 0.45% L-Lys HCl, 0.085% DL-Met, and 0.15% L-Thr; 3) diet 2 with 0.05% L-Ile; 4) diet 2 with 0.05% L-Val; 5) diet 2 with 0.05% L-Trp and 6) diet 2 with 0.05% L-Ile, 0.05% L-Val, and 0.05% L-Trp. In Exp. 1, ADG was 0.87, 0.77, 0.82, 0.80, 0.82, and 0.87 kg/d and G/F was 0.39, 0.37, 0.37, 0.38, 0.38, and 0.38 for treatments 1 to 6, respectively. Pigs fed the positive control and the diet with the combination of added Ile, Trp, and Val had greater ADG (P<0.05) than all other treatments. Pigs fed added Ile or Trp had greater ADG (P<0.05) than pigs fed the negative control. Pigs fed the combination of added Ile, Trp, and Val had greater ADFI (P<0.05) then pigs fed the negative control. There were no differences in G/F. In Exp. 2, ADG was 0.88, 0.74, 0.78, 0.75, 0.84, and 0.85 kg/d and G/F was 0.33, 0.28, 0.29, 0.29, 0.31, and 0.31 for treatments 1 to 6, respectively. Pigs fed the positive control, added Trp, or the combination of added Ile, Trp and Val had greater (P<0.05) ADG then pigs fed the negative control or pigs fed either Ile or Val. Pigs fed the positive control had greater (P<0.05) G/F then pigs fed all other diets. Pigs fed the combination of added Ile, Trp, and Val had greater (P<0.05) G/F compared to pigs fed the negative control or added Val. These results suggest that, in diets containing NutriDense® corn, Trp and Ile are the co-fourth limiting amino acids for 36 to 59 kg pigs, while Trp is fourth limiting for 77 to 100 kg pigs.

Key Words: Amino acids, Corn, Swine

145 Effect of increasing lysine/net energy concentration on growth performance and plasma urea nitrogen concentration of late-finishing barrows fed low-protein amino acid-supplemented diets and Paylean. R. Moreno*, P. S. Miller, and T. E. Burkey, *University of Nebraska, Lincoln.*

A study was conducted to evaluate the effects of increasing the lysine (lys):NE ratio on growth performance and plasma urea nitrogen concentration (PUN) of late-finishing barrows fed low-CP AA-supplemented diets and Paylean (ractopamineÃ¢â‚¬Â¢HCl; RAC). Twenty-four late-finishing barrows (83.6 kg) were used in a 28-d experiment. Pigs were individually penned and had ad libitum access to feed and water. The pigs were randomly allotted to 1 of 6 dietary treatments consisting of 1 corn-soybean meal diet (5.24 g lys/Mcal NE; 20% CP) and 5 low-CP AA-supplemented diets with increasing lys/NE concentration (16% CP; 3.35 to 5.83 g lys/Mcal NE) and RAC inclusion (0 and 5 ppm). Body weight and feed disappearance were measured and ADG, ADFI, and G:F were calculated. Blood samples were collected weekly. Backfat depth (BF) and LM area (LMA) were measured at the 10th rib by ultrasound. There were no differences among treatments for final weight ($P = 0.62$). No effect of lys/NE was detected for ADG, ADFI or G:F ($P = 0.41$, 0.33, and 0.55). Increasing dietary lys/NE concentration resulted in a linear decrease in BF ($P = 0.01$). The greatest BF (2.26 cm) was recorded for the 3.35 g lys/Mcal NE treatment and the lowest (1.65 cm) corresponded to the 5.2 g lys/Mcal NE treatment; treatments did not affect final LMA ($P = 0.69$). We observed treatment effect for PUN on d 21 and 28 ($P = 0.01$ and 0.03 respectively), which indicates that feeding low-CP AA-supplemented diets and RAC resulted in decreased AA deamination and catabolism, especially at the end of the experimental period. The results of this experiment indicate that growth performance was not affected by increasing lys/NE concentration in low-CP AA-supplemented diets with 5 ppm of RAC inclusion; however, increasing lys/NE concentration results in decreased BF and decreased AA breakdown.

Key Words: Ractopamine, Pigs, Protein

146 True ileal digestible lysine requirement of finishing pigs fed low or high synthetic amino acid Paylean® diets. R. Hinson*[1], A. Gaines[2], J. Usry[3], and G. Allee[1], [1]*University of Missouri, Columbia,* [2]*The Maschhoffs Inc., Carlyle, IL,* [3]*Ajinomoto Heartland LLC, Chicago, IL.*

Two experiments were conducted to determine the true ileal digestible (TID) Lys requirement of finishing pigs fed low or high synthetic amino acid Paylean® diets. In Exp. 1, 840 barrows and gilts (TR-4 × C22; 104 ± 0.27 kg BW) were fed a diet containing Paylean® (7.15 ppm) with 0.75, 0.85, 0.95, 1.05, or 1.15% TID Lys for 21 d with 8 replicate pens/treatment and 21 pigs/pen. All diets were formulated to be isocaloric (3405 kcal/kg ME) and contained 0.075% L-Lys•HCl. In Exp. 2, 840 barrows and gilts (TR-4 × C22; 105 ± 0.23 kg BW) were fed a diet containing Paylean® (7.15 ppm) with 0.75, 0.85, 0.95, 1.05, or 1.15% TID Lys for 21 d with 8 replicate pens/treatment and 21 pigs/pen. All diets were formulated to be isocaloric (3405 kcal/kg ME) and contained 0.325% L-Lys•HCl. Additional synthetic amino acids were included in the diets in order to maintain proper ratios in respect to TID Lys. In each experiment, pen weights and feed disappearance were measured at d 21 and intact pens were marketed in order to obtain carcass data. In Exp. 1, increasing the TID Lys resulted in a linear ($P < 0.001$) increase in ADG (1003, 1007, 1044, 1062, and 1030 g/d) and a linear increase ($P < 0.001$) of G/F (0.353, 0.370, 0.370, 0.384, 0.383). The TID Lys level had no effect on any of the carcass measurements. In Exp. 2, increasing the TID Lys resulted in a linear ($P = 0.01$) increase in ADG (948, 980, 1021, 1012, and 1039 g/d) and a linear increase of G/F (0.337, 0.355, 0.370, 0.380, 0.377). The TID Lys level had no effect on any of the carcass measurements. These studies would indicate that when feeding 7.15 ppm Paylean® for 21 d in diets containing either low or high levels of L-Lys•HCl, diets should be formulated to at least a 0.95% TID Lys.

Key Words: Pigs, Lysine, Paylean®

147 Dietary inclusion of colicin E1 prevents post weaning diarrhea in a seeder challenge model. S. A. Cutler*[1], N. A. Cornick[1], S. M. Lonergan[1], and C. H. Stahl[2], [1]*Iowa State University, Ames,* [2]*North Carolina State University, Raleigh.*

Post-weaning diarrhea (PWD) continues to cause significant economic losses to the swine production industry. The efficacy of Colicin E1 (Col E1) as an alternative to dietary antibiotics to prevent PWD has been demonstrated. A pure Col E1 was included at 20 mg/kg diet for the

first 2 wks of this 4 wk study. A seeder model was used for challenge with an F18 positive enterotoxigenic E. coli (ETEC) strain previously isolated from piglets with PWD. Two animals, paired by body weight, and exhibiting severe diarrhea 2 days after oral inoculation, were placed into pens of piglets that were either fed a diet containing 20mg/kg diet Col E1 (n=10) or a basal diet (n=9) with no addition. All animals were determined to be genetically susceptible to ETEC infections prior to their selection for this study and at the start of the study the average body weight was 5.4 kg (±0.17).

In the first week after the seeder pigs were added, 4 of the control animals lost weight and two pigs lost more than 10% of their initial body weight. Body weight gain was greater in the Col E1 fed animals at week 1 ($P \leq 0.05$) and a trend existed for lower body weight in the control animals at weeks 2, 3, and 4 ($P \leq 0.1$). Final body weight was 14.2 kg in the controls and 16.3 kg in the E1 fed pigs. 80% of the control animals exhibited ETEC diarrhea within the first week compared to 30% of the Col E1 fed pigs. Of the 3 Col E1 animals that showed signs, the duration was less than 3 days for 2 of the animals compared to 6 days for the controls. Despite not showing diarrheal signs for over 10 d prior to the end of the study, higher levels ($P \leq 0.05$) of TNFα mRNA were seen in the ileal mucosa of pigs which did not receive the Col E1. The ileal mucosa of pigs fed the Col E1 diet had higher levels ($P \leq 0.05$) of message for COX2 and PGHS compared to the controls. This could suggest a lower ETEC challenge to these animals coupled to an upregulation of intestinal prostaglandins to preserve membrane integrity. The addition of 20 mg/kg Colicin E1 to the post-weaning swine diet prevented F18 ETEC caused PWD in piglets exposed to a natural route of infection.

Key Words: Colicin E1, Post weaning diarrhea, Pigs

148 Effects of chitooligosaccharide supplementation on growth performance, nutrient digestibility, blood characteristics, and immune responses after lipopolysaccharide challenge in weanling pigs. Y. J. Chen*[1], J. H. Cho[1], J. S. Yoo[1], Y. Wang[1], Y. Huang[1], H. J. Kim[1], S. O. Shin[1], K. Y. Whang[2], I. H. Kim[1], S. Y. Ji[3], and S. D. Lee[3], [1]*Dankook University, Cheonan, Choongnam, Korea,* [2]*Korea University, Seoul, Korea,* [3]*National Institute of Animal Science, Seonghwan, Choongnam, Korea.*

The objective of this study was to evaluate the effects of chitooligosaccharide (COS) on growth performance, nutrient digestibility, blood characteristics, and immune response in lipopolysaccharide (LPS) challenged weanling pigs. Ninety weanling pigs (5.44 ± 0.50 kg BW) were used in Exp. 1. Three dietary treatments were basal diets supplemented with 0, 0.25, and 0.5% COS, and fed for 28 d (6 replications and 5 pigs per pen). The ADG (394, 406 and 420 g) and ADFI (543, 567 and 582 g) tended to increase linearly with the increasing levels of COS addition ($P<0.10$). Digestibilities of DM (71.1, 73.6 and 75.8%; $P<0.05$) and N (70.8, 73.4 and 76.9%; $P<0.10$) were also improved linearly by COS supplementation. Albumin, total protein, IgG, WBC, RBC and lymphocyte concentrations were not influenced by COS supplementation. In Exp. 2, 20 pigs (5.22 ± 0.31 kg BW) were assigned to two dietary treatments and fed on a diet supplemented with 0 or 0.5% COS for 28 d. Thereafter, half of the pigs in each treatment (n=5) were injected i.p. with either LPS or sterile saline solution (100 μg/kg of BW), resulting a 2 × 2 factorial arrangement. Blood sample and rectal temperature data were collected at 0, 2, 4 and 12 h post–challenge. Rectal temperatures (4 and 12 h), cortisol (2 and 4 h) and TNF–α (2, 4 and 12 h) concentrations were increased while IGF–1 (12 h) concentration was decreased by LPS challenge ($P<0.05$). Rectal temperature tended to be decreased (39.7 vs 39.1 °C) by COS addition ($P<0.10$). The COS treatments resulted in lower cortisol concentrations (11.4 vs 8.6 μg/dl) at 2 h and higher IGF–1 concentrations (208 vs 264 ng/ml) at 4 h post–challenge ($P<0.05$). In conclusion, dietary supplementation with COS could increase DM and N digestibilities and improve immune response under inflammatory challenge conditions.

Key Words: Chitooligosaccharide, Immune response, LPS

149 Effect of ACIDOMATRIX™ LowLac in low lactose nursery pig diets. R. J. Harrell*, B. V. Lawrence, F. Navarro, R. Anderson, and C. D. Knight, *Novus International, St Charles, MO.*

Early nursery diets contain sources of lactose to optimize pig performance and the cost of these sources has risen dramatically in the past year. The trial was conducted to determine if ACIDOMATRIX™ LowLac (LowLac), a blend of organic acids, mannanoligosaccharide, esters of butyrate, and ethoxyquin could alleviate reduced pig performance fed low lactose diets. Approximately 550 pigs (5.92±0.32 kg) were blocked by size and sex to a pen (23 pigs/pen) and randomly assigned to 1 of 4 treatments (6 pens/treatment). Treatments were implemented from 0 to 21 days postweaning in two phases (0 to 10 and 11 to 21 days). Treatments were 1) HL (20 and 10% lactose) 2) LL (5 and 2.5% lactose) 3) LL + LowLac (0.69%), 4) LL + LowLac (0.69 and 0.48%, for phase I and II, respectively). Lactose was supplied from whey permeate and all diets contained Mecadox (50 g/ton) and ZnO (2500 ppm). No differences in BW or GF were detected among treatments ($P>0.05$). Pigs fed HL had greater ADG than pigs fed LL or LowLac from 0 to 10 days (183 vs 153 vs 160 vs 157±7.7 g/d; $P<0.05$). Pigs fed HL had greater ADFI than pigs fed LL or LowLac from 0 to 10 days (205 vs 177 vs 185 vs 183±6.9 g/d; $P<0.05$). No differences were detected in ADG among treatments from 11 to 21 days ($P>0.15$). Pigs fed HL had greater ADFI than pigs fed LL (454 vs 395±19.6 g/d; $P<0.05$), but similar to pigs fed LowLac from 11 to 21 days (437 and 409 ±19.6 g/d; $P>0.05$). Overall, from 0 to 21 days, pigs fed LowLac had similar ADG ($P>0.25$) compared to pigs fed HL. Pigs fed HL had greater ADG than pigs fed LL (275 vs 240±12.4 g/d; $P<0.05$) from 0 to 21 days. Pigs fed HL had higher ADFI than pigs fed LL (335 vs 291±12.4 g/d; $P<0.05$) and pigs fed the reduced dose of LowLac from 0 to 21 days (301±12.8 g/d; $P< 0.05$). Pigs fed the full dose of LowLac had similar ADFI as pigs fed HL ($P>0.20$). Feed cost per unit gain was 27% higher for HL ($P<0.05$) than LL or LowLac. In summary, reductions in lactose content reduced pig performance from 0 to 10 days, but data suggests the loss in performance was mitigated from 11 to 21 days and overall from 0 to 21 days postweaning with ACIDOMATRIX™ LowLac.

Key Words: Lactose, Nursery, Swine

150 Evaluation of an enzyme blend (Natuzyme®) in diets for weanling pigs. J. R. Bergstrom*, M. D. Tokach, J. L. Nelssen, S. S. Dritz, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan.*

Two experiments were conducted to evaluate an enzyme blend (Natuzyme®) in nursery diets. In Exp. 1, 210 pigs (6.2 kg) were used in a factorial to evaluate increasing levels of enzyme (0, 0.035, and 0.05%)

in a negative control (NC) diet with 12.5% soy hulls and no antibiotic; or a positive control (PC) without soy hulls, but with antibiotic (154 ppm of neomycin and 154 ppm of oxytetracycline). Pigs were blocked by BW and allotted to treatment at weaning, with 7 pigs/pen and 5 pens/treatment. For d 0 to 14, ADG (213 vs 191 g/d) and d 14 wt (9.2 vs 8.8 kg) tended to improve (P<0.08) by feeding the PC diets. There were trends for improved (quadratic, P<0.09) ADG (186, 222, and 200 g/d), ADFI (204, 245, and 218 g/d), and d 14 wt (8.8, 9.3, and 9.0 kg) with increasing enzyme. Overall (d 0 to 35), ADG and d 35 wt tended (linear, P<0.09; and quadratic, P<0.07; respectively) to increase for pigs fed increasing enzyme or PC diets (P<0.07 and P<0.08, respectively). In Exp. 2, 180 pigs (6.4 kg) were used in a 2 × 3 factorial to evaluate increasing enzyme (0, 0.035, and 0.05%) in NC and PC diets. The NC diet contained no soy hulls or antibiotic. The PC was identical to that used in Exp. 1. Pigs were blocked by BW and allotted to treatment at weaning with 5 pigs/pen and 6 pens/treatments. From d 0 to 14, pigs fed the PC diet had improved (P<0.01) ADG (150 vs 118 g/d), G/F (0.80 vs 0.69), and d 14 wt (8.45 vs 8.0 kg), and tended (P<0.06) to have increased ADFI (181 vs 163 g/d) compared to the NC. Pigs fed increasing enzyme had improved (linear, P<0.05) ADG (118, 141, and 145 g/d), G/F (0.68, 0.78, and 0.77), and d 14 wt (8.0, 8.3, and 8.4 kg). From d 14 to 35, pigs fed increasing enzyme had poorer (linear, P<0.05) G/F. Overall (d 0 to 35), ADG, ADFI, and d 35 wt improved (P<0.01) for pigs fed the PC diets. When data of the PC diets in both experiments were combined, overall (d 0 to 35) ADG, ADFI, and d 35 wt were improved (linear and quadratic, P<0.05) with increasing enzyme levels, with 0.035% Natuzyme® resulting in the best performance.

Key Words: Pig, Enzymes, Antibiotic

151 Effect of individual or combined xylanase and phytase supplementation on site of nutrient digestion of a diet with reduced nutrient specifications containing wheat and millrun fed to weaned pigs. T. Nortey*[1], J. Sands[2], and R. Zijlstra[3], [1]*Shur-Gain/Nutreco, St. Mary's, ON, Canada*, [2]*Danisco Animal Nutrition, Marlborough, U.K.*, [3]*Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta, Canada*.

Millrun can partially replace wheat in diets with a reduced nutrient specification for weaned pigs if enough improvement is provided by xylanase (Xyl) and phytase (Phy). The effects of Xyl (4375 U/kg of feed) and Phy (500 FTU/kg of feed) supplementation on energy, site of nutrient digestibility, and pH in the gut, and on performance were studied in a 2 x 2 factorial arrangement together with a positive control diet (3.50 Mcal DE/kg, 3.25 g true digestible Lys/Mcal DE, 0.65% total P, and 0.80% Ca). The contents of Lys, P, and Ca were reduced by 10% and DE by 150 kcal/kg in the other 4 diets. Weaned pigs (8.6 ± 0.5 kg) had free access to feed for 21 d. Feces were collected on d 19. On d 20 and 21, pigs were euthanized and gut contents was collected. Feeding a nutrient reduced diet reduced (P < 0.01) total tract energy digestibility. Xyl and Phy interacted to improve (P < 0.05) the total tract DE content of the negative control (NC) diet from 3.58 to 3.82 Mcal/kg. Xyl improved (P < 0.01) energy digestibility of the NC diet in the mid jejunum and over the total tract by 6.3 and 4.6% to 59.5 and 85.7% respectively. Phy addition improved (P < 0.05) the DE content of the NC by 160 kcal/kg to 3.74 Mcal/kg. Phy raised (P < 0.01) the pH of the upper mid small intestine (SI). Xyl improved (P < 0.05) BW, ADG, and G:F of the NC diet at d 21 by 1.7 kg, 0.18 kg/d, and 0.06, to 20.8 kg, 0.59 kg/d, and 0.69 respectively. On d 21, Phy improved BW (P < 0.01) and ADG (P < 0.05) of the NC diet by 11.0 and 31.0% respectively. Xyl and Phy improved total tract DE content and performance of weaned pigs fed nutrient reduced diets. Phy accelerated the return to alkaline conditions in the upper part of the SI. Exogenous enzymes can be used to improve the digestibility of diets based on wheat and millrun with reduced nutrient specification for weaned pigs.

Key Words: Pigs, Millrun, Phytase

152 Effects of mannanase addition to copra meal and palm kernel meal diets on growth performance and nutrient digestibility of growing-finishing pigs. Y. D. Jang*, J. H. Yun, D. H. Kim, J. H. Lee, W. S. Ju, and Y. Y. Kim, *Seoul National University, Seoul, Korea*.

This study was investigated to evaluate the copra meal and palm kernel meal with mannanase on growth performance, nutrients digestibility, blood urea nitrogen(BUN) and microflora of large intestine in growing-finishing pigs. The experiment was conducted during 13 weeks. A total of 80 crossbred pigs, averaging 20.04 kg body weight, were allotted to treatments in four replicates with four pigs per pen. Treatments included: 1) CON (basal diet - corn-soy bean meal based); 2) CM5 (copra meal 5% + 0.1% mannanase(800IU)), 3) CM10 (copra meal 10% + 0.1% mannanase(800IU)), 4) PKM5 (palm kernel meal 5% + 0.1% mannanase(800IU)), 5) PKM10 (palm kernel meal 10% + 0.1% mannanase(800IU)). During the whole experimental period, pigs fed PKM5 diet showed higher average daily gain (ADG). But pigs fed diet of CM10 had lower body weight(104.26, 105.47, 100.28, 108.37, 105.04, P<0.05 for CON, CM5, CM10, PKM5, PKM10, respectively) and ADG (924, 939, 882, 968, 934, P=0.080 for CON, CM5, CM10, PKM5, PKM10, respectively) than other treatments. There were not significantly different in ADFI and G/F among all dietary treatments. The supplementation of copra meal and palm kernel meal with mannanase had no significant difference in nutrients digestibility. But the digestibility of crude fiber in pigs fed diets supplemented copra meal and palm kernel meal was lower compared to CON. At the end of experiment, BUN concentration was the highest in pigs fed diets of PKM10 and CM10 and was the lowest in pigs fed diets of PKM5 and CM5 (8.95, 11.62, 10.60, 12.93 mg/dl, P<0.05 for CM5, CM10, PKM5, PKM10, respectively). There were no significant differences on the count of E.coli and Salmonella in rectum of the pigs at the end of experiments. These results may suggest that copra meal and palm kernel meal with mannanase could be possible alternatives to corn in pigs' diets with minor detrimental influence on growth performance and nutrients digestibility.

Key Words: Pig mannanase, Copra meal, Growth performance

153 Feeding distillers dried grains with solubles (DDGS) to pigs. H. H. Stein*, *University of Illinois, Urbana*.

The digestibility of energy and nutrients in distillers dried grains with solubles (DDGS) has been measured and performance of pigs fed diets containing DDGS has been reported from many experiments. Seven experiments in which diets containing corn or sorghum DDGS were fed to weanling pigs from 2 weeks post-weaning were completed. Improvements in G:F were reported from 2 experiments, whereas no change in performance was reported from the remaining experiments. Results of 17 experiments in which performance of growing finishing pigs fed diets containing corn DDGS were compared with performance of pigs fed diets containing no DDGS have been reported. The ADG was

improved in 1 experiment, reduced in 6 experiments, and not affected by treatment in the remaining 9 experiments. The G:F was improved in 4 experiments, reduced in 3 experiments, and not affected by dietary treatments in the remaining 10 experiments. The ADFI was improved in 1 experiment, reduced in 6 experiments, and not affected by treatment in 9 experiments. Data from 6 additional experiments showed that 25 or 30% sorghum or wheat DDGS may be included in diets fed to growing finishing pigs without affecting pig performance. Inclusion of DDGS in diets fed to finishing pigs increased dressing percentage in 1 experiment, reduced dressing percentage in 6 experiments, and did not influence dressing percentage in 3 experiments. Lean percentage of the carcass of pigs fed DDGS was reported in 13 experiments, and with 1 exception, there was no influence of DDGS on lean percentage. A reduction in belly firmness has been observed in pigs fed DDGS and the iodine value of fat from pigs fed DDGS was increased in 3 experiments. Gestating and lactating sows may be fed diets containing up to 50 and 30% DDGS, respectively, without negatively impacting sow or litter performance. The litter size of sows fed DDGS was greater than in sows fed a corn soybean meal diet in 1 experiment. It is concluded that although variable results have been reported, the results of recent research suggest that most categories of pigs may be fed 20-30% DDGS without compromising pig performance.

Key Words: Distillers dried grains with solubles (DDGS), Performance, Pigs

154 Effects of increasing levels of distillers dried grains with solubles (DDGS) on growth performance of weanling pigs. T. E. Burkey*, P. S. Miller, R. Moreno, S. S. Shepherd, and E. E. Carney, *University of Nebraska, Lincoln.*

Research documenting the effects of DDGS has focused on growing-finishing pig performance with less emphasis on the effects of DDGS on nursery pig performance. The objective of this experiment was to evaluate growth performance of weanling pigs introduced to low levels (5%) of DDGS during phase 2 of the nursery period followed by high levels (30%) during phase 3 of the nursery period. Ninety-six weaned pigs were sorted by weight (5.6 kg) and sex and randomly allotted to dietary treatment in a 42-d experiment (4 treatments; 6 pigs/pen; 4 replicates/treatment). During phase 1 (d 1 to 7) all pigs were fed a common transition diet, during phase 2 (d 8 to 21) and 3 (d 22 to 42) the 4 dietary treatments were arranged as follows: 1) basal diet (CTL; 0% DDGS in phase 2 and 3); 2) 0% DDGS (0% DDGS in phase 2, 30% DDGS in phase 3); 3) 5% DDGS (5% DDGS in phase 2, 30% DDGS in phase 3); and 4) 30% DDGS (30% DDGS in phase 2 and 3). Body weight (BW) and feed disappearance were measured weekly and ADG, ADFI, and G:F were calculated. During phase 2, pig BW were similar among treatments; however, pigs fed 30% DDGS had decreased ADG and ADFI compared to all treatments ($P < 0.05$). During phase 3, pigs that were fed 5 or 30% DDGS (during phase 2) had decreased ADG compared to CTL pigs ($P < 0.05$). Overall (d 0 to 42), pigs fed 30% DDGS (during both phase 2 and 3) had decreased ADG, ADFI and BW compared to CTL pigs ($P < 0.05$); however, pigs that were introduced to 30% DDGS late in the nursery (received 30% DDGS during phase 3 only) had similar BW and growth performance compared to CTL pigs. This research indicates that inclusion of DDGS at low concentrations during phase 2 may not help to maintain growth performance when high concentrations of DDGS are included during phase 3 and that inclusion of high levels of DDGS throughout the nursery period may have negative effects on growth performance. However, growth performance may be maintained when high levels of DDGS are included during the late nursery period.

Key Words: Distillers dried grains with solubles, Weanling pigs

155 Feeding pelleted DDGS-based diets to finishing pigs in deep-bedded hoop barns. D. Stender* and M. S. Honeyman, *Iowa State University, Ames.*

Pelleted DDGS-based diets fed to finishing pigs in bedded hoop barns were evaluated. Crossbred finishing pigs (74 kg), were allocated to 6 pens with 5 barrows and 5 gilts per pen for 2 trials (n = 120). Trial 1 was January, February, and March 2007 at the ISU Western Research Farm, Castana, IA. Trial 2 was April, May, and June 2007. The pens were in small hoop barns (6 × 10.8 m) with 2 pens per barn. Each pen was assigned to 1 of 3 dietary treatments—corn-soy, 20% DDGS, and 40% DDGS. Diets were pelleted and fed ad libitum. Recent plant analysis of DDGS was used in diet formulation. Diets were formulated to be equal in apparent digestible lysine (0.59%). The pellets were evaluated for quality (durability) by tumbling 500 g of pellets for 10 min with four 1.9 cm steel nuts. Quality was the amount of pellets remaining (relative to the amount of fines) compared with the initial amount of pellets. Durability of pellets was expressed as percentage of whole pellets after the test. Pellet durability decreased as the percentage of DDGS increased with 78.9%, 66.8% and 47.4% durability for corn-soy, 20% DDGS, 40% DDGS diets, respectively. The pigs were allowed 1 wk of adjustment and were then continued in their respective pens on the assigned diets for 6 wks. Two carcasses from each pen in Trial 2 were randomly selected for fatty acid and iodine value analyses. End weight (121 kg) did not differ (P = 0.36). ADFI (7.5, 7.5 and 5.8 kg/d; P = 0.04) and ADG (2.68, 2.61 and 2.45 kg/d; P = 0.09) were depressed on the 40% DDGS diet. No differences were noted in BF, LMA, carcass yield, or fat free lean percentage. The 40% DDGS-fed pigs had more liveweight gain per unit of feed (G:F) (P = 0.05) and more lean gain per unit of feed (P = 0.08) than the pigs fed the other diets. As DDGS in the diet increased, levels of palmitic and stearic fatty acids decreased and linoleic fatty acid increased. Iodine values were 64.7, 74.6, 80.5 for pigs fed the corn-soy, 20% DDGS, and 40% DDGS diets, respectively. Pelleting may be a viable method to aid in feeding DDGS to pigs.

Key Words: Finishing pigs, Dried distillers grains with solubles, Pellets

156 Effects of expander conditioning on the nutritional value of diets with corn- and sorghum-based distillers dried grains with solubles in nursery and finishing pigs. C. Feoli*[1], J. D. Hancock[1], T. L. Gugle[1], and S. D. Carter[2], [1]*Kansas State University, Manhattan,* [2]*Oklahoma State University, Stillwater.*

Two experiments were conducted to determine the effects of expander conditioning on the nutritional value of diets without and with corn- and sorghum-based distillers dried grains with solubles (DDGS). For the nursery experiment, 180 pigs (13 kg avg BW) were assigned to 30 pens. Treatments were arranged as a 3 × 2 factorial with main effects of diet formulation (corn-soybean meal vs diets with 30% corn- or 30% sorghum-based DDGS) and conditioning (standard steam vs expander) prior to pelleting. Pigs fed corn-soy had greater ADG and G:F (P < 0.004) vs pigs fed diets with DDGS. Diets with corn-DDGS supported greater

ADG and G:F ($P < 0.02$) vs diets with sorghum-DDGS and expander processing improved ADG and G:F ($P < 0.009$) vs standard conditioning. But, pigs fed diets with sorghum-DDGS showed the greatest response in G:F to expander conditioning (DDGS source × conditioning interaction, $P < 0.02$). For the corn-soy-standard, corn-soy-expander, corn-DDGS-standard, corn-DDGS-expander, sorghum-DDGS-standard, and sorghum-DDGS-expander treatments, ADG was 670, 719, 605, 655, 548, and 632 g/d and G:F was 689, 711, 692, 706, 585, and 672 g/kg. For the finishing experiment, 176 pigs (75 kg avg BW) were assigned to 16 pens. Treatments were arranged as a 2 × 2 factorial with main effects of diet formulation (corn-soy vs 40% sorghum-based DDGS) and conditioning (standard steam vs expander) prior to pelleting. Pigs fed corn-soy had greater ($P < 0.03$) ADG and G:F vs pigs fed diets with DDGS. Expander conditioning did not affect ADG ($P > 0.8$) but improved G:F and dressing percentage ($P < 0.005$). For corn-soy-standard, corn-soy-expander, DDGS-standard, and DDGS-expander ADG was 1.08, 1.05, 0.98, and 1.01 kg/d, G:F was 334, 349, 328, and 338 g/kg, and dressing percentage was 73.6, 74.3, 72.5, and 73.6%. In conclusion, expanding diets without and with DDGS improved ADG and G:F in nursery pigs and G:F and dressing percentage in finishing pigs.

Key Words: Distillers dried grains, Expander, Pig

157 Effects of feeding increasing levels of distillers dried grains with solubles to grow-finish pigs on growth performance and carcass quality. D. Weimer, J. Stevens*, A. Schinckel, M. Latour, and B. Richert, *Purdue University, West Lafayette, IN.*

Crossbred pigs (N=140; initial BW = 52 kg) were assigned to one of 5 dietary treatments (6 pens/trt; pen exp. unit) to evaluate the effect of increasing levels of distillers grains plus solubles (DDGS) on pig growth and carcass traits. Two control diets were used, one with supplemental choice white grease (Cont+Fat) and one without supplemental fat (Cont-NF). The three remaining diets contained 10, 20, or 30% DDGS. Diets were equal in digestible Lys and minimum digestible amino acid ratios along with equal ME for all DDGS and Cont+Fat diets. Growth performance was evaluated on a four phase feeding program. Pigs were fed a grower diet for 28 d and a finisher diet from d28 to 56, a 5 ppm Paylean finisher diet from d56-70, and a 10 ppm Paylean finisher diet from d70 to either 79 or 84 d on test (market; BW=128.2 kg). Overall ADG ($P < 0.10$) and G/F ($P<0.01$) decreased as DDGS levels increased to 20 and 30%. Hot carcass weight ($P< 0.10$) and dressing percentage ($P< 0.01$) decreased linearly as DDGS inclusion levels increased. Kidney and liver weights increased linearly ($P <0.06$) as DDGS levels increased. Tenth rib backfat depth and leaf fat ($P<0.03$) decreased linearly as DDGS inclusion levels increased. Loin muscle (LM) marbling, firmness, color, and 24 hr pH were not affected ($P>0.40$) by the dietary DDGS level. The percentage of pigs with separation of the backfat layers and inner backfat layer from the LM increased (25.0, 16.7, 66.7, 75.0 and 91.7% for Cont-NF, Cont+Fat, 10, 20 and 30% DDGS, respectively, $P < 0.001$) with increasing dietary DDGS. Belly firmness (measured by suspension over a 2.54 cm rod) decreased ($P<0.01$) as the DDGS inclusion levels increased. Gilts had greater belly bending and a greater impact of DDGS on belly quality at every level of dietary inclusion. Diets formulated on a digestible lysine basis containing up to 10% DDGS can be fed to grow-finish pigs without decreased growth performance and carcass traits. Utilization of DDGS above 10% of the diet needs to be carefully evaluated before implementing in a grow-finish swine feeding program.

Key Words: Pgs, Distillers dried grains with solubles, Pork quality

158 Effects of adding increasing levels of corn dried distillers grains with solubles (DDGS) to corn-soybean meal diets on pork fat quality of growing-finishing pigs. G. Xu*[1], S. K. Baidoo[1], L. J. Johnston[1], J. E. Cannon[2], D. Bibus[1], and G. C. Shurson[1], [1]*University of Minnesota, St. Paul*, [2]*Hormel Foods, Austin, MN.*

A total of 512 pigs (22.1 ± 0.54 kg BW; 8 pigs/pen; 64 pens) from 2 groups (each = 256 pigs) were used to evaluate the effects of increasing dietary DDGS levels on pork fat quality. Pigs within group were randomly allotted to one of 4 dietary treatments (16 pens per treatment) which consisted of a corn-soybean meal control (D0), or corn-soybean meal diets containing 10% (D10), 20% (D20), or 30% (D30) DDGS in a 3-phase feeding program to a final BW of about 128.6 ± 3.1kg. There was a linear increase ($P < 0.01$) in linoleic acid concentration of backfat (9.1, 12.8, 16.2, and 19.5%; $P < 0.01$), belly fat (9.4, 11.7, 14.8, and 17.2%; $P < 0.01$), and loin i.m. fat (6.8, 9.3, 9.5, and 9.5 %; $P < 0.05$) as pigs were fed D0 to D30, respectively. Total polyunsaturated fatty acids content of backfat and belly fat increased linearly ($P<0.01$), while saturated fatty acids content were reduced linearly ($P < 0.01$) with increasing dietary DDGS levels. As dietary DDGS level was increased from 0 to 30%, iodine value of backfat (58.4, 65.6, 68.4, and 72.4), belly fat (61.4, 65.4, 69.3, and 72.3), and loin fat (54.8, 56.8, 57.1, and 57.7) increased ($P < 0.01$) linearly, respectively. Loin fat oxidation measured on d 1, 14, 21, and 28 of storage was not different among pigs fed increasing levels of DDGS. Loin sensory taste tests revealed no effects of diet on flavor, off-flavor, tenderness, juiciness, and overall acceptability. Similarly, bacon flavor, off-favor, crispiness, and overall liking were not impacted by DDGS levels, although bacon fattiness ($P < 0.01$) and tenderness ($P < 0.05$) were reduced linearly with increasing dietary DDGS levels. Results from this study suggest that acceptable pork fat quality can be achieved when 20% DDGS is added to grower-finisher swine diets based upon an iodine value standard of 70. Feeding diets containing 30% DDGS may result in acceptable pork fat quality depending on individual pork processors standards for fat quality.

Key Words: DDGS, Pork fat quality, Pigs

159 Effects of dried distiller grain with solubles on fat quality of finishing pigs. J. M. Benz*, S. K. Linneen, J. M. DeRouchey, M. D. Tokach, S. S. Dritz, J. L. Nelssen, and R. D. Goodband, *Kansas State University, Manhattan.*

A total of 1,112 pigs were used in a 78-d growth assay evaluating the effects of increasing dried distillers grains with solubles (DDGS, 0, 5, 10, 15, or 20%) on carcass and fat quality characteristics. Growth performance for this trial was previously published and can be found at J. Anim. Sci. 85 (Supple. 2): (Abstr.). All diets contained 6% choice white grease. The experiment was conducted in a commercial research finishing barn in southwestern Minnesota. There were 9 replicates per treatment with 25 to 28 pigs per pen. Barrows and gilts were distributed equally in each pen. At the end of the trial, jowl fat, belly fat, and backfat samples were collected and analyzed for fatty acid profile and iodine value (IV). Fat quality data was analyzed as a split plot with DDGS treatments as a whole plot and gender as the subplot. Increasing DDGS decreased ($P < 0.04$) carcass weight (89.3, 88.9, 88.7, 87.7, 87.5 kg) and percent yield (75.7, 75.5, 75.4, 75.2, 75.1%). Increasing DDGS level increased (linear, $P < 0.05$) iodine value and percentage C 18:2 fatty acids in backfat (68.3, 70.0, 71.2, 72.4, 72.8 g; 14.0, 14.9, 15.8, 17.1, 17.6%), jowl fat (70.7, 70.8, 71.9, 72.6, 73.8 g; 14.1, 14.0, 14.9, 15.6, 16.5%), and belly fat (70.2, 71.5, 72.4, 73.3, 74.5 g; 14.5,

15.3, 16.3, 16.8, 17.9). Increasing DDGS decreased (linear, P < 0.05) percentage saturated fatty acids in jowl fat (36.0, 35.0, 34.5, 34.4, 34.5%), backfat (33.3, 33.1, 32.8, 32.7, 32.3%) and belly fat (34.4, 33.8, 33.7, 33.2, 32.9%). Barrows had decreased (P < 0.04) belly fat iodine values (71.8 vs 72.9 g) and percentage 18:2 fatty acids (15.9 vs 16.5) when compared to gilts. Barrows also had increased (P < 0.05) percentage of saturated fatty acids in jowl (33.2 vs 32.5 g) and belly fat (33.9 vs 33.3) when compared to gilts. In summary, feeding DDGS linearly increased IV of backfat, jowl fat and belly fat with a similar response in all three fat depots.

Key Words: DDGS, Iodine value, Fat quality

160 Withdrawal of distillers dried grains with solubles (DDGS) prior to slaughter in finishing pigs. G. M. Hill*[1], J. E. Link[1], D. O. Liptrap[2], M. A. Giesemann[3], M. J. Dawes[1], J. A. Snedegar[1], N. M. Bello[1], and R. J. Tempelman[1], [1]*Michigan State University, E. Lansing,* [2]*Hubbard Feeds, Mankato, MN,* [3]*Dakota Gold Research Association, Sioux Falls, SD.*

Use of DDGS in swine finisher diets has raised concern about carcass composition because of its higher unsaturated fat and fiber content. Our study was designed to determine the effect of DDGS in grow-finish diets on growth and carcass fat characteristics when high concentrations of DDGS were withdrawn during late finishing. Pigs (308 pigs; 30 kg) were blocked by wt, allotted to 4 treatments (11/pen; 7 reps) by sex and litter and fed 3 dietary phases. Dietary treatments contained 0, 10, 20, or 30% DDGS until 30 d prior to harvest when DDGS was withdrawn from the 20 and 30% diets and fed the 0% diet. All diets contained Phytase and 4% choice white grease. Wheat midds were added to the 0, 10, and 20% diets to equalize net energy. Overall ADG did not differ between treatments (0.90, 0.91, 0.91, 0.91 kg/d; *P* = 0.98). Overall G:F was greater for pigs fed 10% DDGS than for 0% (0.39, 0.41, 0.39, 0.40; *P* = 0.02). Dressing % did not differ by treatment for 245 pigs killed at a commercial facility (75, 75, 75, 76%, *P* = 0.53). Dressing % (*P* = 0.26) and Standardized Fat Free Lean (*P* = 0.39) did not differ in pigs (n = 28, 1/pen) killed at the MSU Meat Lab. The fatty acid (FA) composition of jowl fat showed a linear increase in Arachidic 20:0 and Docosanoic 22:0 acids (*P* < 0.0001), and a linear decrease in Palmitoleic 17:0 (*P* = 0.01), Stearic 18:0 (*P* = 0.03), and Oleic 18:1n9 (*P* = 0.02) acids with increasing DDGS in the diet. Myristoleic 14:1 (*P* = 0.001) and Palmitoleic 16:1 (*P* = 0.003) were lower from pigs fed 30% DDGS than for other treatments. Iodine value (IV) was increased (*P* = 0.006) in fat from pigs fed the 20 and 30% DDGS diets compared with those fed the 0% diet. These data indicate that IV may not be reflective of FA composition. Feeding well balanced commercial swine diets with 20 to 30% DDGS results in acceptable performance and carcasses when DDGS is removed from the diet 30 d prior to harvest.

Key Words: DDGS, Pig, Fatty acids

161 Effects of dietary corn dried distillers grains with solubles (DDGS), and DDGS withdrawal intervals, on pig growth performance, carcass traits, and fat quality. G. Xu*[1], S. K. Baidoo[1], L. J. Johnston[1], J. E. Cannon[2], D. Bibus[1], and G. C. Shurson[1], [1]*University of Minnesota, St. Paul,* [2]*Hormel Foods, Austin, MN.*

A study was conducted to determine the quantitative effects of feeding level and withdrawal interval of DDGS on growth performance, carcass, and pork fat quality. A total of 432 pigs (29.8 ± 0.2 kg BW; 9 pigs/pen with total 48 pens) were allotted randomly to one of 9 dietary treatment combinations in a completely randomized design. The nine treatment combinations were: control (D0), 15% DDGS with 0 wk DDGS withdrawal before slaughter (D15-0wk), D15-3wk, D15-6wk, D15-9wk, D30-0wk, D30-3wk, D30-6wk, and D30-9 wk. Each treatment had 5 pens except D0 (8 pens). A 3-phase feeding program was used for pigs to a slaughter weight of 123.5 ± 1.13 kg. Adding 15 or 30% DDGS to the diet, with or without a withdrawal interval, had no effect on ADG, ADFI and G:F except for a reduction (0.87 vs. 0.92 kg/d; P < 0.05) in ADG for pigs fed D30-0wk compared to D0. Carcass quality, loin quality, and Japanese fat color score of pigs were not different among treatments. Belly firmness score was reduced (P < 0.05) in pigs fed D30-0wk compared to D0, but was not different among pigs assigned to the other treatments. Linoleic acid (C18:2) content and iodine value (IV) of belly fat increased with increasing DDGS level (P < 0.01). Withdrawal of DDGS from the diet for 0 wk to 9 wk before slaughter linearly reduced C18:2 content and IV of belly fat in pigs fed 15% DDGS diets (C18:2: 14.6, 13.3, 12.6, and 10.9%; P < 0.01; IV: 67.3, 64.4, 64.1, and 62.7; P < 0.05; for wk 0, 3, 6, and 9 withdrawal, respectively) and 30% DDGS diets (C18:2: 17.3, 16.1, 14.2, and 12.4%; P < 0.01; IV: 71.2, 68.2, 64.5, and 62.7; P < 0.01; for wk 0, 3, 6, and 9 withdrawal, respectively). These results indicate that inclusion rate of DDGS up to 30% in grower-finisher diets reduced ADG, and the desired effect of reducing C18:2 content and iodine value of pork fat could be elicited in as little as 3 wk of withdrawing DDGS from the diet prior to slaughter for pigs fed diets containing 30% DDGS based upon an iodine value standard of 70.

Key Words: DDGS withdrawal, Pork quality, Pigs

162 Effects of adding beef tallow and palm oil to diets with sorghum-based distillers dried grains with solubles on growth performance and carcass characteristics in finishing pigs. C. Feoli*[1], J. D. Hancock[1], S. Issa[1], T. L. Gugle[1], and S. D. Carter[2], [1]*Kansas State University, Manhattan,* [2]*Oklahoma State University, Stillwater.*

A total of 112 barrows (seven pigs/pen and four pens/treatment with an avg BW of 63 kg) was used in a 69-d growth assay to determine the effects of adding sources of saturated fatty acids to diets with sorghum-based distillers dried grains with solubles (DDGS). Treatments were a corn-soybean meal-based control and diets having 40% DDGS (US Energy Partners, Russell, KS) without and with 5% added tallow and palm oil. Feed and water were consumed on an ad libitum basis until the pigs were slaughtered (avg BW of 129 kg) to allow collection of carcass data. Fatty acid composition of jowl samples was used to calculate iodine value (IV). The corn-soy control supported greater ADG and ADFI (P < 0.001) with no difference in G:F (P > 0.9) compared to the DDGS treatments. Adding 5% fat to diets with DDGS improved G:F by 7% (P < 0.02) but there was no difference (P > 0.12) in growth performance among pigs fed the tallow vs palm oil treatments. As for carcass data, pigs fed the control diet had greater (P < 0.004) hot carcass weights, dressing percentages, and backfat thicknesses than pigs fed the DDGS treatments. Adding fat to the DDGS diets improved hot carcass weights and dressing percentages (P < 0.06) but there were no effects of fat source on carcass measurements (P > 0.16). Changes in IV indicated softer fat in pigs fed DDGS (P < 0.001) even when the saturated fat sources were added to the diets. For the control, DDGS, DDGS + tallow, and DDGS + palm oil treatments, ADG was 1,029, 926, 890, and 934 g/d, ADFI was 3.3, 3.1, 2.9, and 2.9 kg/d, G:F was 312, 299, 307, and 322 g/kg,

hot carcass weight was 93, 90, 91, and 90 kg, dressing percentage was 72, 70, 71, and 70%, backfat thickness was 20, 18, 18, and 18 mm, and IV was 67, 73, 74, and 73, respectively. Adding sources of saturated fat to diets with DDGS improved efficiency of growth but resulted in less saturated carcass fat.

Key Words: Distillers dried grains, Palm oil, Pig

163 Effects of adding stearic acid and coconut oil to diets with sorghum-based distillers dried grains with solubles on growth performance and carcass characteristics in finishing pigs. C. Feoli*[1], J. D. Hancock[1], D. H. Kropf[1], S. Issa[1], T. L. Gugle[1], and S. D. Carter[2], [1]*Kansas State University, Manhattan,* [2]*Oklahoma State University, Stillwater*.

A total of 112 barrows (seven pigs/pen and four pens/treatment with an avg BW of 68 kg) was used in a 67-d growth assay to determine the effects of adding sources of saturated fatty acids to diets with sorghum-based distillers dried grains with solubles (DDGS). Treatments were a corn-soybean meal-based control and diets having 40% DDGS (US Energy Partners, Russell, KS) without and with 5% added stearic acid and coconut oil. Feed and water were consumed on an ad libitum basis until the pigs were slaughtered (avg BW of 123 kg) to allow collection of carcass data. Fatty acid composition of jowl samples was used to calculate iodine value (IV) and bellies were scored for firmness (scale of 1 = very soft to 10 = very firm). The corn-soy control tended to support greater ADG ($P < 0.09$) with no difference in ADFI and G:F ($P > 0.13$) compared to the DDGS treatments. Adding coconut oil to diets with DDGS improved G:F ($P < 0.001$) compared to the stearic acid treatment. As for carcass data, pigs fed the control diet had greater ($P < 0.05$) hot carcass weights than pigs fed the DDGS treatments. However, those differences disappeared ($P > 0.11$) when final BW was used as a covariate. Pigs fed the diet with coconut oil had lower IV and firmer bellies compared to pigs fed the diet with stearic acid ($P < 0.001$). For the control, DDGS, DDGS + stearic acid, and DDGS + coconut oil treatments, ADG was 816, 766, 780, and 794 g/d, ADFI was 2.9, 2.8, 2.9, and 2.6 kg/d, G:F was 281, 274, 269, and 305 g/kg, hot carcass weight was 88, 86, 86, and 88 kg, dressing percentage was 72, 70, 70, and 72%, backfat thickness was 17, 16, 16, and 18 mm, IV was 67, 72, 71, and 67, and firmness score was 6, 4, 5, and 6, respectively. Adding 5% coconut oil to diets with DDGS increased efficiency of growth, reduced iodine value of jowl fat, and improved scores for belly firmness compared to diets with 5% stearic acid.

Key Words: Distillers dried grains, Coconut oil, Pig

164 Standardized ileal digestibility of reactive lysine in distillers dried grains with solubles (DDGS) fed to growing pigs. A. A. Pahm*[1], C. Pedersen[2], and H. H. Stein[1], [1]*University of Illinois, Urbana,* [2]*DANISCO Animal Nutrition, Wiltshire, UK*.

Distillers dried grains with solubles (DDGS) are produced by drying a mixture of wet distillers grains and condensed solubles. During this process, some of the epsilon-NH2 groups in Lys may be bound to reducing sugars through the Maillard reaction. This Lys is called unreactive Lys, whereas Lys that is not bound to reducing sugars is called reactive Lys. It has been suggested that the conventional procedure to measure standardized ileal digestibility (SID) of Lys in DDGS may over-estimate the amount of digestible Lys in DDGS because this procedure does not distinguish between reactive and unreactive Lys, although only the reactive Lys is bioavailable to animals. By measuring the SID of only the reactive Lys, it is expected that the estimation of digestible Lys will be more accurate. The objective of this experiment, therefore, was to test the hypothesis that the SID of reactive Lys is lower than the SID calculated using the conventional procedure.
Ileal cannulated pigs were fed diets containing each of 12 sources of DDGS and the SID for Lys was measured using standard procedures. Diets and ileal digesta samples were also guanidinated with O-Methylisourea and analyzed for the concentration of homoarginine. It was assumed that only the reactive Lys would be transformed to homoarginine, whereas the unreactive Lys would not. This procedure, therefore, allows for a separation of reactive and unreactive Lys, and the SID of reactive Lys could be calculated. Results showed that Lys in DDGS is only 76% reactive. The mean SID of reactive Lys was 66.9%, which is close to the mean SID of total Lys (66.5%). However, the concentration of SID reactive Lys (3.9 g/kg) was lower ($P < 0.05$) than the concentration of SID total Lys (5.1 g/kg). Thus, 24% of the digestible Lys that was calculated using the conventional procedure was unreactive Lys. The implication of this is that the conventional procedure overestimates the concentration of digestible Lys in DDGS, and measurement of reactive Lys may more accurately estimate how much Lys is available too the pig.

Key Words: Amino acids, Digestible reactive Lys, Distillers dried grains with solubles

165 Amino acid digestibility and energy content of corn distillers meal for swine. J. Y. Jacela*[1], J. M. DeRouchey[1], S. S. Dritz[1], M. D. Tokach[1], R. D. Goodband[1], J. L. Nelssen[1], R. C. Sulabo[1], and R. C. Thaler[2], [1]*Kansas State University, Manhattan,* [2]*South Dakota State University, Brookings*.

An experiment was conducted to determine the apparent and standardized ileal digestibility of amino acids and energy of corn distillers meal (CDM) in pigs. Corn distillers meal is distillers grains with the oil partially removed. Five growing barrows (initially 68 kg) were fitted with a T-cannula in the distal ileum and allotted to one of two diets in a crossover design. One diet contained CDM (66.7%) as the sole protein source. The second diet was nitrogen-free to determine basal endogenous AA losses. Each period consists of 7 d with the first 4 d as adaptation period to the diet. On d 5 and 6, feces were collected in the morning and ileal digesta was collected on d 6 and 7 over a 10 h period (between 0600 and 1800 each day). Ileal digesta and fecal samples from each period were analyzed for amino acid and energy contents, respectively. Based on these analyses, apparent ileal digestibility (AID), standardized ileal digestibility (SID), gross energy (GE), digestible energy (DE), metabolizable energy (ME), and net energy (NE) were calculated. The analyzed composition of CDM was 30.8% CP, 4.64% ash, 4.0% EE, 16.1 % ADF, and 34.6% NDF. The GE, DE, ME, and NE values of CDM were 4,090; 2,719; 2,506; and 1,793 kcal/kg on a dry matter basis, respectively. Analyzed amino acids and digestibility values are shown in the table.

Table 1.

Amino acid	Amino acid, %	SID, %	AID, %
Arginine	1.50	82.70	79.65
Histidine	0.93	74.63	72.79
Isoleucine	1.38	74.52	72.46
Leucine	4.15	83.79	82.68
Lysine	0.99	50.38	47.20
Methionine	0.67	80.41	79.42
Phenylalanine	1.92	80.77	79.35
Threonine	1.26	66.31	64.09
Tryptophan	0.22	77.96	73.72
Valine	1.75	73.75	71.75

Key Words: Swine, Corn distillers meal, Digestibility

166 Selected additives do not improve flowability of dried distillers grains with solubles (DDGS) in commercial systems. L. J. Johnston*[1], A. M. Hilbrands[1], G. C. Shurson[2], and J. Goihl[3], [1]*West Central Research and Outreach Center, University of Minnesota, Morris, MN,* [2]*University of Minnesota, St. Paul,* [3]*Agri-Nutrition Services, Inc., Shakopee, MN.*

An experiment was conducted at a commercial, dry-grind ethanol plant to determine if selected additives would improve flowability of DDGS. Experimental treatments were imposed on 4 different days in a 2 × 4 factorial arrangement. Main treatment effects were moisture content of DDGS (9 vs 12%) and flowability additive (FA). The FA treatments were: No additive (CON); a moisture migration control agent at 0.25% (DMX-7, Delst, Inc.); calcium carbonate at 2% (CA, Unical-P, ILC Resources); or a clinoptilolite zeolite at 1.25% (ZEO, St. Cloud Mining Co.). The FA were added at the desired level to about 2,250 kg of DDGS using a vertical-screw feed mixer. After 3 min of mixing, batches of DDGS were weighed and loaded into one of eight compartments in an auger-equipped feed truck. After loading, the truck traveled 250 km, sat idle for at least 60 h, and traveled 250 km back to the ethanol plant. Time required to unload each compartment was recorded. Samples of each lot were collected at loading for analysis of moisture content and angle of repose (AOR). The statistical model included effects of moisture level, FA, and their interaction. There were no significant interactions between moisture level and FA for any response criteria. Mean moisture levels were 9% and 11.6% for low and high moisture treatments. Flow rate of DDGS at unloading was higher ($P < 0.05$) for the 9% compared with 12% moisture level (620 vs. 390 kg/min). Similarly, drained AOR at loading (57.7 vs. 65.7°) and poured AOR after storage (40.9 vs. 42.0°) were lower ($P < 0.05$) for 9% compared with 12% DDGS. Flow rates of DDGS at unloading were: 509 (CON), 441 (DMX-7), 512 (CA), and 558 (ZEO) kg/min. None of the FA created flow rates that differed significantly from CON. Drained AOR at loading was higher ($P < 0.05$) for DMX-7 compared with CON, CA, and ZEO (65.1 vs. 61.0, 60.4, 60.3°, respectively). Poured AOR after storage was not affected by FA. In conclusion, increasing moisture content from 9 to 11.6% clearly decreased flowability of DDGS. The FA used in this experiment at the selected concentrations did not improve flowability of DDGS.

Key Words: Flowability, DDGS, Angle of repose

167 Effects of nutrition during gilt development on lifetime productivity of sows of 2 prolific maternal lines: Summary of growth characteristics and sow productivity. P. S. Miller*, R. K. Johnson, M. W. Anderson, and R. Moreno, *University of Nebraska, Lincoln.*

A total of 471 gilts from 2 prolific sow lines derived from the Nebraska index line (L45) and the Nebraska nutrition maternal line (LW × LR) were studied over 4 parities. Gilts were penned in groups (n = 10) and received identical diets (corn-soybean meal-based) and management until 123 d of age (3-phase growing-finishing period). At this time, gilt pens were assigned to receive 1 of 2 dietary regimens; ad libitum treatment (**AL**) that was a corn-soybean meal diet (0.70% lysine, 0.70% Ca, 0.60% P) provided (ad libitum access to feed and water) until gilts were moved into the breeding barn (d 226), or a restricted treatment (**R**). The R group received a corn-soybean diet at approximately 75% of the energy intake of the AL group. At approximately 110 d of gestation, females were placed in farrowing crates. Litters were weighed and weaned at 17 d post-farrowing. The LW × LR gilts were heavier ($P < 0.001$) than L45 gilts at d 123 (71.6 vs. 65.8 kg) and at d 226 (131.0 vs. 123.5 kg). Dietary energy restriction compared to the AL treatment resulted in 21-kg decrease ($P < 0.001$) in d 226 BW. On d 226, there was no difference in BF between genetic lines; however, BF decreased ($P < 0.001$) 33% in R vs. AL gilts. Longissimus muscle area (LMA) was greater ($P = 0.005$) in LW × LR compared to L45 gilts (40.71 vs. 38.71 cm2) at d 226. Energy restriction during the developmental period decreased ($P < 0.001$) LMA (42.52 vs. 37.35 cm2). There was a trend ($P = 0.073$) for R sows to wean more pigs. The LW × LR sows weaned heavier ($P = 0.007$) litters compared to the L45 gilts (53.4 vs. 50.5 kg). Energy restriction during the developmental period resulted in sows that had heavier litters at weaning (AL = 50.7 kg, R= 53.6 kg). Differences in litter performance between genetic lines do not appear to be due to gilt management. Dietary energy restriction during the gilt development period increased litter weaning weight.

Key Words: Sow, Performance, Energy intake

168 Effects of restricting energy intake during development and genetic line on productivity through three parities. R. K. Johnson*, P. S. Miller, M. W. Anderson, and R. Moreno, *University of Nebraska, Lincoln.*

Effects of energy restriction during gilt development, breeding weight (W) and backfat (BF), and sow W and BF pre-farrowing and at weaning on farrowing rate and productivity through Parity 3 were evaluated. Treatments were ad libitum intake to breeding (AL) or 75% of AL from 123 d to breeding, but without restriction of protein, vitamins, and minerals (R). Large White × Landrace (LWxLR) and NE Index Line cross gilts (L45X) were assigned to treatments within litter. Age at puberty and W, BF, and longissimus muscle area (LMA) at 226 d of age were recorded; W and BF were recorded in sows pre-farrowing and at weaning; thereafter, females were managed alike. Gilts were mated at 2nd or later post-pubertal estrus. Sows were given ≥10 d to express estrus postweaning. Culling was for health or infertility. There were 462 gilts at 226 d; 414 attained puberty, 379 were designated as breeders, and 296, 176, and 133 P1, P2, and P3 litters, respectively. Females were scored as 0 or 1 if they did or did not farrow a litter. Scores were fitted

with general linear models to estimate line, treatment, and interaction effects; W, BF, and LMA were fitted as covariates in separate analyses. 91.4% of LWxLR gilts on AL and 78% on R attained puberty ($P < 0.01$). Treatment did not affect this percentage for L45X (AL = 97.1%, R = 94.2%). More L45X than LWxLR gilts produced P1 litters (L45X=69%, LWxLR=56%, $P< 0.01$). L45X gilts produced 2.85 ±1.57 ($P = 0.07$) more live pigs through Parity 3 than LWxLR females. Treatment did not affect lifetime number of live pigs based on breeding gilts; but of females with a P1 litter, those on AL produced 2.91±1.61 ($P= 0.07$) more live pigs than those on R. An increase in W at 226 d was associated with increased likelihood of a P1 litter only for L45X, R gilts (0.0068±0031/kg). An increase of BF at 226 d was associated with increased likelihood of producing a P1 litter only for LWxLR gilts (AL=0.013±0.006/mm; R=0.031±0.009/mm). W and BF at P1 and P2 did not affect the likelihood of another litter.

Key Words: Gilt, Energy intake, Lifetime production

169 Effects of sow parity and L–arginine treatment during early gestation on litter size and birth weight. M. Hahn*[1], S. Town[1], M. Smit[1], J. Patterson[1], A. Pasternak[1], D. Guggenbiller[2], C. Smits[3], P. Ramaeker[3], M. Dyck[1], and G. Foxcroft[1], [1]*Swine Research & Technology Centre, University of Alberta, Edmonton, Alberta, Canada*, [2]*Trouw Nutrition, Highland, IL*, [3]*Nutreco Swine Research Centre, Sint Anthonis, The Netherlands*.

L–arginine, a key regulator of embryogenesis as well as placental and fetal growth has been reported to increase litter size born. L–arginine could also counteract effects of intrauterine growth retardation (IUGR) likely due to intra-uterine crowding established in the higher parity sows used in the study. However, the optimal dose/duration of L–arginine treatment is not known. Therefore, parity two to six sows in estrus within ten days of weaning (n = 735) were bred by artificial insemination and allocated equally to one of six treatments: Controls – untreated; Tmt 1 – full dose (20g) L–arginine (ProgenosTM) fed on gestation days 16-28; Tmt2 – half dose on days 16–22; Tmt3 – full dose on days 30–44; Tmt4 – full dose on days 16–22; Tmt5 – full dose on days 23–29. Parity was equally distributed among all treatments. Litter data was collected from the 586 pregnant sows within 24 hours after farrowing. Total pigs born was affected by parity (12.1 ± 0.3, 12.6 ± 0.3, 11.03 ± 0.3, and 11.5 ± 0.3, in parity 2, 3, 4, and 5&6, respectively; P<0.01) but not by L–arginine treatment (P = 0.17). Overall, litter birth weight was strongly and negatively correlated with total born (r = -0.53) and was not affected by L–arginine treatment (P = 0.26). For litters of 10-15 total born, birth weight was less affected by total born (r = -0.18) but still not affected by L–arginine treatment (P = 0.2). Litter size and birth weight were not affected by L–arginine treatment; however, litter size was affected by parity.

Key Words: L-arginine, Pig

170 Effects of different creep feeder designs and feed accessibility on proportion of piglets consuming creep feed and litter performance. R. C. Sulabo*, M. D. Tokach, J. L. Nelssen, S. S. Dritz, R. D. Goodband, and J. M. DeRouchey, *Kansas State University, Manhattan*.

A total of 54 sows (PIC Line 1050) and their litters were used to determine the effects of different creep feeder designs on the proportion of piglets consuming creep feed (eaters) and pre-weaning performance. Two groups of sows were blocked according to parity and date of farrowing using a randomized complete block design and allotted to three experimental treatments: Treatment 1 – rotary feeder with hopper; Treatment 2 – rotary feeder without hopper; and Treatment 3 – pan feeder. A creep diet (3,495 kcal ME/kg, 1.56% TID Lys) with 1.0% chromium oxide was offered ad libitum at d 18 until weaning (d 21). A single lactation diet (3,503 kcal ME/kg, 0.97% TID Lys) was used, and sows were allowed free access to feed throughout lactation. Fecal samples from all piglets were taken twice using sterile swabs between 3 and 12 h before weaning for all treatments. Piglets were categorized as eaters when the fecal sample was colored green at least once on any of the two samplings. Results showed no differences in pig (5.6, 5.9, and 5.9 kg; P>0.18) and litter (59.1, 61.6, and 61.3 kg; P>0.51) weights at weaning among litters using the different types of creep feeder. Total and daily gains of pigs (0.72, 0.82, 0.77 kg and 245, 268, 263 g/d; P>0.20) and litters (7.7, 8.3, 8.1 kg and 2.6, 2.8, 2.7 kg/d; P>0.31) were similar across treatments. Litters using the rotary feeder with the hopper had 2.7 times lower (0.44 kg; P<0.01) total creep feed disappearance than litters using the rotary feeder without the hopper (1.18 kg) and the pan feeder (1.24 kg). Creep feeder design influenced (P<0.01) the proportion of eaters with a higher percentage of eaters created when litters were fed using the rotary feeder with hopper (69%) than when using the rotary feeder without hopper (47%) or the pan feeder (42%). In conclusion, the proportion of eaters in creep-fed litters and feed wastage can be influenced by non-dietary factors, such as creep feeder design.

Key Words: Feed management, Creep feed, Feeder design

171 Effect of dietary vitamin levels and group size on performance of growing pigs. Y. Huang*[1], Y. Wang[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], H. J. Kim[1], K. Y. Whang[2], and I. H. Kim[1], [1]*Dankook University, Cheonan, Choongnam, Korea*, [2]*Korea University, Seoul, Korea*.

This study was conducted as an effort to assess the effects of dietary vitamin levels and group sizes on growth performance, nutrient digestibility, and blood characteristics in growing pigs. A 2×3 factorial (two vitamin levels, three regimens of group sizes) arrangement was utilized with 96 pigs (BW=23.10±0.95kg). The pigs were divided into 6 treatment groups with 4 replications. The group sizes were 3, 4, or 5 pigs per pen, respectively. The floor-space allowances for all treatments were 0.64, 0.48, and 0.38 m^2 /pig. The diets used in this study were a basal diet and a high vitamin diet (twice the NRC recommended requirement). The ADG and ADFI of pigs were decreased linearly as the group size increased (P=0.03 and P=0.01, respectively). The G/F of pigs was 5% lower (P=0.03) in the high vitamin treatment group (0.531) as compared with the control treatment group (0.557). Both DM and N digestibility were affected negatively to a significant degree by high vitamin levels in diets (P=0.05 and P=0.04, respectively). Moreover, a negative effect (linear, P=0.02) on N digestibility was detected in the large groups. Cortisol concentrations were increased with increasing group size (linear, P=0.03). And the principal effects of dietary vitamin level were observed, cortisol concentration in control treatment group (4.20μg/dl) was 11% higher (P=0.04) than in the high vitamin treatment group (3.79μg/dl). Serum urea nitrogen concentration was affected in a linear fashion by group size (P=0.03) with the highest concentration noted in the 3 pigs/pen treatment. Group size also caused a linear reduction in WBC concentration (P=0.05). Our data indicated that the principal effect of group size had no interaction with dietary vitamin levels. In conclusion, our results indicate that pigs with lower feed intakes as a

result of larger group size do not have higher vitamin requirements than pigs in smaller groups.

Key Words: Group size, Vitamin level, Growing pigs

172 Effects of combinational uses of zinc sulfate and zinc-amino acid chelate on zinc bioavailability in broiler chickens. S. J. Park*[1], B. J. Min[2], R. A. Royce[3], and S. W. Kim[2], [1]*Texas Tech University, Lubbock,* [2]*North Carolina State University, Raleigh,* [3]*Albion-Advanced Nutrition, Clearfield, UT.*

A total of 447, 1 d old, broiler chickens was used to determine bioavailability of zinc when 2 zinc sources were combined or used individually. Fifteen birds were killed at d 0 and ground for carcass sampling. Remaining 432 birds were allotted to 4 dietary treatments: **ZS** (with 40 ppm Zn from Zn sulfate); **ZAA** (with 40 ppm Zn from Zn amino acid chelate, Albion-Advanced Nutrition); **ZA1** (with 40 ppm Zn from Zn sulfate and Zn amino acid chelate with 2:1 ratio); and **ZA2** (with 40 ppm Zn from Zn sulfate and Zn amino acid chelate with 1:2 ratio). There were 6 replicates per treatment with initially 18 birds per stainless steel brooder cage with the heater. Birds had feed and water *ad libitum* during 21 d feeding period. Body weight and feed intake were measured on d 1, 3, 5, 7, 14, and 21. Groups of 3 birds were randomly selected and killed at d 1, 3, 5, 7, 14, and 21, ground together for each day, sampled, and analyzed for Zn. The ADG, ADFI, and gain:feed ratio did not differ among treatment groups. Content of Zn (mg/bird) in bird carcass did not differ among treatment groups at d 21. Bioavailability of Zn from ZAA (39.2%) was greater (P<0.05) than ZS (33.1) and ZA1 (33.9) at d 14. However, bioavailability of Zn did not differ among treatment groups at d 21. This study indicates that Zn from Zn amino acid chelate can be better absorbed than Zn from Zn sulfate by broiler chickens until d 14 of age when Zn was supplemented at 40 ppm in the diet. However, combinational uses of Zn amino acid chelate with Zn sulfate (1:2 or 2:1 ratio) did not improve the Zn absorption by broiler chickens.

Key Words: Bioavailability, Broilers, Zinc

173 Effects of single or multi-enzyme preparations supplementation in corn distillers dried grains with solubles diet on growth performance, nutrients digestibility and serum characteristics in 50 kg pigs. Y. Wang*[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], Y. Huang[1], H. J. Kim[1], S. O. Shin[1], I. H. Kim[1], H. K. Moon[2], and I. C. Kim[2], [1]*Dankook University, Cheonan, Choongnam, Korea,* [2]*National Institute of Animal Science, Seonghwan, Choongnam, Korea.*

Ninety six crossbred pigs (47.5 kg), 6 pens/treatment and 4 pigs/pen, were used in a 4 week growth trial. Pigs were randomly allocated to four dietary treatments, which included: 1) HC, high nutrient-corn-soybean meal diet; 2) LC, low nutrient-DDGS included diet; 3) LCS, low-nutrient DDGS included diet + single enzyme (β-mannanase); 4) LCM, low nutrient-DDGS included diet + multi-enzyme (blend of α-1,6-galactosidase and β-1,4-mannanase). Through the entire experimental period, average daily gain (ADG) in LC treatment (0.707kg) was significantly lower (P<0.05) than HC treatment (0.848kg), however, LCS (0.759kg) and LCM (0.756kg) treatments tended to be higher (P<0.10) than LC treatment (0.707kg). The three low nutrient-DDGS treatments (1.75kg, 1.82kg and 1.78kg) had lower (P<0.05) average daily feed intake (ADFI) than HC treatment (2.00kg). There was no notable difference in gain/feed among the treatments. HC treatment (80.65%) had higher dry matter (DM) digestibility than LC (72.21%) and LCM (75.29%) treatments (P<0.05), furthermore, LCS (77.60%) had higher (P<0.05) DM digestibility than LC treatment (72.21%). Nitrogen digestibility was higher (P<0.05) in HC treatment (79.79%) than LC treatment (73.81%). A significant difference (P<0.05) was obtained for energy digestibility, with the highest value in HC treatment (79.13%), intermediate values for LCS (73.21%) and LCM (78.06%) treatments, and lowest value in LC treatment (74.67%). No significant difference was observed on blood urea nitrogen (BUN) and creatinine. In conclusion, single or multi-enzyme supplementation in low nutrient-DDGS included diet can improve growth and digestibility in 50 kg pigs.

Key Words: DDGS, Digestibility, Pig

174 Amino acid and energy digestibility of two different sources of soy hulls for swine. J. Y. Jacela*, J. M. DeRouchey, S. S. Dritz, M. D. Tokach, R. D. Goodband, J. L. Nelssen, and R. C. Sulabo, *Kansas State University, Manhattan.*

This study was conducted to determine the digestibility of amino acids (AA) and energy of soy hulls from two different sources. Five barrows (initially 68 kg) fitted with T-cannulas were fed three diets in a crossover design. The first two diets contained 66.7% soy hulls from two different sources (SH-A and SH-B). The third diet was N-free to determine endogenous AA losses. Each period was 7 d with the first 4 d as adaptation period to the diet. Fecal samples were collected on d 5 and 6. Digesta samples were collected between 0600 and 1800 of d 6 and 7. Samples were analyzed for AA and energy content. Apparent (AID) and standardized (SID) ileal digestibilites and GE, DE, ME, and NE values were calculated from these analyses. Only four pigs were used for all data analyses due to poor flowability of digesta through the T-cannula in one pig when fed the soy hull diets. The analyzed composition were 15.9% CP, 5.1% ash, 1.6% EE, 37.5% ADF, and 50.8% NDF for SH-A; and 12.1% CP, 5.6% ash, 2.3% EE, 40.3% ADF, and 53.6% NDF for SH-B. Soy hull-A had higher (P<0.03 to 0.12) AID and SID values for most amino acids. However, when expressed as a ratio to CP, there were no differences in actual SID AA content. As a percentage of CP; SID Lys, Met, and Thr values were 4.1, 0.8, and 2.2% for SH-A; and 4.0, 0.9, and 2.0% for SH-B, respectively. Energy digestibility was similar between sources; however, GE was higher (P<0.05) for SH-A. The GE, DE, ME, and NE values were 4,190; 2,670; 2,551; 1,777 kcal/kg for SH-A and 4,075; 2,399; 2,308; 1,565 kcal/kg for SH-B.

Table 1.

	SH-A			SH-B			P < (A vs B)	
Item	AA, %	AID	SID	AA, %	AID	SID	AID	SID
Arg	0.87	71.4	76.5	0.69	62.8	69.6	0.03	0.05
His	0.41	57.9	61.9	0.33	49.6	54.7	0.06	0.08
Ile	0.65	58.4	62.5	0.52	43.3	48.9	0.03	0.04
Leu	1.08	58.9	63.1	0.87	45.4	51.0	0.05	0.06
Lys	1.06	58.4	61.1	0.89	51.1	54.6	0.06	0.07
Met	0.19	65.9	69.5	0.17	57.5	62.3	0.02	0.03
Phe	0.66	66.3	70.4	0.50	57.6	62.9	0.07	0.09
Thr	0.55	50.7	62.3	0.47	37.5	52.0	0.06	0.12
Trp[a]	0.08	N/A	N/A	0.06	N/A	N/A	N/A	N/A
Val	0.72	57.5	62.2	0.59	43.8	50.1	0.04	0.05

[a]Values were too low to be determined in some samples

Key Words: Swine, Soy hulls, Digestibility

175 Dietary lysine levels on carcass composition, meat quality, and growth performance in growing-finishing pigs. P. S. Heo*, C. K. Park, Y. H. Jin, E. J. Jun, H. K. Oh, and Y. Y. Kim, *Seoul National University, Seoul, Korea*.

This experiment was conducted to evaluate the effect of reducing dietary lysine level on growth performance and pork quality traits. A total of 64 crossbreed pigs ([Landrace × Yorkshire] × Duroc) at 24.18 kg of initial body were used in this experiment during growing (6 weeks) and finishing (8 weeks) phases. The experiment was consisted of 4 treatments in a randomized complete block (RCB) design with 4 replicates. The treatments were 1) CON (basal diet, NRC requirement), 2) LD1 (reduce 10% lysine level than basal diet), 3) LD2 (reduce 20% lysine level than basal diet), 4) LD3 (reduce 30% lysine level than basal diet). All feed and water were provided ad libitum. During the whole experimental period, pigs fed LD1 diet were the greatest on body weight (BW) and average daily gain (ADG). And body weight, ADG and feed efficiency (G/F ratio) in CON and LD1 groups were higher (P<0.05) than other lysine-deficient diet groups. Carcass trait and meat quality measurements were determined when average weight of pigs reached at 107kg. LD2 group had highest lipid and it was 74.26% higher than CON group. Marbling score of LD2 group was higher than others and CON group had the lowest marbling score (P<0.1). Water holding capacity tended to increase by lysine deficiency although it was not significant difference. Lysine-deficient diet did not affect meat color, pork pH and shear force significantly. These results suggested that the supplementation of low lysine level diet in growing-finishing resulted in decreasing growth performance of pig but influencing fat composition as well as marbling score of pork.

Key Words: Lysine deficient, Growing finishing pig, Growth performance

176 Effects of dietary probiotic complex(*Lactobacillus acidophilus, Bacillus subtilis & Aspergillus oryzae*) on growth performance, blood immunological parameters and fecal malodor gas emission in growing pigs. H. D. Jang*[1], H. J. Kim[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], K. Y. Whang[2], I. H. Kim[1], J. C. Park[3], and H. J. Jung[3], [1]*Dankook University, Cheonan, Choognam, Korea*, [2]*Korea University, Seoul, Korea*, [3]*National Institute of Animal Science, SeongHwan, Korea*.

This study was conducted to evaluate effect of probiotic complex(PC=Lactobacillus acidophilus, Bacillus subtilis & Aspergillus oryzae) on growth performance, blood immunological parameters and fecal malodor gas emissions in growing pigs. Forty-eight pigs[(Landrace × Yorkshire) × Duroc, 25.31±1.29kg average initial body weight] were used in 35d growth trial. Dietary treatments included CON(basal diet), PC1(basal diet + 0.1% probiotic complex) and PC2(basal diet + 0.2% probiotic complex). The pigs were assigned to the treatments according to body weight and each treatment had 8 replicates of 2 pigs per pen in a randomized complete block design. From d 0 to 20, PC(PC1=1.436 kg, PC2=1.428 kg) increased (linear effect, P=0.013) ADFI. From d 21 to 35, PC(PC1=1.791 kg, PC2=1.711 kg) increased (quadratic effect, P=0.024) ADFI. For the whole period, ADFI was increased (quadratic effect, P=0.004) with PC(PC1=1.613 kg; PC2=1.569 kg). For the whole period, ADG was increased (quadratic effect, P=0.017) with PC(PC1=0.910 kg; PC2=0.863 kg). Dry matter digestibility increased (linear effect, P=0.001) with PC(PC1=78.29%; PC2=80.32%). Nitrogen digestibility was also higher (linear effect, P=0.005) for PC(PC1=75.25%; PC2=77.53%). For blood immunological parameters, Total protein, IgG, red blood cell(RBC) and white blood cell(WBC) were increased(quadratic effect, P<0.001) with PC(PC1= 0.42 g/dl, 175.67 mg/dl, 1.07×106/ul and 8.21×103/ul; PC2=0.74 g/dl, 236.67 mg/dl, 2.53×106/ul and 11.56×103/ul) . In fecal malodor gas emission, ammonia and acetic acid were significantly reduced (linear effect, P<0.02) with PC(PC1= 8.25 and 0.50 ppm; PC2= 7.00 and 0.25 ppm). Hydrogen sulfide was reduced (quadratic effect, P=0.018) with PC(PC1= 6.25 ppm; PC2=2.25ppm). In conclusion, 0.2 % PC improved ADFI, apparent dry matter and nitrogen digestibility, total protein, IgG, RBC and WBC. Ammonia, acetic acid and hydrogen sulfide emissions were also reduced.

Key Words: Probiotic complex, Growth performance, Fecal malodor gas emission

177 Effects of transgenic *Bacillus subtilis* secreting chitinase supplementation on growth performance, nutrient digestibility, blood characteristics and carcass traits in finishing pigs. H. J. Kim*[1], J. H. Cho[1], Y.J. Chen[1], J. S. Yoo[1], Y. Wang[1], Y. Huang[1], K.Y. Whang[2], and I. H. Kim[1], [1]*Dankook University, Cheonan, Choongnam, Korea*, [2]*Korea University, Seoul, Korea*.

This study was conducted to investigate the effects of transgenic *Bacillus subtilis*secreting chitinase supplementation on growth performance, nutrient digestibility, blood characteristics and carcass traits in finishing pigs. A total of sixty-four pigs(50.82±0.82kg, average initial body weight) were used during 84 days. Dietary treatments included: 1) CON (basal diet without antibiotics), 2) AD (basal diet + 0.1% Virginiamycin), 3) CD0.5 (basal diet + 0.5% transgenic *Bacillus subtilis*), 4) CD1.0 (basal diet + 1.0% transgenic *Bacillus subtilis*). In growth performance, ADG(average daily gain) and Gain/Feed ratio were significantly increased in CD1.0 treatment comparedto AD treatment during 0~4 weeks(P<0.05). During 4~8 weeks, ADG was significantly increased in AD treatment compared to CON and CD0.5 treatments(P<0.05). Also, ADFI was significantly increased in AD treatment compared to others(P<0.05). During 8~12 weeks, ADFI was significantly increased in CON treatment compared to other treatments(P<0.05) and Gain/ Feed ratio was significantly increased in CD0.5 and CD1.0 treatments compared to AD treatment(P<0.05). During whole period, ADFI was significantly increased in AD treatment compared to CD0.5 and CD1.0 treatments(P<0.05). And Gain/Feed ratio was significantly increased in CD0.5 and CD1.0 treatments compared to CON treatment(P<0.05). In meat color, L* value was improved in CD0.5 treatment compared to CON and AD treatments(P<0.05) and a* value was improved in CON treatment compared to others(P<0.05). In sensory evaluation, meat color was higher in CON, CD0.5 and CD1.0 treatments than AD treatment(P<0.05). And a marbling was higher in CON treatment than others(P<0.05). A hardness was higher in CD0.5 treatment than AD treatment(P<0.05). In conclusion, transformed Bacillus subtilis secreting chitinase supplementation improve Gain/Feed ratio and influence meat color. So, in this experimental result, we suggest that transformed Bacillus subtilis secreting chitinase can partly substitute antibiotics.

Key Words: *iBacillus subtilis*, Performance, Pig

178 VevoVitall® supplementation on the performance, nutrient digestibility, blood profile and ammonia gas emission in weaning and growing pigs. S. K. Jang*, Y. H. Choi, Y. H. Jin, L. G. Pao, Y. S. Noh, and Y. Y. Kim, *Seoul National University, Seoul, Korea*.

This study was investigated to evaluate the effect supplementation of VevoVitall ® (DSM Nutrition Korea Ltd.) on growth performance, nutrient digestibility, urine pH, blood profile, ammonia emission in weaning and growing pigs. A total of 128 pigs weaned at 24 ± 3d of age were allotted to treatments in 8 replicates with 4 pigs per pen. Treatments included: 1) NCon (basal diet), 2) PCon (basal diet + antibiotic colistin sulfate 0.12%, 3) NeVe (basal diet + VevoVitall ® 0.5%), 4) PoVe (basal diet + antibiotic colistin sulfate 0.12% + VevoVitall ® 0.5%). During weaning period (0 to 5 week), NCon treatment showed the lowest on body weight, average daily gain (ADG) and average daily feed intake (ADFI) among all treatments (P<0.05). However, there were not significantly different among NeVe, Pcon and PoVe treatments. Although there were not significantly different among all treatments, pigs fed NCon had lower ADG than other treatments during growing period. In ADG, Pcon, NeVe and PoVe were increased 6.78%, 5.65% and 8.62%, respectively, compared with Ncon. Also, the ADFI in PCon and PoVe groups were significant higher than other groups (P<0.05). There were not significantly different in nutrients digestibility and blood urea nitrogen level among all dietary treatments during experiment period. There were no significant differences the number of red blood cell, lymphocyte, and total protein among all treatments. The urinary pH was decreased by supplementing benzoic acid(NeVe, PoVe) during weaning phase (P=0.069) and growing phase (P=0.059). The pH in feces tended to be lowered in pigs fed the diets supplemented with benzoic acid (NeVe & PoVe treatments) than in pigs fed the diets without benzoic acid by -9.01% and -4.05% respectively. Although the difference was not statistically significant, ammonia gas emission was also reduced by benzoic acid supplement during growing period. In conclusion, this experiment suggested that VevoVitall ® supplementation resulted in improving growth performance and decreased urine pH of pigs during weaning and growing phase.

Key Words: VevoVitall, Weaning growing pig, Ph, digestibility

179 Effects of dietary γ-Butyrobetaine and L-Carnitine on carnitine concentrations in various muscle tissues of finishing pigs. J. M. Benz*, J. L. Nelssen, M. D. Tokach, R. D. Goodband, J. M. DeRouchey, and S. S. Dritz, *Kansas State University, Manhattan*.

One-hundred-twenty-five barrows with an initial BW of 74.8 kg were used in a 34 d study to determine the effect of dietary L-carnitine and γ-Butyrobetaine on carnitine concentrations in various muscle tissues in finishing pigs. A primary method of L-carnitine production is from the fermentation of γ-Butyrobetaine, which is similar to the biological process that naturally occurs in the liver and kidneys. Dietary treatments were corn-soybean meal based with a control diet or diets containing either L-carnitine (100 ppm), γ-Butyrobetaine (100 ppm), or a combination of L-carnitine (50 ppm) and γ-Butyrobetaine (50 ppm). At the end of the study, longissimus, diaphragm, heart, and kidney tissues were collected from 40 pigs. Pigs fed supplemental L-carnitine, γ-Butyrobetaine and the combination of L-carnitine and γ-Butyrobetaine increased (P < 0.01) free carnitine concentration over pigs fed the control diet in the longissimus (162.8, 158.7, 156.7 vs 111.7 ppm), diaphragm (200.2, 212.2, 210.7 vs 150.5 ppm), and heart (101.5, 89.2, 102.7 vs 66.1 ppm). L-carnitine and the combination of L-carnitine and γ-Butyrobetaine increased (P < 0.01) free carnitine concentration over the control in the kidney (17.0, 16.3 vs 12.3 ppm). Therefore, supplementing dietary γ-Butyrobetaine and L-carnitine can be used to increase free carnitine concentrations of organ and muscle tissues.

Key Words: L-carnitine, γ-Butyrobetaine, Carnitine concentrations

180 Effects of two TID lysine concentrations, Optipak®, Paylean®, and their combinations, on the growth performance and carcass characteristics of finishing pigs. J. R. Bergstrom*, M. D. Tokach, S. S. Dritz, J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan*.

A total of 1,207 pigs (PIC 337 × 1050; BW 99.8 kg) were used in a 28-d experiment to evaluate the effects of two TID lysine concentrations, Optipak®, Paylean®, and their combinations on growth performance and carcass characteristics. There were 6 reps per treatment and 19 to 26 pigs/pen. Pigs were allotted to six corn-soybean meal-based dietary treatments. Four diets were formulated to 0.80% TID lysine; including: 1) control diet, the control diet with 2) 0.25% Optipak®, 3) 5 ppm Paylean®, or 4) both Optipak® and Paylean®. Treatments 5 and 6 were formulated to 0.94% TID lysine and contained 5 ppm Paylean®, one without Optipak® and the other with 0.25% Optipak®. Pigs fed diets containing Paylean® had improved (P<0.04) ADG, F/G, and final weight. When diets contained Paylean®, ADFI tended (P<0.07) to be lower when TID lysine was increased from 0.80 to 0.94%. There were no other differences in growth performance among the treatments. For carcass characteristics, live weight, HCW, and yield were improved (P<0.04) for pigs fed Paylean®. Overall, loin depth increased (P<0.03) when Optipak® was included in the diet. This experiment provides further evidence that Paylean® improves late-finishing pig growth performance, HCW, and yield. Although Optipak® did not improve growth performance, it increased loin depth. The different responses to Paylean® and Optipak® suggest that the incentives for justifying their use need to be evaluated independently.

Table 1.

TID Lys, %	0.80	0.80	0.80	0.80	0.94	0.94
Optipak®	-	+	-	+	-	+
Paylean®	-	-	+	+	+	+
Growth						
D 0 wt, kg	99.8	100.7	100.7	99.4	100.3	98.9
ADG, g	875	907	966	984	962	953
ADFI, g	2,595	2,717	2,731	2,722	2,613	2,622
G/F	0.33	0.33	0.35	0.36	0.37	0.36
Carcass						
Live wt., kg	123.9	124.3	125.7	126.1	126.1	125.2
HCW, kg	93.0	93.5	95.7	95.7	95.7	95.3
Yield, %	75.3	75.1	76.1	76.0	76.1	75.8
Backfat – 10th rib, mm	17	18	18	18	17	18
Loin depth, cm	6.22	6.25	6.15	6.43	6.30	6.45
FFLI	50.5	50.1	50.2	50.5	50.6	50.3

Key Words: Pig, Lysine, Ractopamine

181 Evaluation of arabinogalactan (Larafeed® AG) as a neutraceutical growth promoter in starter diets for weanling pigs. J. R. Bergstrom*[1], J. L. Nelssen[1], M. D. Tokach[1], S. S. Dritz[1], and J. C. Woodworth[2], [1]*Kansas State University, Manhattan,* [2]*Lonza, Inc., Allendale, NJ.*

A total of 288 pigs (6.8 kg) were used in a 28-d experiment. Pigs were blocked by weight and randomly allotted to one of 8 dietary treatments. There were 6 replications with 6 pigs per pen. Treatments were arranged in a 2 × 4 factorial of diets without or with a feed-grade antibiotic (154 ppm neomycin and 154 ppm oxytetracycline), and with 4 levels of arabinogalactan (0, 0.05, 0.10, and 0.20%). Arabinogalactan is a water-soluble proteoglycan/polysaccharide, most commonly harvested from the bark of the Western Larch (*Larix occidentalis*) tree. There were no arabinogalactan × antibiotic interactions (P>0.11). From d 0 to 14, ADG (163, 172, 163, and 141 g/d), ADFI (200, 195, 195, and 177 g/d), and d 14 wt (9.1, 9.1, 9.1, and 8.8 kg) decreased (linear, P<0.05) with increasing level of arabinogalactan. Due to the reduction in ADFI at the highest level (0.20%) of arabinogalactan, ADFI (422, 413, 422, and 390 g/d) also decreased (linear, P<0.05) from d 0 to 28 with increasing arabinogalactan. Arabinogalactan did not influence (P>0.10) overall ADG (327, 322, 336, and 304 g/d) or G/F (0.78, 0.78, 0.79, and 0.78). From d 0 to 28, pigs fed diets with antibiotic had greater (P<0.01) ADG (340 vs 304 g/d) and ADFI (431 vs 390 g/d), and were heavier (P<0.05) on d 14 (9.1 vs 8.9 kg) and 28 (16.5 vs 15.3 kg) than pigs fed diets without antibiotic. In conclusion, the addition of neomycin and oxytetracycline to weanling pig diets improved ADG and ADFI; however, the addition of arabinogalactan to weanling pig diets did not improve growth performance.

Key Words: Pig, Antibiotic, Arabinogalactan

182 Evaluation of astaxanthin as a neutraceutical growth promoter in diets for weanling pigs. J. R. Bergstrom*, J. L. Nelssen, M. D. Tokach, S. S. Dritz, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan.*

A total of 210 pigs (initially 5.7 kg) were used in a 28-d experiment to evaluate the effect of increasing dietary astaxanthin (0, 5, 10, and 25 ppm) on weanling pig performance. Pigs were blocked by weight and randomly allotted to one of five dietary treatments. Pigs were fed simple corn-soybean meal-dried whey-based diets from d 0 to 14; and corn-soybean meal diets from d 14 to 28. Treatments consisted of a negative control diet without added feed-grade antibiotic; the negative control with 5, 10, or 25 ppm added astaxanthin; or a positive control with an antibiotic (154 ppm of neomycin and 154 ppm of oxytetracycline). From d 0 to 14, ADG (132, 136, 136, 141 vs 168 g/d) and G/F (0.79, 0.79, 0.78, 0.79 vs 0.86) were improved (P < 0.05) by including an antibiotic in the diet; with pigs fed antibiotic being heavier (P < 0.05) on d 14 than pigs fed 0, 5, or 10 ppm astaxanthin (7.6, 7.6, 7.6 vs 8.1 kg), and tending to be heavier (P < 0.10) than pigs fed 25 ppm astaxanthin (7.6 kg). From d 14 to 28, pigs fed antibiotic had greater (P < 0.05) ADG than pigs fed 0, 5, and 25 ppm astaxanthin (472, 463, 472 vs 513 g/d); with pigs fed 10 ppm astaxanthin having intermediate ADG (481 g/d). Pigs fed antibiotic had greater (P < 0.05) ADFI than pigs fed all other treatments (599, 585, 599, 608 vs 676 g/d). Pigs fed antibiotic had poorer (P < 0.05) G/F than pigs fed 0, 5, or 10 ppm astaxanthin (0.79, 0.79, 0.81 vs 0.76), and pigs fed 25 ppm astaxanthin had poorer (P < 0.05) G/F (0.78) than pigs fed 10 ppm astaxanthin. Overall, ADG (304, 299, 308, 304 vs 340 g/d), ADFI (381, 381, 386, 390 vs 435 g/d), and BW on d 28 (14.2, 14.1, 14.3, 14.2 vs 15.2 kg) were improved (P < 0.05) by including an antibiotic in the diet. Pigs fed 25 ppm astaxanthin had poorer (P < 0.05) G/F (0.78 vs 0.80) than pigs fed 10 ppm astaxanthin. In conclusion, growth performance of pigs receiving astaxanthin was not different than that of pigs fed the negative control diet. However, ADG and ADFI were improved by the feed-grade antibiotic.

Key Words: Pig, Antibiotic, Astaxanthin

183 Supplementation of inorganic acidifier on growth performance nutrient digestibility, intestinal morphology, and microflora in the gastrointestinal tract of weaning pigs. K. W. Kang*, H. B. Lee, H. F. Long, K. H. Kim, H. K. Oh, and Y. Y. Kim, *Sepul National University, Seoul, Korea.*

This study was investigated to evaluate the effect supplementation of inorganic acidifier on growth performance nutrient digestibility, intestinal morphology, and microflora in the GI tract of weaning pigs. HCl was premixed with carrier to addition to the experimental diet. A total of 80 crossbred pigs, averaging 7.57 kg body weight, were allotted to treatments in five replicates with four pigs per pen. Treatments included: 1) Pcon(basal diet ; corn-soy based+avliamycin 0.12%); 2) HCl 0.1%(basal diet+HCl 0.1%), 3) HCl 0.2%(basal diet+HCl 0.2%)4) HCl 0.3%(basal diet+HCl 0.3%). During total experimental period, PCon treatment showed the greatest on body weight gain (16.39, 15.65, 13.87, 15.27, P<0.05 for Pcon, HCl 0.1%, HCl 0.2%, HCl 0.3%, respectively) and average daily gain(252, 229, 180, 220, P<0.05 for Pcon, HCl 0.1%, HCl 0.2%, HCl 0.3%, respectively). Also, the ADG in HCl 0.1% group was significant higher than other groups supplemented HCl. Pigs fed diet of HCl 0.2% had lower body weight and ADG than other treatments. There were no significant differences in ADFI and gain : feed(G/F) among all treatments(P>0.05). The supplementation of inorganic acidifier had no significant difference on the nutrients digestibility and blood urea nitrogen level. During 1~3 weeks, there were significant differences in diarrhea score(1.92, 1.77, 2.32, 2.11, P<0.05 for Pcon, HCl 0.1%, HCl 0.2%, HCl 0.3%, respectively). But during total experimental period, there were no significant differences in diarrhea score and morphology of the small intestine. The count of B. subtilis in ileum(Ct-value;19.13, 20.97, 21.58, 22.34, P<0.05 for Pcon, HCl 0.1%, HCl 0.2%, HCl 0.3%, respectively) were significantly higher than those of other treatments. There were no significant differences on the count of S. bovis, L. plantarum and E.coli K88ac among all treatments. These results may be suggested that the inorganic acidifier(HCl 0.1%) may be used for growth promoters instead of antibiotics in weaning diet.

Key Words: Inorganic, Weaning pigs, Growth performance

184 Effects of feeding Iowa-grown field peas on finishing pig performance. J. G. Njoka*, M. S. Honeyman, and T. Miller, *Iowa State University, Ames.*

The objective of this study was to investigate feeding Iowa-grown field peas to finishing pigs. Field peas (winter, spring, and summer types) grown in southeast Iowa during 2005 and 2006, were sampled and analyzed for nutrient content. The Iowa peas averaged 86% DM, 2% ether extract, 5.6% crude fiber, 3% ash, 20.3% CP, 1.54% lysine, 0.20% methionine, 0.20% tryptophan, and 0.74% threonine. The four diets were: (1) winter pea 30% of the total diet (by weight), (2) summer

pea 30%, (3) spring pea 30%, and (4) corn-soybean meal control. The three pea diets contained corn but no soybean meal. The pea diets were supplemented with synthetic lysine, tryptophan, and threonine. Each of the four diets had 0.64% total lysine, calculated analysis. Barrows (n = 64) were randomly assigned to 16 pens of 4 pigs each. There were 4 replications per dietary treatment group. The pigs started the experiment at 80 ± 2.5 kg live weight and were fed the experimental diets for 39 d. Pigs were weighed individually at the start, at 14-d interval and at the end of the experiment. At final weighing, each pig was scanned with real-time ultrasound. There was no difference in final pig weight (123 ± 3 kg; P = 0.63), across the dietary treatments. There were no treatment effects in ADG (P = 0.22). ADFI was influenced by dietary treatments (P < 0.10). Pigs consumed less corn-soybean meal and spring pea diets than winter and summer pea diets, with ADFI of 4.0, 3.8, 3.5 and 3.4 kg/d for winter, summer, spring pea, and the control diets respectively. The G:F ratio was not different among the treatment groups (P > 0.10). Pigs fed winter peas had more BF than pigs fed spring peas or the control diet (P < 0.10). There was no difference in loin muscle area (P = 0.65). There were no differences in fat-free lean and the efficiency of lean gain (P > 0.10). Results indicate that Iowa-grown field peas at a 30% inclusion rate when supplemented with synthetic amino acids can replace all soybean meal and a portion of the corn in typical finishing pig diets with no negative effects on performance.

Key Words: Finishing pigs, Field peas

185 Milling characteristics of yellow, short season field peas for swine diets. A. L. Meteer*[1], B. R. Wiegand[2], K. R. Brooks[3], J. W. Rickard[1], and H. L. Evans[2], [1]*Illinois State University, Normal*, [2]*University of Missouri, Columbia*, [3]*Oklahoma State University, Stillwater*.

Previous work has shown that yellow, short season field peas (peas) are nutritionally adequate feedstuffs for nursery, growing, and finishing pigs. However, literature reports indicate that particle size of field peas influences pig performance. Little information is available regarding the milling and particle size characteristics of this alternative feedstuff. The objective of this study was to evaluate the milling characteristics of field peas using two mill types. Peas grown in South Dakota were obtained and the seeds cleaned of foreign matter. Peas were compared with number two yellow corn in six replications of each subjected to hammer (H) and roller (R) milling applications. Grains were milled and samples (200g) were collected for moisture and particle size determination through a USA sieve system using a RoTap agitator. Least squares means were calculated for corn and pea samples collected from six sieve diameters (300 to 1000 microns). Mean particle size was calculated and standard deviation of particle size was determined. Corn and pea samples did not differ for moisture percentage at time of milling. Statistical analysis resulted in a grain × milling type interaction (P=0.05) R corn had the greatest sample weight screened by the 1000 micron sieve (107 g). Similar interactions were observed for R peas with 850 (P<0.02) and 710 (P<0.001) micron sieves producing 27.45 g and 27.16 g of sample weight, respectively. At the smallest sieve size (300 micron), H milling produced more total sample weight regardless of grain type with 19.24 g vs 10.70 g for H and R milling, respectively. Feed particles of this size can be detrimental to pig growth performance. Mean particle size differed (P<0.05) for H corn (575 micron±1.38) and R corn (619 micron±1.37), H peas (616 micron±1.37), and R peas (658 micron±1.34). R corn and H peas were not different, but each differed from R peas for mean particle size. Mean particle sizes vary by milling and grain type and should be carefully considered in applications of swine feed formulation.

Key Words: Field peas, Milling, Particle size

186 Digestibility energy determination of canola meal and full-fat canola seeds in pigs: limitations of the substitution method. P. Leterme*, P. Kish, and A. D. Beaulieu, *Prairie Swine Centre Inc., Saskatoon, SK, Canada*.

The dietary inclusion rate of ingredients such as canola meal (CM) and full-fat canola seeds (FFCS) in must be limited for swine (< 25%) due to the high fiber content (CM) or the difficulty for the pig to digest large amounts of oil (FFCS). Therefore, nutrient digestibility of these ingredients is measured by the substitution method where the studied ingredient is incorporated into a diet of known digestibility. The digestibility of the diet is measured and, by calculation, the digestibility of the ingredient of interest is calculated. Precision depends on the inclusion rate of the ingredient in the diet. An experiment was carried out using the substitution method to determine the digestible and net energy (DE and NE) contents of 3 CM and 3 ground FFCS in growing pigs (35kg). The CMs and the FFCS contained from 46 to 76 and 353 to 364 g oil/kg DM, respectively. A total of 130 barrows were fed either a basal diet composed 96% barley and 4% minerals(including 0.4% of Celite, as a source of acid-insoluble ash) or one of 12 treatment diets composed of either 12.5 or 25% of one of each of the 3 CM or FFCS, at the expense of the basal diet. Following 9 d adaptation, fecal samples were collected for 3 d.. Diet and fecal samples were analyzed for ether extract and gross energy. The DE content of the CMs and FFCSs was calculated by difference and the NE content using prediction equations. The range of variation in DE content of the experimental diets did not exceed 5%. However, this variation was sufficient to induce large variability in the DE content calculated by difference: The DE contents obtained with the 12.5% diets ranged from 1974 to 2815 kcal/kg DM for FFCS and from 3474 to 4314 kcal/kg DM for CM. Those obtained with the 25% inclusin ranged from 2,430 to 3,150 kcal/kg DM for CM and from 2,382 to 3041 kcal/kg DM for FFCS. The NE contents varied accordingly. The oil of the FFCS-based diets was poorly digested. Because of the limited inclusion rates of CM and FFCS for swine, the substitution method is not suitable for the calculation of the DE content of ingredients such as FFCS or CM.

Key Words: Pigs, Canola, Digestible energy

187 Effects of dietary pine cone meal on growth performance, blood characteristics, carcass quality and fecal odor emission gases in finishing pigs. S. O. Shin*[1], J. H. Lee[2], K. W. Park[2], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], K. Y. Whang[3], and I. H. Kim[1], [1]*Dankook University, Cheonan, Choognam, Korea*, [2]*Korea National Arboretum, gyeongi, Korea*, [3]*Korea University, Seoul, Korea*.

This study was conducted to evaluate effects of dietary pine cone meal on growth performance, blood characteristics, carcass quality and fecal odor emission compounds in finishing pigs. A total of sixty [(Landrace×Yorkshire)×Duroc] pigs (86.01±0.25 kg of average initial body weight) were used in a 35 days assay. Dietary treatments included

1) T1 (2% cottonwood sawdust), 2) T2 (1% cottonwood sawdust + 1% pine cone meal) and 3) T3 (2% pine cone meal). There were five replicate pens per treatment and four pigs per pen. During the overall period, there were no significant differences in ADG, ADFI and gain/feed ratio among treatments (P>0.05). Also, nutrient digestibility and blood characteristics were not affected by dietary treatments. At the end of this experiment, a*-value of logissimus dorsi muscle color and sensory evaluation color were higher in T3(18.15; 2.36) treatment than T1(16.50; 1.98) treatment (P<0.05). For fatty acid content of lean, C18:1 and total MUFA were significantly lower in T1(34.70%; 38.10%) treatment than other (38.67% and 38.73%; 42.09% and 42.07%) treatments (P<0.05). However, total ω6 and total PUFA were higher in T1(15.89%; 16.31%) treatment than T2(11.78%; 12.17%) treatment (P<0.05). For fatty acid content of fat, total SFA was significantly higher in T2(35.97%) treatment than T3(33.68%) treatment (P<0.05). C18:1 was higher in T2(39.21%) treatment than T1(37.86%) treatment (P<0.05). There were no significant differences in fecal noxious gas emission compounds among the treatments. In conclusion, dietary supplementation of pine cone meal influenced meat color and fatty acid composition of pork in finishing pigs. However, growth performance, blood characteristics and fecal odor emission compounds were not affected by dietary treatments.

Key Words: Pine cone meal, Fatty acid, Finishing pigs

188 Evaluation of dextrose, lactose, and whey sources in phase 2 starter diets for weanling pigs. J. R. Bergstrom*, C. N. Groesbeck, J. M. Benz, M. D. Tokach, J. L. Nelssen, S. S. Dritz, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan.*

Two experiments were conducted to evaluate dextrose, lactose, and whey sources for phase 2 diets. In Exp. 1, 228 pigs (7.8 kg) were used in a 14-d experiment. There were 6 treatments which included: 1) control (corn-soybean meal diet), or control diet with 2) 7.2% lactose; 3) 7.2% dextrose anhydrous; 4) 7.2% dextrose monohydrate; 5) 10% feed-grade whey; and 6) 10% food-grade whey. Pigs were blocked by BW and randomly allotted to treatment on d 7 after weaning, with 8 reps and 4 or 5 pigs/pen. Pigs fed lactose (381 g/d) or food-grade whey (376 g/d) had improved (P<0.05) ADG compared to pigs fed feed-grade whey (331 g/d) with pigs fed the control and dextrose sources (358, 358 and 363 g/d) being intermediate. Pigs fed food-grade whey had greater (P<0.05) G/F than pigs fed dextrose monohydrate. Feeding the control diet improved (P<0.05) margin-over-feed cost (MOF) compared to diets containing lactose, dextrose anhydrous, or either whey source. In Exp. 2, 352 pigs (7.8 kg) were used in a 14-d experiment to evaluate 7 sources of whey. There were 8 treatments consisting of a corn-soybean meal-based control diet and 7 diets containing 10% whey, each of a different source. Pigs were blocked by BW and randomly allotted to treatment on d 5 after weaning, with 8 reps and 5 or 6 pigs/pen. Pigs fed sources A and E had improved (P<0.05) ADG compared to the control and sources B and D with pigs fed other sources being intermediate (295, 349, 308, 327, 308, 349, 327, and 318 g/d for the control and sources A-F). Pigs fed source E had greater (P<0.05) ADFI than the control or sources B, C, D, and G. Pigs fed source A had improved (P<0.05) G/F compared to the control with pigs fed other sources being intermediate. Feeding the control diet improved (P<0.05) MOF compared to sources B, D, and G. In conclusion, differences in growth performance of pigs fed various lactose and dextrose sources exist. Feeding a Phase 2 diet without a lactose source provided the greatest margin over feed in these trials.

Key Words: Lactose, Dextrose, Whey

189 Effects of feeding fermented soy protein (FSP) on nitrogen balance and apparent ileal amino acid digestibility in weaned pigs. J. S. Yoo*[1], J. H. Cho[1], Y. J. Chen[1], S. O. Shin[1], H. J. Kim[1], Y. Hwang[1], Y. Wang[1], K. Y. Whang[2], I. H. Kim[1], S. B. Cho[3], and D. W. Kim[3], [1]*Dankook University, Cheonan, Choognam, Korea,* [2]*Korea University, Seoul, Korea,* [3]*National Institute of Animal Science, Suwon, Korea.*

Four [(Y×L)×D] barrows were surgically fitted with a simple T-cannula approximately 15 cm prior to the ileo-cecal junction. The experimental designs were 4×4 latin squares with pigs and periods as blocking criteria. The treatments were SDPP (spray-dried porcine plasma 3% diet), RBP (RubyZyme 5% diet), PSP (include PepSoyGen 5% diet) and RPP (RubyZyme 2.5% + PepSoyGen 2.5% diet). RubyZyme and PepSoyGen were both the fermented soy products. Fecal DM excretion, fecal N concentration, fecal N excretion were increased in RBP, PSP and RPP treatments compared to SDPP treatment (P<0.05). Total excretion was increased for the RPP treatment (922.13 g/d) compared with the PSP treatment (814.23 g/d; P<0.05). In the apparent digestibility, DM and N digestibilities were decreased in RBP, PSP and RPP treatments compared with SDPP treatment (P<0.05). Ash and energy digestibilities were higher in SDPP and RBP treatments than PSP and RPP treatments (P<0.05). Energy apparent ileal digestibility was higher in SDPP treatment (85.54%) compared with RBP treatment (83.27%; P<0.05). Total amino acid apparent ileal digestibility was higher for the SDPP treatment (87.57%) than other treatments (RBP: 82.33%; PSP: 79.95%; RPP: 80.03%; P<0.05). In conclusion, animal protein has more bioavailability than plant protein. However, N absorption ratio and N apparent ileal digestibility was shown similar level to SDPP (81.63% and 79.78%) and RBP (85.77% and 84.53%). Moreover, among different method fermented soybean protein there were different effects on nitrogen balance, but no effects on apparent ileal amino acid digestibility.

Key Words: Fermented soy protein, Nitrogen balance, Apparent ileal amino acid digestibility

190 Evaluation of FSP (fermented soy protein) to replace soybean meal in weaned pigs: growth performance, blood urea nitrogen and total protein concentrations in serum and nutrient digestibility. J. H. Cho*[1], B. J. Min[1], Y.J. Chen[1], J. S. Yoo[1], Q. Wang[1], J. H. Ahn[2], I. B. Chung[2], and I. H. Kim[1], [1]*Dankook University, Cheonan, Choongnam, Korea,* [2]*National Institute of Animal Science, Suwon, Gyeonggi-do, Korea.*

A total of one hundred and forty four weaned pigs with an average BW of 8.09±0.05 kg were used in 28 days study. Pigs blocked by initial body weight and randomly allocated to one of four dietary treatments in a randomized complete block design(6rep./Trt., 6 pigs/ pen). Dietary treatments included: SBM (corn-soybean meal basal diet), F 5, 10 and 15 (fermented soy product was used at 5, 10 and 15% to replace soybean meal in basal diet, respectively). Average daily gain, feed intake, dry matter and nitrogen digestibility were not affected (P>0.05) by dietary treatments during the entire 4-wk study period. There were linear increments in feed efficiency (P<0.01) as the dietary FSP (0.684, 0.676, 0.728 and 0.747) level increased during entire feeding period. Digestibilities of histidine (68.13, 67.70, 73.92 and 73.65%), lysine (77.75, 77.72, 81.62 and 81.68%) and methionine (70.98, 69.95, 74.61 and 76.24%) were increased as the FSP level increased (linear effect, P<0.05, P<0.01). Among non-essential amino acids, alanine (67.43, 66.33, 71.04 and 72.66%), glutamic acid (77.52, 76.90, 80.20 and 81.03%), serine (75.37, 74.76, 78.87 and 79.21%), tyrosine (70.49,

70.14, 74.02 and 76.03%) and total non essential amino acid (73.30, 71.78, 75.70 and 76.81%) digestibilities were increased linearly (P<0.05, P<0.01). There were quadratic effect in proline (78.80, 75.42, 77.82 and 79.90%) digestibility (P<0.05). Total amino acids digestibility of F15 (76.94%) diet was improved compared with F5 (72.02%) diet (P<0.05). There were no significant differences in fecal consistency score among the treatments (P>0.05). At the end of experiment, blood urea nitrogen concentration (10.87, 13.65, 13.77 and 14.55%) was increased as the FSP level increased (linear effect, P<0.01) and total protein concentration was lowest (P<0.05) for pigs fed SBM diet among treatments. In conclusion, the feeding of 10 or 15% FSP to nursery pigs improved feed efficiency, amino acids digestibility and blood urea nitrogen and total protein concentrations in blood.

Key Words: Fermented soy protein, Nutrient digestibility, Weaned pigs

191 Comparative efficacy of import fish meals and fermented fish meal on ileal nutrient digestibility in weaned pigs. J. H. Cho*[1], Y. J. Chen[1], J. S. Yoo[1], Y. Wang[1], Y. Huang[1], H. J. Kim[1], S. O. Shin[1], I. H. Kim[1], J. H. Ahn[2], and I. B. Chung[2], [1]*Dankook University, Cheonan, Choongnam, Korea*, [2]*National Institute of Animal Science, Soowon, Gyeonggi, Korea*.

The present study was conducted to evaluate and compare the effects of feeding import fish meals and fermented fish meal on ileal nutrient digestibility after weaning. Sixteen [(Yorkshire×Landrace)×Duroc] barrows (6.70±0.20 kg average initial BW) were surgically fitted with a simple T- cannulas approximately 15 cm prior to the ileo-cecal junction. Dietary treatments included: E1 (5% LT fish meal), E2 (5% Bio-CP fish meal), LF (5% non-fermented fish meal) and FLF (5% fermented fish meal by L. acidophillus). There were no significant differences in dry matter, nitrogen, ash, calcium, phosphorous and gross energy digesitibilities among treatments (P>0.05). In essential amino acid digestibility, digestibilities of histidine, threonine and total essential amino acid were higher in E1 (5% LT fish meal) and E2 (5% Bio-CP fish meal) treatments than in LF (5% non-fermented fish meal) treatment (P<0.05). Valine digestibility of pigs fed E2 (5% Bio-CP fish meal) diet was improved compared with LF (5% non-fermented fish meal) treatment (P<0.05). In non essential amino acid digestibility, aspartic acid and serine digesitibilities of E2 (5% Bio-CP fish meal) treatment were higher than those of LF (5% non-fermented fish meal) treatment (P<0.05). Also, compared with LF (5% non-fermented fish meal) treatment, E1 (5% LT fish meal), E2 (5% Bio-CP fish meal) and FLF (5% fermented fish meal by L. acidophillus) treatments yield higher (P<0.05) ileal amino acid digestibility values for glutamic acid, total non essential amino acid and total amino acid. In conclusion, fermented fish meal in the present study showed similar effects on ileal nutrient digestibilities compared to import fish meals.

Key Words: Fish meal, Ileal amino acid digestibility, Weaning pigs

192 Effects of plant protein source containing multienzyme supplementation on performance, nutrient digestibility and milk characteristics in sow. H. J. Kim*[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], S. O. Shin[1], Y. Huang[1], I. H. Kim[1], S. J. Lee[2], and H. J. Jung[2], [1]*Dankook University, Cheonan, Choongnam, Korea*, [2]*National Institute of Animal Science, Seonghwan, Choongnam, Korea*.

Thirty sows (Landrace × Yorkshire) were used to determine the effects of plant protein source containing multienzyme (cysteine proteases, galactosidase, mannanase, phosphatase, peroxidase, amylase, cellulase) on performance, nutrient digestibility and milk characteristics. The feeding trial was conducted for 28 days from parturition to weaning. Experimental diets were supplied 7 days before the parturition day and 21 days after. Dietary treatments included: 1) Control (CON; basal diet), 2) CGLT (basal diet with 2.5% corn gluten) and 3) FSPM (basal diet with 2.5% fermented soy protein containing multienzyme). Through the entire experimental period, backfat loss and return-to-estrus interval were not affected by the treatments (P>0.05). Nitrogen digestibility was significantly increased (P<0.05) in FSPM (83.23%) treatment compared to CON (79.10%) treatment. Blood urea nitrogen (BUN) concentration was significantly improved (P<0.05) in FSPM (17.62mg/dL) treatment compared to CGLT (13.25mg/dL) treatment at weaning and difference between parturition and weaning also was significantly improved in FSPM (3.15mg/dL) treatment compared to CON (1.55mg/dL) and CGLT (1.97mg/dL) treatments. Total protein content of milk was significantly higher (P<0.05) in FSPM (23.25%) treatment than CGLT (19.37%) treatment at parturition and total fat content of milk was significantly higher (P<0.05) in FSPM (9.97%) treatment than CON (8.17%) treatment at the end of experiment. Rectal temperature showed similar tendency of change among treatments. The piglet BW at weaning, weight gain and ADG were significantly higher in FSPM (7.01kg, 5.51kg and 0.26kg) treatment than CON (6.22kg, 4.70kg and 0.22kg) treatment. In conclusion, 2.5% dietary plant protein source containing multienzyme supplementation improved N digestibility, BUN concentration, fat and protein contents in milk in sow and weight gain in piglet.

Key Words: Plant protein source, Performance, Nutrient digestibility

193 Glucose release correlates with piglet′s preference for cereal based feeds. D. Solà-Oriol[1], S. Pujol[1,2], T. van Kempen[2], E. Roura*[3], and D. Torrallardona[1], [1]*IRTA, Mas de Bover, Constantí, Spain*, [2]*Provimi RTC, Belgium*, [3]*Lucta SA, Barcelona, Spain*.

We have previously reported an effect of cereal nature on piglets feed preference which may be explained in part by feed texture, nutrient concentration or digestibility. As glycemia is directly involved in the regulation of feed intake, appetite for a given cereal may be influenced by its glucose release characteristics. The present work studies the relationship between the glycemic index (GI) of 25 cereals and their feed preference at 60% of inclusion. The cereals tested were: short-grain rice: white, un-hulled, brown or white-extruded; long-grain rice: white or white-cooked; barley: raw or extruded; corn: raw (2 sources) or extruded; wheat: raw or extruded; cassava meal; biscuit meal; rye; sorghum; oats: raw (3 sources), dehulled-rolled or cooked; and naked oats: raw, extruded or micronized. Feed preferences for the 25 cereal-based feeds

were obtained with double choice trials using a reference diet containing 60% white short grain rice, 20% of a SBM product with 56% CP, 13% wheat bran, 3% sunflower oil and amino acids, vitamins and minerals formulated to provide 1.25% lys; 13.9 MJ×kg^{-1} ME and to meet NRC requirements. To prepare each test feed, rice from the reference feed was replaced by the test cereal without correcting for nutrient content. Preference was calculated as the percentage contribution of the cereal feed of interest to total feed intake. For each cereal, the glucose released as a function of time was evaluated in an in vitro digestibility system. GI was calculated as the maximal glucose release rate per minute of the predicted data obtained after fitting the glucose release values to the Chapman Richards model, and ranged between 0.7 (raw corn, source-2) and 1.7 (extruded white short-grain rice). A positive Pearson's correlation between preference and GI was observed (r=0.48; P=0.015). It is concluded that the different cereal sources affect the GI and that this may partially explain the piglet′s feed preferences observed.

Key Words: Cereal preference, Glycemic index, Pigs

194 Evaluation of alternative energy systems when applied to two genetic populations of pigs with different body composition. A. Schinckel*[1], D. Mahan[2], T. Wiseman[2], and M. Einstein[1], [1]*Purdue University, West Lafayette, IN*, [2]*The Ohio State University, Columbus*.

Swine growth models can be used to predict the nutrient requirements, feed costs and economic returns of specific genetic populations of pigs. The objective of this study were: 1) predict changes in energetic and economic efficiency of two genetic populations of pigs with different compositional growth rates, 2) compare the predictions of three energetic models (ME-NRC, NE and ME-Tess, J. Anim. Sci., 1983), and 3) evaluate the impact of predicting maintenance energy requirements as a function of BW or lipid-free empty BW (LFBW). Corn-soybean meal based diets were formulated to meet the daily lysine and energy requires for each genetic population and sex. The high lean-gain (HLG) pigs had 32.8% lesser rates of lipid deposition, 12.3% greater protein deposition and similar BW growth rates as the low lean-gain (LLG) pigs. The HLG pigs were predicted to require 28.4, 29.9 and 30.1 kg less feed and to have 33.5, 34.1 and 29.1% greater carcass lean gain/feed intake than the LLG pigs from 25 to 125 kg based on the ME-NRC, NE and ME-Tess equations, respectively. When maintenance requirements were based on LFBW, the ME-NRC, NE and ME-Tess equations predicted $2.32, 2.48 and 2.48 lesser feed costs for the HLG versus LLG pigs. The NE and ME-NRC energy systems predicted that HLG pigs had 17.3 to 21.4% lesser feed cost per kilogram carcass lean gain than LLG pigs. Overall, the ME-NRC and NE energy systems predicted similar feed intakes, diet composition, feed costs, and similar differences between the genetic populations and sexes. The three energy systems predict similar changes in energetic efficiency of growth due to genetic changes in compositional growth.

Key Words: Pigs, Energy system, Net energy

195 The feeding of dry distillers grain with solubles to lactating sows. L. L. Greiner*[1], X. Wang[2], G. Allee[2], and J. Connor[3], [1]*Innovative Sow Solutions, LLC, Carthage, IL*, [2]*University of Missouri, Columbia*, [3]*Professional Swine Management, LLC, Carthage, IL*.

An experiment was conducted with 155 multiparous sows (parity 1 – 4, PIC, Camborough 22, 248 ± 45 kg) to evaluate the effect of dry distillers grain with solubles (DDGS) on sow and litter performance during a 19 d lactation period and on subsequent reproductive performance. Prior to farrowing, sows were fed a 10% DDGS diet throughout gestation. Sows were randomly allotted to one of four corn soybean meal lactation diets formulated to contain different levels of DDGS (0, 10, 20 and 30%, respectively). All diets were formulated to be isocaloric 3.46 Mcal ME/kg and contained vitamins and minerals that exceeded recommendations (NRC, 1998). Experimental diets were given to sows from 112 d of pregnancy throughout the 19 d lactation period. Litters were standardized to average 10.4 pigs within 48 h after farrowing, and sows had free access to feed throughout lactation (lactation length = 18.6 ± 1 d). Sows were fed with a computerized feeding system that assured free ad libitum feed intake, and allowed the determination of daily individual sow feed intake during the lactation period. Sow ADFI exceeded expectation, averaging 6.9, 6.7, 6.3 and 6.5 kg/d for 0, 10, 20, and 30% DDGS, respectively, with no differences ($P \geq 0.1$) between DDGS levels. Increasing DDGS resulted in a linear increase ($P < 0.06$) in sow weight gain (6.5, 3.7, 8.7, and 17.7 kg gained), percent bred in 10 days (85, 91, 93, and 95%), and a reduction in wean to first service interval (7.4, 6.3, 6.0, 5.5 days). Sow reproductive performance was highest at 30% DDGS. Litter growth rate and piglet pre-wean mortality was not affected (P>.1) by the inclusion of DDGS. In addition, increasing DDGs did not affect subsequent total born per litter (13.9, 13.6, 12.2, 14.1, $P > 0.09$). The inclusion of 30% DDGS in sow lactation diets did not effect sow feed intake but did increase sow weight gain during lactation. This may suggest that DDGS has a higher energy value for sows than that previously reported with growing pigs.

Key Words: DDGS, Sow, Lactation

196 Plasma insulin concentrations of sows fed omega-3 fatty acids or high protein diet individually or in combination during late gestation and lactation. B. J. Min*[1], R. D. Mateo[2], and S. W. Kim[1], [1]*North Carolina State University, Raleigh*, [2]*Texas Tech University, Lubbock.*

Forty nine primiparous sows (197.7±2.5 kg BW and 14.9±0.2 mm BF) were used to determine the effects of omega-3 fatty acid supplementation (0 or 0.4%) with different dietary protein levels (12.3 and 17.9% or 18.4 and 19.5% CP for gestation and lactation, respectively) on plasma insulin concentration during gestation and lactation. Sows were allotted to 4 dietary treatments based on a 2x2 factorial arrangement on d 60 of gestation. Two factors were omega-3-fatty acid supplementation levels and dietary protein levels. Restaurant grease was used in non omega-3-fatty acid supplemented diets to match oil content among all diets. Blood samples were collected 2 h after feeding (1000) via jugular venipuncture using heparinized tubes at d 60 and 110 of gestation, and d 10 and 21 of lactation. Plasma insulin concentration was measured using Porcine Insulin ELISA Kit (Mercodia Inc., Winston Salem, NC). Plasma insulin concentration did not differ at d 60 of gestation when the study was initiated. On d 110 of gestation, sows fed diets with omega-3-fatty acid had a lower ($P<0.05$) plasma insulin concentration than sows in other treatments (0.91 vs. 1.09 μg/L). Sows fed high protein diets had a greater ($P<0.05$) plasma insulin concentration than sows in other treatments (1.08 vs. 0.93 μg/L). On d 10 of lactation, sows fed diets with omega-3-fatty acid had a greater ($P<0.05$) plasma insulin concentration than sows in other treatments (1.74 vs. 1.22 μg/L). On d 21 of lactation, sows fed high protein diets had a greater ($P<0.05$) plasma insulin concentration than sows in other treatments (1.79 vs. 1.43 μg/L). This study shows that high protein diets increase insulin release during

absorption period in sows especially when protein requirements are high (i.e., late gestation and lactation). This study also suggests that dietary omega-3-fatty acid supplementation controls insulin release during late gestation and early lactation.

Key Words: Insulin, Omega-3-fatty acid, Sows

197 Effects of lactation feed intake and creep feeding on sow and piglet performance. R. C. Sulabo*, M. D. Tokach, J. Y. Jacela, J. L. Nelssen, S. S. Dritz, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan.*

The interaction of lactation feed intake (*ad lib* vs. restricted) and creep feeding (none vs. creep) was evaluated using a total of 84 sows and litters blocked according to day of farrowing and parity. *Ad lib* fed sows were allowed free access to a common lactation diet (3,503 kcal ME/kg, 0.97% TID Lys) while restricted sows were fed 25% less than sows fed *ad lib*. A creep diet (3,495 ME/kg, 1.56% TID Lys) with 1.0% chromic oxide was offered to creep-fed pigs from d 3 to 21. Fecal samples from creep-fed pigs were taken using sterile swabs on d 7, 14, and 21 and color was assessed to categorize pigs as eaters or non-eaters. There was no interaction between lactation feed intake and creep feeding. Total and ADFI of *ad lib*-fed sows (99.4, 4.9 kg) were greater (P<0.01) than limit-fed sows (67.9, 3.6 kg). *Ad lib* feeding of sows reduced BW loss (-15 vs. -24 kg; P<0.01), improved total (46.7 vs. 43.0 kg; P<0.04) and daily (2.56 vs. 2.36 kg; P<0.04) gains of litters, and increased (90 vs. 71%; P<0.03) the percentage of sows returning to estrus by d 14 compared with limit-fed sows. Creep feeding did not affect (P>0.34) sow BW and backfat loss, but increased days to estrus (5.4 vs. 4.9 d; P<0.03). Creep feeding tended to improve litter weaning weights (60.2 vs. 56.7 kg/d; P<0.09) by reducing mortality after cross-fostering (3.9 vs. 7.3%; P<0.06). Weaning weights were similar (5.8, 5.8, and 5.7 kg; P>0.81) between eaters, non-eaters, and no creep pigs. Post-weaning performance of creep-fed pigs were similar (P>0.86) to non-creep fed pigs. Eaters tended to be heavier at d 28 post-weaning (16.7, 16.3, and 16.3 kg; P<0.16) and have greater (P<0.06) ADG (0.39, 0.37 and 0.37) and total gains (11.0, 10.5 and 10.5 kg) than non-eaters or no creep pigs. In conclusion, creep feeding improved survivability, but had no effects on pre-weaning gain and sow performance. Low feed intake during lactation negatively affected sow and litter performance. Creating more eaters may benefit post-weaning performance.

Key Words: Creep feeding, Feed management, Lactation

198 Effects of varying creep feeding duration on pre-weaning performance and the proportion of pigs consuming creep feed. R. C. Sulabo*, M. D. Tokach, E. J. Wiedemann, J. Y. Jacela, J. L. Nelssen, S. S. Dritz, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan.*

A total of 54 sows (PIC Line 1050) and their litters were used in this study to determine the effects of varying creep feeding duration on the number of pigs consuming creep feed (eaters) and pre-weaning performance. Two groups of sows were blocked according to parity and date of farrowing and allotted to three experimental treatments using a randomized complete block design. Creep feeding was initiated at d 7, 14, and 18 from birth for durations of 13, 6, and 2 d of creep feeding. A creep diet (3,495 kcal ME/kg, 1.56% TID Lys) with 1.0% chromic oxide was offered ad libitum until weaning (d 20) using a rotary creep feeder with hopper. Sows were allowed free access to a single lactation diet (3,503 kcal ME/kg, 0.97% TID Lys) during lactation. Fecal samples from all piglets were taken twice per day using sterile swabs on d 14, 18, and 20 for Treatment 1, d 18 and 20 for Treatment 2, and d 20 for Treatment 3. Piglets were categorized as eaters when fecal sample was colored green at least once on any of the sampling days. Overall, there were no differences in weaning weights (5.7, 5.6, and 5.6 kg; P>0.61), total gain (3.3, 3.1, and 3.1 kg; P>0.38), and daily gain (0.25, 0.24, and 0.24 kg; P>0.38) among pigs fed creep for 13, 6, or 2 d, respectively. Total creep feed intake of litters fed creep for 13 (0.68 kg) and 6 d (0.74 kg) were greater (P<0.01) than those litters provided creep feed for 2 d (0.35 kg). Litters provided with creep feed for 13 d produced 10% more (80 vs. 70%; P<0.03) eaters than litters fed creep for either 6 or 2 d. There were no differences (P>0.98) in the percentage of eaters between litters fed creep for 6 and 2 d. In conclusion, longer durations of creep feeding did not affect pre-weaning gain and weaning weights but increased the proportion of eaters in whole litters; however, a relatively high percentage of pigs (70%) were classified as eaters by providing creep feed for only 2 d prior to weaning.

Key Words: Feed management, Creep feed, Pig

199 Response of cull sows to ad libitum feeding. M. T. Knauer*[1], M. T. See[1], J. A. Hansen[2], A. L. P. de Souza[2], and D. C. Kendall[2], [1]*North Carolina State University, Raleigh,* [2]*Murphy-Brown LLC.*

The ability to add weight and therefore value to cull sows, depending on input costs, may increase farm net income. Two experiments were conducted to define gain and efficiency response in cull sows. Exp.1 was a 2×4 factorial arrangement of production stage (Wet vs. Dry) by starting BW block (< 180 kg, 181-220 kg, 221-245 kg, and > 246 kg). Pelleted gestation diets (0.63% lysine and 3358 kcal/kg ME) were provided ad libitum for 4 wk. Exp. 2 evaluated the effect of Paylean® on dry sow performance over six BW blocks. Pelleted gestation diets consisted of control (0.63% lysine, 3358 kcal/kg ME) and Paylean® 4.5g/ton (0.94% lysine, 3351 kcal/kg ME) fed ad libitum for 4 wk. All sows (n = 190 exp. 1 and n = 192 exp. 2) came from two commercial swine farms and were housed two per pen at the NC Swine Evaluation Station, Clayton. Dry sows had superior (P < 0.01) G:F when compared to wet sows throughout the trial (0.26 vs. 0.22). Dry sows had higher (P < 0.05) ADG in comparison to wet sows throughout the trial (1.25 vs. 0.98 kg/d). Dry sows had greater (P < 0.01) increase in fat depth (9.4 vs. 6.2 mm) and loin muscle area (8.6 vs. 6.4 cm2) but did not differ in change in body condition score. For Wk 1 to 4, lighter sows had higher (P < 0.05) G:F in comparison to heavier groups (0.29 vs. 0.24, 0.22, and 0.21, respectively). For Wk 1 to 4, the lightest weight group had lower (P < 0.05) ADFI compared to the heaviest two weight groups (4.28 vs. 4.79 and 5.04 kg, respectively). Sows did not differ by weight group for changes in fat depth and loin muscle area but sows > 246 kg did have a smaller increase (P < 0.01) in body condition score than lighter sows (0.27 vs. 0.76). Cull sows fed Paylean® diet were more efficient (0.29 vs. 0.25; P < 0.01), showed a smaller increase in fat depth (7.9 vs. 10.5 mm; P < 0.01), greater increase in loin muscle area (10.0 vs. 6.7 cm2; P < 0.01), greater Wk 1 to 2 ADG (1.54 vs. 1.24 kg; P < 0.04), greater Wk 1 to 3 ADG (1.43 vs. 1.20 kg; P < 0.03) and tended to grow faster throughout the trial (1.35 vs. 1.21 kg; P = 0.11). However, sows fed Paylean® and control diets did not differ in ADFI or change in body condition score.

Key Words: Sow, Growth, Efficiency

200 The effects of organic trace minerals on sow reproductive and litter performance. J. S. Jolliff* and D. C. Mahan, *The Ohio State University, Columbus.*

A study was conducted to evaluate various levels of trace minerals (TM), in organic (Bioplex) or inorganic form, on reproductive responses when fed to multiparous female swine. The dietary mineral treatments were: organic trace minerals at 100% NRC (OTM-100); Organic trace minerals at 125% NRC (OTM-125); Organic trace minerals at 150% NRC (OTM-150); and Inorganic trace minerals at 125% NRC (ITM-125). The trace minerals provided at each of the treatment levels were Cu, Zn, Fe, Mn, whereas Se was provided in all diets at 0.30 mg/kg. The Se in the organic diets was from organic source while in the inorganic diet it was as Na selenite. The inorganic minerals were in the sulfate form. Gilts were fed 1.95 kg of their treatment diet/day, while older sows received an additional 0.18 kg for each subsequent parity. Diets were corn soybean meal mixtures formulated to 0.65% Lys during gestation and 1.15% Lys during lactation. The treatment diets were initially fed at breeding and continued with that sow if she continued onto the next parity. Sows were weighed at breeding, during gestation, farrowing, and weaning (17 d) with backfat thickness also measured. During lactation, sows were provided their treatment diet ad libitum. Litters were equalized within 3 days in each farrowing group. A total of 104 sow units were analyzed for reproductive and litter responses. Treatments were analyzed using the mixed model procedure of SAS with sow and litter serving as the experimental unit. Litter size (total and live) tended ($P < 0.12$) to increase as the level of organic TM increases. The OTM-125 and ITM-125 diets had similar litter sizes and weights. The OTM-125 fed sows produced more stillborns but a large number of these stillbirths occurred in only a few sows. Sow weights and backfat thicknesses were unaffected by dietary treatments. These data indicate that increasing organic trace mineral supplementation to gestating sows may have some potential benefit for increasing litter size and that the effect was not attributable to Se.

Key Words: Sow, Reproduction, Trace minerals

201 Factors affecting sow mortality may be related to nutrition. D. C. Mahan*, B. L. Bishop, and J. C. Peters, *The Ohio State University, Columbus.*

Selenium and vitamin E deficiencies and corresponding declines in serum antioxidants have resulted in elevated mortalities in weanling pigs. Consequently, a study evaluated the antioxidant status of multiparous sows over a 12 month period. Antioxidants measured in serum were: the 3 ascorbic acid forms (total, ascorbate [active] and dehydroascorbic acid [inactive]), glutathione peroxidase (GSH-Px), and serum Se and vitamin E concentrations. A total of 50 multiparous sows were bled via the jugular vein at monthly intervals. The effect of mineral source (organic vs. inorganic) and level (NRC vs. elevated), parity (1 to 6) and seasonal effects (hot vs. cold months) were evaluated for each antioxidant. The data were grouped by day of reproduction intervals (± 5 d) from breeding to weaning and analyzed using a simple spline regression analysis model with each experimental variable, or antioxidant, modeled on day of reproduction. Serum antioxidant levels were relatively constant from breeding to 80 d postcoitum, whereupon there was a decline ($P < 0.01$) through early lactation. Each of the ascorbic acid forms declined ($P < 0.01$) by 50% from d 80 through weaning. Ascorbate (active form) declined at a faster rate from 80 d to weaning than dehydroascorbic acid, indicating the active form was more rapidly oxidized. Serum Se and GSH-Px activity declined ($P < 0.01$) by > 50% after 70 d postcoitum, whereas serum vitamin E declined ($P < 0.01$) after 90 d postcoitum. Parity 1 sows had higher ($P < 0.01$) serum antioxidant levels than parity 2 to 6 sows. Seasonal effects demonstrated that during warmer months the antioxidant status was lower ($P < 0.01$) compared to the cooler months. Mineral source had no effect on the antioxidants except for GSH-Px activity which was greater ($P < 0.01$) when organic minerals were fed. These results indicate that sows appear to be more vulnerable to oxidative stress during late gestation and early lactation, due to a lower antioxidant status, which may contribute to sow mortality.

Key Words: Antioxidants, Mortality, Sow

202 Net portal absorption of zinc from zinc sulfate and zinc amino acid chelate in growing pigs. S. W. Kim*[1], M. I. Perret-Gentil[2], M. W. Hart[2], and R. A. Samford[3], [1]*North Carolina State University, Raleigh,* [2]*Texas Tech Health Sciences Center, Lubbock, TX,* [3]*Albion-Advanced Nutrition, Clearfield, UT.*

This study was to compare net portal absorption (**NPA**) of zinc from zinc sulfate and zinc amino acid chelate (**ZAA**) provided in different ratios. Our previous study (ASAS 2007 National Meeting) demonstrated that zinc from ZAA was absorbed faster than zinc from zinc sulfate in pigs. Three pigs (24.1±0.6 kg BW) were surgically fitted with catheters into carotid artery, portal vein, mesenteric vein, and pyloric stomach and allotted to a 3×3 Latin square design with 3 treatments presenting injection of (1) zinc sulfate (**ZS**); (2) zinc sulfate:ZAA=25:75 ratio (**Z75**); and (3) zinc sulfate:ZAA=50:50 ratio (**Z50**) through the pyloric stomach catheter and with 3 periods (48-h intervals). Each period was composed of 24-h feeding (0.09 kg×$BW^{0.75}$), 19.5-h fasting, and 4.5-h infusion. A corn-soybean meal based diet with 18.2% CP and 3.35 Mcal ME/kg was fed to pigs before fasting. Para-aminohippuric acid (**PAH**) was infused (3.2 mg/min) into the mesenteric vein for a 4.5 h period. Zinc (230 mg) from one of the three aforementioned sources was injected into the lumen of the pyloric catheter 60 min after beginning the PAH infusion period. Blood samples (3 mL) were collected simultaneously from the carotid artery and portal vein catheters at -60, -30, 0, 15, 30, 45, 60, 90, 120, 150, and 210 min relative to zinc injection to measure PAH and zinc concentration in the plasma. Zinc NPA was calculated by multiplying the portal vein plasma flow rate by the porto-arterial plasma zinc concentration. Blood flow averaged 1.47±0.15 L/min. Zinc NPA from ZS tended to peak (P<0.10) at 45, 90, and 150 min (0.76, 0.84, and 0.60 mg/min, respectively). Zinc NPA from Z75 did not have any clear peaks (P>0.10) during 210 min. Zinc NPA from Z50 tended to peak (P<0.10) at 90, 150, and 150 min (1.48, 1.55, and 1.16 mg/min, respectively). Z50 had a greater (P<0.05) zinc NPA at 210 min (1.16 vs. -0.49 mg/min) and tended to have a greater (P<0.10) zinc NPA at 150 min (1.55 vs. 0.60 mg/min) than ZS. This study suggests that zinc from a combination of zinc sulfate and ZAA at 50:50 ratio is absorbed better than zinc from zinc sulfate and 25:75 ratio.

Key Words: Net portal absorption, Pigs, Zinc

203 Evaluating organic trace mineral levels on growth, tissue mineral and plasma responses in weanling and grower pigs. R. E. Howdyshell* and D. C. Mahan, *The Ohio State University, Columbus.*

Dietary trace mineral (Cu, Fe, Mn, Se, and Zn) source (organic, O-TM; and inorganic, I-TM) and level were evaluated in weanling and grower

pigs. Two Exp. both conducted in a randomized complete block design evaluated pig performances, liver mineral contents and various serum constituents. In Exp. 1 crossbred pigs (n=160) were randomly allotted (4/pen) at weaning (18 d) to 5 treatments: (1) Basal diet + 0% TM, (2) as 1 + 50% NRC O-TM, (3) as 1 + 100% NRC O-TM, (4) as 1 + 150% NRC O-TM, and (5) as 1 + 100% NRC I-TM in 8 replicates. Pigs were bled at d 0, 10, and 35 with hemoglobin (Hb), hematocrit (Hct), ceruloplasmin oxidase (Cp), and glutathione peroxidase (GSH-Px) activity determined. The liver from 1 pig/pen was collected at 35 d and analyzed for minerals. Performance responses were lowest (P<0.01) for pigs fed the 0% TM diet where they also had the lowest Hb, Hct, and GSH-Px and the highest Cp values (P<0.01). Adding O-TM at 50% NRC resulted in similar performances to the other O-TM treatments. Pigs fed the O-TM and I-TM diets at 100% NRC had similar growth, blood, and plasma responses. Liver Cu and Fe were lowest for the 50% O-TM diet, Mn was lowest in the 150% O-TM diet, and liver Zn content increased to the 150% NRC level. In Exp 2, treatment pens from the nursery were continued on test (except trt 1), but grouped into 4 replicates. Grower pigs were bled at wks 2, 4, 6, and 8, whereupon 2 pigs/pen were harvested and liver samples collected for mineral analysis. Pig performance, tissue mineral content, and plasma resulted in similar responses between the various O-TM levels and the O-TM and I-TM NRC levels. These results indicate that feeding O-TM at 50% of NRC appears adequate for weanling and grower pigs resulting in similar performance, tissue mineral contents and blood measurements as higher dietary levels of organic TM.

Key Words: Trace minerals, Weaning, Pigs

204 Effects of dietary supplementation of benzoic, formic, and lactic acids on growth and health of pigs. S. W. Kim*[1], J. O. Vaughn[2], and D. A. Monson[3], [1]*North Carolina State University, Raleigh,* [2]*Emerald Performance Materials, Kalama, WA,* [3]*Texas Tech University, Lubbock.*

A total of 384 pigs was used to evaluate the effects of benzoic acid supplementation on growth performance and health of pigs compared to antibiotics and organic acids. Pigs were fed 6 diets from wean (21 d of age) to 110 kg BW based on 6 phase feeding program following nutrient requirements from NRC. There were 8 replicates per treatment and 8 pigs per pen. Treatments were (1) **NC**: negative control without any supplements; (2) **PC**: positive control with Aureomycin during phase 1, 2, and 3 and Tylan during phase 4, 5, and 6; (3) **BA**, and **BB**: benzoic acid supplementation groups with 0.5 and 1.0% benzoic acids (Emerald Performance Materials, Kalama, WA), respectively; and (4) **OA** and **OB**: organic acid supplementation groups with 0.5 and 1.0% organic acids at 1:1 ratio of formic and lactic acid, respectively. Contents of ME and CP were matched among treatment diets. Pig had access to feed and water *ad libitum*. Feed intake and BW were measured at the end of each phase and blood samples were taken at 21 (prior to weaning), 28, and 42 d of age to measure the number of immune cells in blood using CELL-Dyn 3200 (Abbott Lab, Abbott Park, IL). During the entire period, ADG of PC (739 g/d), BA (714), and OB (639) were 20.4, 15.6, and 7.4% greater (P<0.05) than NC (614), respectively. The ADG of BA did not differ from PC whereas it was greater (P<0.05) than OA. There were no differences in ADFI among treatments during the entire period. Gain:feed ratios of PC (0.47) and BA (0.45) were 20.0 and 15.6% greater (P<0.05) than NC (0.39), respectively. Gain:feed ratios of PC and BA did not differ each other. Gain:feed ratios of PC and BA were greater (P<0.05) than BB (0.39) and OA (0.39). Gain:feed ratios of BB and OA did not differ from NC. Numbers of eosinophil in blood from BB (390 cell/μL) and OA were greater (P<0.05) than NC (160), PC (200), BA (160), and OB (200) at 42 d of age. This study demonstrates long term supplementation of benzoic acid at 0.5% improves the growth and feed efficiency of pigs similar to the effects of antibiotics. However, the use of formic and lactic acid was not as effective as the use of benzoic acid and antibiotics.

Key Words: Benzoic acid, Organic acid, Pigs

205 Effects of dietary supplementation of benzoic, formic, and lactic acids on carcass characteristics of pigs. B. J. Min*[1], J. O. Vaughn[2], and S. W. Kim[1], [1]*North Carolina State University, Raleigh,* [2]*Emerald Performance Materials, Kalama, WA.*

A total of 384 pigs was used to evaluate the effects of benzoic acid supplementation on growth performance and health of pigs compared to antibiotics and organic acids. Pigs were weaned at 21 d of age and fed 6 diets until they reach 110 kg BW based on 6 phase feeding program following nutrient requirements from NRC. There were 8 replicates per treatment and 8 pigs per pen. Treatments were (1) **NC**: negative control without any supplements; (2) **PC**: positive control with Aureomycin during phase 1, 2, and 3 and Tylan during phase 4, 5, and 6; (3) **BA**, and **BB**: benzoic acid supplementation groups with 0.5 and 1.0% benzoic acids (Emerald Performance Materials, Kalama, WA), respectively; and (4) **OA** and **OB**: organic acid supplementation groups with 0.5 and 1.0% organic acids at 1:1 ratio of formic acid and lactic acid, respectively. Contents of metabolizable energy and crude protein were matched among treatment diets by adjusting corn and oil contents as supplementing either benzoic acid or organic acid. Pig had access to feed and water *ad libitum*. At 106.0±4.0 kg BW, each pig representing the average body weight of each pen was selected and slaughtered to measure carcass traits (n=8). Dressing percentage, loin eye area, loin color, lean percentage, and drip loss did not differ among the treatment groups. Backfat thickness of PC at 1st rib (24.0 mm) was greater (P<0.05) than other treatment groups. Backfat thickness of PC at last lumber vertebra (19.0) was greater (P<0.05) than BA (10.0), BB (12.7), and OB (12.5). Marbling score of NC (2.50) was greater (P<0.05) than BA (1.33), BB (1.33), and OB (1.25) but not different from PC (2.25) and OA (2.25). Marbling scores of BA, BB, and OB did not differ among each other. This study shows that dietary supplementation of benzoic acid produces pigs with less backfat but also produces loins with less intramuscular fats compared to those from PC. Carcass characteristics did not differ between pigs fed diets with benzoic acids and organic acids.

Key Words: Benzoic acid, Carcass, Pigs

206 Fermentable non-starch polysaccharides increase the excretion of bacterial proteins in the pig's faeces and reduce urinary N excretion. J. Bindelle[1], P. Leterme*[2], J. Wavreille[3], J. P. Destain[3], and A. Buldgen[1], [1]*Gembloux Agricultural University, passage des Déportés, B-5030 Gembloux, Belgium*, [2]*Prairie Swine Centre Inc., Saskatoon, SK, Canada*, [3]*Centre Wallon de Recherches agronomiques, B-5030 Gembloux, Belgium.*

Diets based on fermentable non-starch polysaccharides (NSP) shift N excretion from urea in urine to the feces in pigs. However, it is unclear whether the increase in fecal N excretion is due to an increase of the bacterial biomass. A previous in vitro experiment with colonic inoculum showed that bacterial protein synthesis (BPS) is enhanced in presence of fermentable NSP (J. Anim. Sci. 2006, 85, Suppl. 2, 114-115). The aim of the present study was to confirm those observations in vivo. A control diet, composed of corn and soybean meal, was prepared. Three other diets were formulated to contain 10, 20 and 30% of sugarbeet pulp (SBP; fermentable NSP), and 2 others to contain respectively 22% oat hulls (non-fermentable NSP) or 11% SBP + 11% oat hulls. The experimental scheme was a cross-over design: male pigs (32 kg) were randomly assigned to a diet (4/diet). After 14 d of adaptation, feces and urine were collected for 5 d. The pigs were then randomly assigned to another diet and the operation was repeated. An in vitro study, based on the gas technique, was also carried out to measure the rate of BPS of colonic bacteria populations incubated with one of the diets, after pre-incubation with pepsin/pancreatin. BPS was estimated by measuring the rate of incorporation of ^{15}N in the isolated bacteria at mid-fermentation by IRMS. In vivo, the ingestion of SBP resulted in an increase in fecal N excretion ($P < 0.01$), a decrease in urinary N excretion ($P < 0.01$) but did not affect N retention ($P = 0.60$). BPS measured in vitro was highly correlated to fecal N excretion ($r = 0.88$; $P < 0.05$) and bacterial N was estimated to represent from 38 to 46% of the total fecal N excretion. The diet composed of SBP and oat hulls presented similar values but the diet with oat hulls caused a marked drop in BPS and in the proportion of bacterial N in the feces (22%). It is concluded that BPS in the colon is responsible for the increase in fecal N excretion following fermentable NSP intake.

Key Words: Pig, Nitrogen excretion, NSP

207 The effect of common antimicrobial feed additives on the survival and viability of MicroSource S in swine excreta. T. Parrott*[1], A. Veldkamp[1], C. Wehnes[1], J. Tchetter[2], and R. Stock[3], [1]*Agtech Products, Inc., Waukesha, WI*, [2]*Pleasant Valley Colony Farm, Flandreau, SD*, [3]*DSM Nutritional Products, Inc., Parsippany, NJ.*

MicroSource S is a blend of direct fed *Bacillus* species that has been used as a tool to improve manure management, air quality and performance of swine. Because MicroSource S is used in all stages of swine production, information on its compatibility with various therapeutic and growth promoting antimicrobials was needed. Forty-four individually fed lactating sows were given *ad libitum* access to a standard corn:soy ration and water. The standard diet included MicroSource S at a rate of 0.5 g/kg of complete feed. On d 4 after farrowing, a fresh fecal sample, designated as Pre-AB treatment was collected from each sow to determine baseline levels of specific *Bacillus* spores. Beginning on d 5 after farrowing and continuing through d 8 after farrowing, 4 sows each received the standard diet with the addition of various feed additives. On d 8 after farrowing, a fresh fecal sample was collected from each sow and designated as Post AB treatment. *Bacillus* spores were enumerated from fecal samples using standard microbiological methodology. Data were analyzed using analysis of variance (ANOVA) of the log transformed bacterial counts. No differences ($P > 0.05$) were observed in baseline *Bacillus* spores for all groups which ranged from 3.71 to 4.56. Mean fecal *Bacillus* counts of fecal samples collected after antimicrobial treatment ranged from 3.49 to 4.22, however no differences ($P > 0.05$) were observed between any of the treatments and the control. This study indicates that the use of common therapeutic and growth promoting antimicrobial feed additives does not reduce the viability of direct fed *Bacillus* spores obtained from fecal excreta. Therefore, MicroSource S can be fed in combination with various antimicrobial compounds without a loss in the performance relative to manure management benefits.

Key Words: Swine, Manure, *Bacillus*

208 Prevalence of antibiotic resistant *E. coli* in water runoff collected from soil to which swine manure was applied. J. P. Holt*, E. van Heugten, A. K. Graves, M. T. See, and W. E. M. Morrow, *North Carolina State University, Raleigh.*

An experiment was conducted to determine the prevalence of antibiotic resistant *E. coli* in water runoff collected from soil to which manure from swine fed growth-promoting antibiotics was applied. Runoff events were performed after the nursery and finishing phases. For the nursery phase, pigs had been fed either a control (CON) or an antibiotic diet (AB) containing chlortetracycline (CTC, 55 mg/kg diet) for 5 weeks. For the finishing phase, diets consisted of: control in nursery and finishing (CC), control in nursery, antibiotic (virginiamycin, VIR, 11 mg/kg diet) in finishing (CA), antibiotic in nursery, control in finishing (AC), or antibiotics throughout (AA). Manure samples were collected and applied to 8 boxes containing sandy, loam (Wagram) soil (4 and 2 replicates per treatment for nursery and finishing, respectively), followed by rainfall simulation. Two soil boxes without manure were used as a control. Runoff was collected initially, and at 5, 15 and 30 min. *E. coli* was isolated from runoff samples and tested for resistance to CTC, VIR, and erythromycin (ERY). In the initial runoff of the nursery phase, resistance to CTC and ERY, respectively, was increased for AB (93.7 and 56.8%) compared to CON (72.1 and 28.7%; time x trt effect, $P < 0.05$). Conversely, at 5 min, resistance to ERY was increased (time x trt effect, $P < 0.05$) for CON (27.2%) compared to AB (3.9%) and at 30 min, resistance to CTC was increased (time x trt, $P < 0.05$) for CON (82.2%) compared to AB (15.6%). In the finishing phase, resistance to VIR was lower in the initial runoff for AC (78.3%) than all other treatments (AA, CC, CA, 100% each). At 30 min, AC samples also showed 100% resistance to VIR. *E. coli* was not isolated in runoff from control boxes. Antibiotic resistant *E. coli* are present regardless of the use of growth-promoting antibiotics and can enter the environment through land application of swine manure. Funding for this research was provided by the National Pork Board.

Key Words: Antibiotics, Resistance, Swine manure

209 Effects of a phytase enzyme formulated for meal diets on piglet performance. C. Starkey*, D. Campbell, N. Ward, and J. Wilson, *DSM Nutritional Products, Parsippany, NJ*.

A total of 350 weanling piglets (5.3 kg initial BW, 21 d of age) were used to determine the efficacy of a new phytase product form (Ronozyme P-(M)). The pigs were blocked by sex and weight and allotted to 35 pens with 10 pigs per pen. Initially all piglets received the same diets, formulated to 0.49 and 0.30% available P, for wk 1 and 2 respectively. For wk 3 to 6, treatments included a basal positive control diet (PC) formulated to 0.29% available P and a negative control diet (NC) formulated to 0.15% available P. Phytase treatments were equivalent to the NC plus phytase product form added at 18.5, 37, or 74 g/2000 kg. The diets were fed in meal form and consumed on an ad libitum basis. No differences were observed ($P > 0.19$) for any of the performance parameters for the initial 2 wk prior to the phytase additions. The NC and the 18.5 g/2000 kg treatments were not different ($P < 0.001$) nor did either supply adequate available P to support optimum growth. The 74 g/2000 kg addition rate provided performance equal to the PC for ADG ($P < 0.001$), ADFI ($P < 0.001$), and F/G ($P < 0.001$). In conclusion, the addition of phytase resulted in adequate additional available phosphorus from phytic acid to maintain performance in weanling piglets. Furthermore, these results indicate that incremental increases of Ronozyme P-(M) phytase will allow for further reductions of inorganic P in the diets.

Table 1. Effects of Ronozyme P-(M) on performance of piglets (weeks 3 to 6 post weaning)

Treatment	ADG, g	ADFI, g	F/G
Positive Control	529[a]	730[a]	627[a]
Negative Control	374[c]	591[c]	718[c]
Phytase 18.5 g/2000 kg	416[c]	638[bc]	697[c]
Phytase 37 g/2000 kg	465[b]	689[ab]	673[b]
Phytase 74 g/2000 kg	520[a]	733[a]	638[a]
P<	0.001	0.001	0.001

[abc] Means within columns with different subscripts are different.

Key Words: Pigs, Phytase, Phosphorus

210 Effects of dietary manipulation on the mass balance of N and P during the swine finishing phase. M. B. Lachmann*, S. D. Carter, and J. W. Bundy, *Oklahoma State University, Stillwater*.

Eighty-four crossbred pigs were used to evaluate the effects of reducing dietary CP and P on the mass balance of N and P during the finishing phase (28 to 118 kg BW). Pigs were stratified by sex, blocked by BW, and randomly allotted to two diets. Pigs were housed in an environmentally-controlled building with 4 identical rooms (21 pigs/room, 2 rooms/trt). Each room contained a shallow pit and exhaust air monitoring system. Diets were fed in 4 phases and consisted of a fortified corn-soybean meal diet as control (19.3, 17.2, 15.1 and 13.6% CP; 0.50, 0.46, 0.43, and 0.40% P) and a low nutrient excretion diet (LNE) similar to the control with the exception that CP was reduced by 3% units with crystalline AA, and P was reduced by 0.1% unit with phytase (500 FYT/kg). The estimation of mass balance, on a per pig basis, assumed that N and P entered the finisher via the feed and pigs, and exited via the slurry, exhaust air, and pigs. On day 0 and 110, 2 and 6 pigs/room, respectively, were used to estimate initial and final body composition. Feed intake and composition were used to estimate N and P entering via feed. Slurry volume and composition, and NH_3-N emission were used to estimate N and P exiting via waste. The amount of N (0.84 kg) and P (0.15 kg) initially entering via pigs was similar ($P > 0.10$). However, N (6.2 vs. 4.9 kg) and P (1.06 vs. 0.79 kg) entering via feed were reduced ($P < 0.03$) with LNE. Thus, LNE reduced ($P < 0.03$) total N (7.0 vs. 5.7 kg) and P (1.21 vs. 0.94 kg) entering by 18 and 22%, respectively. The amount of N (3.3 kg) and P (0.45 kg) exiting via the pigs was similar ($P > 0.10$) among diets. However, N (3.7 vs. 2.5 kg) and P (0.68 vs. 0.45 kg) exiting via slurry, and NH_3-N emitted (0.21 vs. 0.09 kg) were reduced ($P < 0.05$) by feeding LNE. Thus, LNE reduced ($P < 0.05$) total N (7.3 vs. 5.7 kg) and P (1.13 vs. 0.89 kg) exiting by 18 and 21%, respectively. The proportion of N and P entering the finisher that exited via the pigs increased from 47 to 58% for N and 37 to 48% for P for pigs fed LNE compared with those fed the control.

Key Words: Mass balance, Nutrients, Pig

211 Effects of soybean hull addition to a low nutrient excretion diet on pig performance and nutrient excretion during the finishing phase. J. W. Bundy*, S. D. Carter, M. B. Lachmann, and J. P. Jarrett, *Oklahoma State University, Stillwater*.

A total of 88 crossbred pigs was used to determine the effects of soybean hull addition to a low excretion diet on pig performance and nutrient excretion during an entire finishing period (32 to 124 kg). Pigs were housed in an environmentally-controlled building with four identical rooms (22 pigs/room), each with a shallow pit, pull-plug system. Pigs were stratified by sex, BW, and ancestry, then randomly assigned to one of four rooms. Rooms were randomly allotted to a 4 × 4 Latin square design with four rooms and four phases. The four dietary treatments included: 1) a fortified corn-soybean meal based diet (CSB); 2) a low nutrient excretion diet (LNE) similar to CSB with a reduction in CP by 3% units with crystalline AA addition, and P reduced by 0.1% with the addition of phytase (500 FYT/kg); 3 and 4) were similar to LNE with inclusion of 7.5 and 15% soybean hulls (SH), respectively. All diets were formulated on a true dig. Lys and ME basis. Each phase consisted of a 4-wk period which included a 1-wk adjustment period followed by a 3-wk slurry collection period. Dietary treatment did not affect ($P > 0.10$) pig performance. Also, daily DM intake was similar ($P > 0.10$) among all treatments. However, slurry concentration and daily excretion of DM increased ($P < 0.01$) linearly with SH inclusion. Daily N and P intake was lower ($P < 0.01$) for pigs fed LNE. Additionally, slurry concentration and daily excretion of N and P was reduced ($P < 0.02$) for pigs fed LNE compared with CSB. The addition of SH to LNE did not affect ($P > 0.10$) N and P intake or excretion. Slurry pH and NH_4-N concentration were decreased ($P < 0.02$) for pigs fed LNE compared with CSB, and linearly reduced ($P < 0.05$) with increasing SH addition to LNE. In addition, NH_3 emissions were reduced ($P < 0.05$) for pigs fed LNE vs. CSB. These results suggest that feeding the LNE diet reduced daily N and P excretion by 28%. Furthermore, the addition of SH to the LNE diet further reduced slurry pH and NH_4-N concentration without affecting pig performance.

Key Words: Diet, Excretion, Pig

212 Aerobic composting or anaerobic stockpiling of feedlot manure. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist, *University of Nebraska, Lincoln*.

Two manure management and storage methods, manure stockpiled anaerobically or composted aerobically for 104 d, were evaluated for

nutrient recovery. In July, manure from 30 pens was scraped, sampled, and weighed before constructing two anaerobic stockpiles and six aerobic windrows. Windrows were turned on days 14, 42, 59, 69, and 83 while stockpiles were not disturbed. Manure core samples and temperature were collected on d 42, 69, 83, and 104. Nutrient recoveries were calculated using total ash as an internal marker. Ammonium N was measured on samples as-is and after drying for 24 h in a 100ºC oven. Total N recoveries were greater ($P < 0.01$) for stockpiles than compost after 42 d (87.5, and 78.5%, respectively at d 42) and remained that way throughout the experiment (85.7, and 56.4%, respectively at d 104). Organic N (% of total N) was greater ($P < 0.01$) for compost than stockpiles on d 69, 83, and 104 (90.2% and 78.5%, respectively, at d 104). Ammonium N (% of total N) for fresh samples was greater ($P < 0.01$) for stockpiles than compost on d 69, 83, and 104 (19.0% and 4.2%, respectively at d 104). Total N recoveries calculated using oven dried samples remained greater ($P < 0.01$) for stockpiled manure compared with compost after 104 d (73.3% and 60.0%, respectively). Organic matter and organic C recoveries were greater for the stockpile than compost. Recovery of P_2O_5 was not different ($P = 0.83$) among storage methods. The N:P ratio was greater ($P < 0.01$) for stockpiled manure compared with compost on d 69, 83, and 104. When manure samples were dried down completely to simulate hot, dry conditions during field application, the amount of ammonia N lost from stockpiled manure was not great enough to offset the total N recovery advantage of this method. When evaluated on a nutrient basis, stockpiled manure has greater value as a fertilizer compared with composted manure.

Key Words: Nitrogen, Cattle, Compost

213 Effect of microbial phytase inclusion on phosphorus digestibility from flaxseed meal for pigs. L. Eastwood*[1], A. Owusu-Asiedu[2], P. Kish[1], A. Jasnier[3], A. D. Beaulieu[1], and P. Leterme[1], [1]*Prairie Swine Centre Inc., Saskatoon, SK, Canada,* [2]*Danisco Animal Nutrition, Marlborough, Wiltshire, U.K.,* [3]*ESITPA, 27100 Val de Reuil, France*.

Flaxseed meal (FSM) has one of the highest phosphorus (P) contents of all ingredients used in swine nutrition (0.875% of DM). Similar to other oilseed meals, a large proportion of this P is bound to phytic acid (~70%), and is thus largely unavailable for monogastric animals. An experiment was carried out to determine the effects of including microbial phytase (Phyzyme XP 5000G; EC 3.1.3.26, Danisco Animal Nutrition, Marlborough, UK) on P digestibility and excretion in pigs fed FSM-based diets. Barrows with initial weights of 45kg were blocked by weight and randomly assigned to one of 5 dietary treatments (8 pigs per treatment), each containing 30% FSM with increasing levels of exogenous phytase. The semi-synthetic basal diet contained pea starch, dextrose, Solka-Floc, canola oil, vitamin/mineral premix (0.09% P) and FSM. The experimental diets consisted of the basal diet supplemented with 0 (control), 575, 1185, 2400 and 2570 FTU/kg diet. Analysis of the basal diet showed that the endogenous phytase activity level was 127 FTU/kg diet, indicating that FSM has a phytase activity level of 423 FTU/kg FSM. Apparent digestibility of P increased from 21% to 61% ($P < 0.0001$) and P excretion decreased from 2940 to 1450 mg/kg DM intake ($P < 0.0001$) by increasing the exogenous phytase level from 0 to 2570 FTU/kg diet; however, inclusion of up to 575 FTU/kg diet accounted for half of the total increase in P digestibility (20%) and reduced P excretion by 850 mg per kg DM intake (1.48 mg P/kg DM intake per unit of phytase activity). The increase from 575 to 1185 FTU/kg diet released an additional 0.39 mg P/kg DM intake per unit of phytase activity. In conclusion, inclusion of microbial phytase in swine diets containing 30% of flaxseed meal significantly improves the apparent P digestibility and subsequently reduces P excretion.

Key Words: Pig, Phosphorus phytase, Flaxseed meal

214 Effects of condensed tannins on hydrogen sulfide production and the sulfate–reducing bacterial population of swine manure. C. Spence*, T. R. Whitehead, and M. A. Cotta, *National Center for Agricultural Utilization Research, USDA-ARS, Peoria, IL*.

Condensed tannins are natural plant compounds that have been shown to have antibacterial properties and have been used in studies to reduce methane emissions and frothy bloat in cattle. The objective of this study was to test the effects of condensed tannins on swine manure in an effort to target bacterial groups responsible for odor production. Odorous compounds and emissions produced from stored swine manure create a nuisance and can influence zoning decisions about the proposed sites of new swine facilities. These nuisance odors largely result from compounds such as sulfides, volatile fatty acids and phenols, which are produced as a result of anaerobic digestion of materials present in the manure. Hydrogen sulfide (H_2S) is an offensive odorant from swine manure and is being considered as a regulatory standard to monitor emissions from swine production facilities. Production of H_2S involves sulfate reduction largely by anaerobic sulfate-reducing bacteria (SRB). A quantitative real–time PCR approach was used to target and quantify the SRB population in manure, in response to treatment with condensed tannins. This assay specifically targeted the conserved *dsrA* gene of SRB, which encodes a key enzyme involved in sulfate respiration and production of H_2S. Swine manure was collected from a local swine facility and diluted in anaerobic buffer to a 10% final solution. 100 ml samples of 10% manure were treated with 0.5% w/v condensed tannins and together with control solutions were incubated anaerobically at room temperature for 28 days. All experiments were performed in triplicate. H_2S production was measured with a gas analyzer and 1 ml aliquots of manure were removed periodically for enumeration of the different populations of SRB. Addition of condensed tannins to swine manure in vitro reduced the numbers of *Desulfobulbus*–like Group 1 SRB by 96% after 7 days. This reduction in SRB correlated with a 98% reduction in H_2S production over the course of the study. This research demonstrates that condensed tannins can suppress H_2S production and reduce levels of SRB in swine manure.

Key Words: Tannins, Swine, Manure

215 Evaluation of the effectiveness of a biocurtain and electrostatic space-charge system for reducing total suspended particulate matter from swine building exhaust streams. A. Rojo*, M. Ellis, B. A. Peterson, T. Funk, Y. Zhang, S. Jerez, Y. Su, and M. Robert, *University of Illinois, Urbana*.

Two studies were carried out to evaluate the effectiveness of a commercially available biocurtain at reducing particulate matter emissions from a commercial wean-to-finish swine building. The biocurtain incorporated an electrostatic space-charge system (ESCS) into the design which was switched off for Study 1 but switched on for Study 2. The 1100-head building was tunnel ventilated, with curtain sides and a deep pit. The biocurtain covered the six room-exhaust fans (five 122 cm diameter and one 91 cm diameter). The evaluation was carried out between the months of July and October which included the period of high summer temperatures and maximum ventilation rates. The effectiveness of the

biocurtain, with the ESCS switched either on or off, was evaluated by comparing the total suspended particles concentration in the exhaust air before the 91 cm diameter room-exhaust fan with that in the exhaust air stream from the top of the biocurtain. Measurement of the concentration of total suspended particles (TSP) in the air streams (using a TSP Isokinetic Sampler) was carried out once per week over a 24-h period for ~8 weeks in each study. In Study 1 (ESCS switched off), the concentration of TSP in the exhaust air after the biocurtain was 57% lower than that before the room-exhaust fan (0.654 versus 1.534 mg/m^3, respectively; SEM 0.2787; P = 0.09). In Study 2 (ESCS switched on), the concentration of TSP after the biocurtain was 61% lower than that before the room-exhaust fan (0.423 versus 1.094 mg/m^3, respectively; SEM 0.1124; P < 0.01). The results of this study suggest that the biocurtain, with or without the ESCS system operating, was effective at reducing the concentration of total suspended particles in the room exhaust air from a commercial wean-to-finish facility.

Key Words: Total suspended particles, Biocurtain, Pigs

Physiology

216 WITHDRAWN

217 Effect of barley and oat β-glucans on intestinal microbiota in the pig. R. Pieper[1], R. Jha[2], P. Leterme[2], B. Rossnagel[3], W. Souffrant[1], and A. Van Kessel*[3], [1]*FBN-Ernährungsphysiologie, 18196 Dummerstorf, Germany*, [2]*Prairie Swine Centre Inc., Saskatoon, SK, Canada*, [3]*University of Saskatchewan, Saskatoon, SK, Canada*.

Isolated non-starch polysaccharides have been shown to influence the gut microflora in pigs. However, little information is available on the effects of cereals differing in NSP composition, namely in β-glucan. An experiment was carried out to compare the effects of hulled barleys, supplemented or not with isolated β-glucan, 4 hulless barleys with β-glucan contents ranging from 46 to 94 g/kg and 2 oat varieties. A total of 72 weaned piglets (12.7 ± 1.9 kg) were kept 15d individually in metabolic cages and fed a diet composed of 80% cereal, 7.5% whey, 7.5% soy protein isolate and 5% minerals. Pigs were killed 4 hours after the last meal and intestinal contents were collected from last 1/4 of the small intestine (SI) and 30 cm of medial colon for extraction of total DNA. Quantitative PCR (qPCR) and a nested PCR-DGGE approach using universal primers were used to evaluate the microbial community profile. Analysis of DGGE fingerprints revealed a graded and significant shift in both, SI and colon microbial communities in pigs fed the hulless barley varieties with normal to high β-glucan content. These hulless barley varieties had the lowest (P < 0.05) microbial diversity in the colon, whereas oats varieties had intermediate diversity compared with low β-glucan hulless varieties and hulled varieties with or without β-glucan supplementation. DGGE band identification suggested hulless high β-glucan varieties favoured xylan and β-glucan degrading bacteria and reduced proteolytic bacteria in colon whereas β-glucan supplemented hulled barley favoured the growth of lactobacilli, specifically Lactobacillus sobrius, in the SI. Enumeration by qPCR revealed hulless/high β-glucan diets decreased abundance of lactobacilli (P < 0.05), enterobacteria (not detected) and streptococci (not detected) in SI. Both form and content of dietary cereal β-glucan affect changes in gut microbial composition in the pig.

Key Words: Pig, Cereal NSP, Lactobacilli

218 Effect of shortening or eliminating the dry period on milk production of lactating cows for a full lactation. A. C. Fitzgerald*, T. H. Klusmeyer, A. C. Fabellar, J. M. Ballam, and J. L. Vicini, *Monsanto Company, St. Louis, MO*.

A three-site study was initiated to examine the effects of altering dry period length in multiparous cows (n=341) on milk production for a full lactation. Herds were located in ID, KS and NE. Cows were assigned to study 60 d before their due dates. Treatments were: 1) 60-d Dry/Label POSILAC®(60-d L), 2) 30-d Dry/Label POSILAC (30-d L), 3) 0-d Dry/Label POSILAC (0-d L), and 4) 0-d Dry/Continuous POSILAC (0-d C). Cows administered POSILAC according to label were supplemented until dry-off and resumed POSILAC at 57-70 days in milk (DIM) of the subsequent lactation. Cows that completed at least 2/3 of the second lactation (196 DIM) were used in the statistical analysis. There were no differences in total milk for all shortened dry periods compared to 60-d L. The 0-d L and 0-d C treatments had significantly lower milk production postpartum when compared to the 60-d L and may not be acceptable to dairy producers. The 30-d L group may have an economic advantage because of the time-value of making more milk upfront. Some of the lactating cows assigned to the shortened dry period treatments were dried-off early before parturition due to low milk not associated with an illness. A second data analysis was performed for cows (n=216) that were ± 7 days of target dry days and milk production results were similar to the first analysis. High-producing cows at 60 d before expected due date made more milk than controls and were the best candidates for the 30-d L dry period management.

Table 1. Summary of actual days dry and LSM and standard errors for prepartum, postpartum and total milk production (kg).

Item	60d-L	30d-L	0d-L	0d-C
No. of Cows	76	66	71	69
Actual Days Dry	61± 1.2	36*±1.4	9*±1.4	8*±1.5
Prepartum Milk	6±72	625*±39	1000*±39	1042*±42
Postpartum Milk	11968±278	11490±297	10316*±300	10195*±321
Total Milk	11974±277	12112±296	11310±299	11230±320

* - significantly different from 60d-L (P<0.05)

Key Words: Shortened dry period, Eliminating dry period, Posilac®

219 Regulation of transporter and enzyme expression by cellular energy. J. C. Matthews*, *University of Kentucky, Lexington*.

Cells express a complement of membrane transporters that include both ATP-hydrolyzing transporters (e.g., Na^+/K^+ATPase, H^+-ATPases, Ca^{2+}-ATPases) and all other transporters that either depend on the ion gradients and membrane potential maintained by ATP-hydrolyzing transporters. The ability to absorb a given set of substrates depends on the complement of membrane transporters expressed, whereas the ability to sustain transport capacity depends on the complement substrate-metabolizing enzymes expressed and on the ability to sustain the ion gradients and membrane potential perturbed during transport events. Because maintenance of the membrane potential ultimately is a function of ATP hydrolysis by primary transporters, the supply of ATP available for primary transporters (and channels) controls transport capacity.

Although mitochondrial production of ATP from oxidative phosphorylation and fatty acid metabolism are the primary sources of ATP to fuel cell functions, the production of ATP by membrane-bound glycolysis may be the membrane transport-controlling source of cellular energy, especially during periods of metabolic stress. In this review we discuss recent specific examples of how transporter (Na^+/K^+ ATPase, glucose, amino acid) and metabolizing enzyme (glucose, fatty acid) expression and functional capacity is regulated individually or by the integration of the glycolytic, AMP-activated protein kinase (AMPK), mammalian target of rapamycin/S6 kinase 1 (mTOR/S6K1), and amino acid response pathways. Prototypical examples to illustrate the coordination of ATP production/use and transport/enzymatic activities are highlighted: (1) AMPK-controlled expression among liver, skeletal muscle, and adipose tissues to support whole-body glucose homeostasis; (2) glutamate-stimulated upregulation of Na^+/K^+ATPase to support fetal brain function, (3) reduced expression of energy and protein metabolism in granulosal cells from persistent vs growing follicles; and (4) mTOR/S6K1-mediated differential regulation of amino acid transporter expression in placentas from intrauterine growth restricted vs normal fetoplacental units.

220 The early gestational uterine environment programs placental nutrient transport. M. Wilson* and J. Koch, *West Virginia University, Morgantown.*

The early gestational uterine environment programs placental nutrient transport. We have recently demonstrated that sustained release growth hormone, given to ewes at breeding, increases placental efficiency leading to an increase in birth weight of ~25%. Furthermore, lambs born to ewes treated with growth hormone around the time of breeding weigh more at 100 days-of-age and have a muted response to a growth hormone releasing hormone challenge. These alterations in fetal and placental development during mid to late gestation appear to result from the exposure of the very early embryo to an altered uterine environment. Early gestational treatment with growth hormone increases uterine luminal growth factor content (i.e., IGF-I and TGF-β) while at the same time reducing total protein and urea. It appears that the modulation of the very early uterine environment leads to an alteration in placental growth and function later in gestation. The expression of L-amino acid transporter 2 was greater in cotylendonary tissue from conceptuses gestated in ewes treated with GH at breeding than control ewes. While the expression of glucose transporters, GLUT-1 and GLUT-3, increased from d 80 and 140 of gestation in cotyledons of placentas from control ewes, there was no observed change in conceptuses from ewes treated with GH. In contrast to the effect of alterations in the very early uterine environment on some nutrient transporters, the expression of excitatory amino acid transporters 1 and 3 were not altered by GH treatment, although their expression increased from d 80 to 140 across both treatments. Umbilical vein IGF-1 concentrations were negatively associated with all amino acid transporters and both glucose transporters. However, a positive correlation was observed between fetal size, measured as fetal weight or crown-rump length, and excitatory amino acid and glucose transporters. The increase in live weight observed in lambs born to ewes treated with GH at breeding may be a result of increased uptake of amino acids from maternal circulation, which are essential for protein accretion.

Key Words: Placental efficiency, Nutrient transport, Growth factor

221 Influence of maternal nutrition on offspring performance. K. A. Vonnahme*, *North Dakota State University, Fargo.*

Developmental programming, defined as a stimulus or insult during a critical period in conceptus development establishing a permanent physiological response, is of growing concern in livestock production. Factors that could impact conceptus development include: genetics, maternal age, litter size, and environmental factors such as altitude or nutrient availability. Decreased nutrient availability during early pregnancy may hinder placental development, ultimately restricting fetal growth during later stages of gestation. Poor dam nutrition during later stages of pregnancy can equate to reduced birth weights due to inadequate supply of nutrients for the placenta to transfer to the fetus. Low birth weights not only impact neonatal morbidity and mortality, but more recently, has been linked to poor growth performance and carcass quality. Furthermore, maternal diet has also been shown to impact reproductive performance of the offspring. Critical developmental milestones do not only occur in utero, but also during the first weeks postnatal. There is limited data in livestock separating maternal nutrition during gestation from lactation. As maternal nutrition during pregnancy impacts mammary gland growth, colostrum yield, and milk production, our laboratory has developed a model to divorce the effects of maternal nutrition during pregnancy with postnatal nutrition in sheep. In our model, lambs are immediately separated from their dams at birth and fed a colostrum replacer to individual lamb body weight. Thereafter, lambs are managed similarly through market weight. Interpretation of measurements, including morbidity and mortality, growth rate, wool quality, glucose tolerance, and carcass quality, are solely due to gestational treatments. Interdisciplinary research efforts in the areas of nutrition, reproductive physiology, and muscle biology are imperative to develop nutrient-balanced gestation diets for optimal postnatal livestock growth, reproductive capacity, carcass quality, and health.

Key Words: Developmental programming, Postnatal responses, Livestock

222 POSILAC® efficacy on six commercial dairy farms. T. H. Klusmeyer*, J. M. Ballam, and J. L. Vicini, *Monsanto Company, St. Louis, MO.*

Monsanto has been selling the POSILAC brand of a bST supplement as a way to increase milk production and productive efficiency of dairy farms since 1994. Critical approval studies were initiated beginning in 1985. Since then, there have been many changes in management including changes in nutrition, cow health, reproduction, and genetics. As an example, average production of US Holsteins increased by 20% between the years 1991 and 2001. This study reports the response of high-producing cows in six dairy herds to bST supplementation for a 12-week period. The herds were located in ID, CA, and AZ. Cows were assigned to five different treatments but only the Control and POSILAC treatments are reported. Cows were between 57 to 150 DIM at start of study and projected 305ME was at least 8,391 kg prior to initiating bST supplementation. Cows were assigned randomly to treatments. There were 360 and 357 cows that were not treated or supplemented with bST every 14 days, respectively. Cows in all herds were fed TMR and cows were milked three times/day. Data were pooled across parity and weighted 1/3 primiparous to 2/3 multiparous cows. Cows supplemented

with POSILAC produced significantly (P<0.001) more total milk (5.1 ± 0.56 kg/d) than Controls. Individual farm responses were 3.9 ± 0.89, 3.9 ± 1.13, 4.7 ± 0.87, 5.0 ± 1.17, 5.7 ± 0.85 and 6.7 ± 1.06 kg/d (P<0.01 within farms). These data indicate that high-producing cows in today′s commercial farms have responses similar to those reported 15 years earlier.

Key Words: rbST, Milk production, Management

223 Effects of summer climatic conditions on body temperature in beef females. D. McGee*, R. Rasby, M. Nielsen, T. Mader, L. Kovarik, and Z. Hall, *University of Nebraska, Lincoln.*

The objectives of these studies were to determine the effects of environmental temperature and humidity on internal body temperature and determine the correlation between vaginal and tympanic measurements of body temperature. Two trials using mature, non-pregnant crossbred cows (n=20) were conducted to determine effects of environmental temperature and humidity on internal body temperature. A modified blank CIDR® containing a DS1922L iButton data logger with a resolution of 0.5°C was inserted into the vaginal cavity. Hourly body temperatures were fitted to Fourier series (sine plus cosine) model. The best fitting model for Trial 1 retained periodicities of 12, 10, 9, 8, 7, 6, 5, and 4 hr. For Trial 2, the best fitting model retained periodicities of 12, 10, 9, 8 and 7 hr. The model for Trial 2, accounted for the interaction with ambient temperature and was used to predict internal body temperature patterns in cows when subjected to different daily maximum temperatures. Regressions of panting score on ambient temperature (P=0.335), humidity (P<.0001) or THI (P<.0001) were all significant. Finally, mature, non-pregnant crossbred cows (n=20; Trial 3) and non-pregnant, pubertal, crossbred heifers (n=48; Trial 4) were used to determine the correlation between vaginal and tympanic temperatures and observe the temperature profile changes during estrus. Loggers had a resolution of 0.125°C. The correlation between vaginal and tympanic temperatures was r=0.83. Hourly body temperatures in Trials 3 and 4, were fit to Fourier series (sine plus cosine) models. For Trial 3, the best fitting model retained periodicities of 12, 11, 10, hr. For Trial 4, the best fitting model retained periodicities of 11, 10, 9, 8, 7, and 5 hr. These models showed the predicted body temperatures of females in estrus compared to body temperatures of females not exhibiting estrus. Models can be used to accurately predict changes in body temperatures of beef females. Tympanic temperature can be used to predict internal body temperature.

Key Words: Beef cattle, Body temperature, Tympanic temperature

224 Effects of administration of prostaglandin $F_{2\alpha}$ (PG) 5 or 7 d after receiving human chorionic gonadotropin (hCG) or gonadotropin releasing hormone (GnRH) in replacement beef heifers. G. Marquezini*[1], C. R. Dahlen[2], M. Blason[1], S. L. Bird[1], J. E. Larson[1], B. J. Lovaas[1], S. Lares[1], and G. C. Lamb[1], [1]*NCROC, University of Minnesota, Grand Rapids,* [2]*NWROC, University of Minnesota, Crookston.*

We determined whether PG administered 5 or 7 d after receiving an injection of GnRH or hCG would alter the interval to ovulation or interval to corpus luteum (CL) regression. Purebred Angus heifers were stratified by age, cycling status and weight before being assigned to one of four treatments in a 2×2 factorial: 1) heifers received a 100 μg injection of GnRH on d 0 followed by a 25 mg injection of PG on d 5. (G5; n=11); 2) same as G5 but PG was administered on d 7 (G7; n=11); 3) heifers received a 1,000 IU injection of hCG on d 0 followed by a 25 mg injection of PG on d 5. (H5; n=11); and 4) same as H5 but PG was administered on d 7 (H7; n=11). Blood samples were collected 3x weekly from d -25 to -4 and -1, 0, 3, 5, 7, 8, 9, 10, 11 to determine concentrations of progesterone. Transrectal ultrasonography was used to determine ovarian dynamics on d -1, 0, 3, 5, 7, plus every 4 hr after each heifer was detected in estrus until disappearance of the ovulatory follicle. Average interval from PG to ovulation was greater (P < 0.05) in G5 (100.7 hr) and H5 (102.7 hr) treatments than G7 (65.5 hr) and H7 (64.5 hr) treatments. Concentrations of progesterone were similar on d 3 (1.84 ng/mL), 5 (2.50 ng/mL), and 7 (1.29 ng/mL) between GnRH and hCG treated heifers. Concentrations of progesterone tended (P = 0.11) to be greater when heifers received PG on d 5 (3.00 ± 0.57 ng/mL) than those receiving PG on d 7 (1.76 ± 0.56 ng/mL) after treatment. Follicle diameter tended (P = 0.10) to be larger at ovulation when treated with PG on d 5 (14.1 ± 0.4 mm) than d 7 (13.1 ± 0.4 mm) after treatment. Progesterone 48 hr after PG was greater (P < 0.05) in hCG (0.57 ± 0.14 ng/mL) than GnRH (0.19 ± 0.15 ng/mL) treated heifers and for those heifers treated with PG on d 5 (0.60 ± ng/mL) than those treated on d 7 (0.17 ± ng/mL). We conclude that the interval to ovulation after PG was greater in heifers treated on d 5 rather than d 7 after treatment with hCG or GnRH and that concentrations of progesterone after PG were altered by both treatment of hCG or GnRH and the interval to PG.

Key Words: Ovulation, Progesterone, Follicle

225 Sildenafil citrate (Viagra™) influences ovarian hemodynamics and progesterone concentrations in Rambouillet ewes. E. J. Windorski*[1], K. A. Vonnahme[1], C. S. Schauer[2,1], J. D. Kirsch[1], L. A. Silva[3], L. P. Reynolds[1], and J. S. Luther[1,2], [1]*North Dakota State University, Fargo,* [2]*Hettinger Research Extension Center, North Dakota State University, Hettinger, ND,* [3]*University of Florida, Gainesville.*

Embryonic mortality contributes to economic loss in the sheep production enterprise, and has been associated with low levels of circulating progesterone in the ewe. The effects of sildenafil citrate (Viagra™) on ovarian hemodynamics and progesterone concentrations were evaluated in sheep.

Synchronization of estrus (day 0) was achieved in Rambouillet ewes (n=12) by removal of a CIDR-G device and injection of 5 ml PG600. Thereafter, ewes were randomly allocated to receive a vaginal suppository without (C) or with 100 mg of sildenafil citrate (SC) on day 11 (morning) and day 12 (evening) of the estrous cycle. Ovarian hemodynamics were assessed using transrectal color Doppler ultrasonography techniques at 0, 12 and 48 hours relative to the first SC treatment. Vascular resistance index (RI) in the ovarian pedicle and corpora lutea, and ovarian vascular perfusion was determined for each ewe. Blood samples collected at 0, 4, 12, 36, 48, 60, and 72 hours relative to the first SC treatment were analyzed for progesterone (P4).

Vascular RI in the ovarian pedicle was reduced (*P*<0.01) in SC (0.30 ± 0.028 index) versus C (0.48 ± 0.055 index) ewes 12 h after treatment, but remained similar between groups at 0 (0.39 ± 0.060 vs. 0.47 ± 0.046 index) and 48 h (0.36 ± 0.045 vs. 0.42 ± 0.044 index). SC treatment did not affect vascular RI or ovarian vascular perfusion in the corpus luteum when compared to C ewes at 0, 12 and 48 h. Although overall P4 concentrations were not influenced by SC, the relative increase in P4 from 0 h was significantly greater (*P*<0.006) in SC (21.8 ± 3.99%)

versus C (6.9 ± 3.26%) ewes. In summary, sildenafil citrate (Viagra™) enhances ovarian vascular indices and promotes a relative increase in circulating P4 concentrations, both of which may be beneficial for embryonic survival in sheep.

Key Words: Ovary, Sheep, Sildenafil citrate

226 Effects of genistein on serum and anterior pituitary (AP) concentrations of IGF-I and IGF binding proteins (IGFBP) in barrows. A. K. Knorr* and J. A. Clapper, *South Dakota State University, Brookings.*

Administration of estradiol to barrows has been demonstrated to cause an increase in serum and AP concentrations of IGF-I and relative amounts of serum and AP IGFBP. However, the effects of other estrogenic compounds on the porcine IGF system remain to be determined. Genistein, an isoflavone found in soybeans, has recently been shown to have estrogenic effects in pigs. Therefore, the objective of this study was to determine if administration of genistein increased serum and AP concentration of IGF-I and relative amounts of serum IGFBP. Twenty barrows of similar age (190 d) and weight (110 kg) were stratified by litter into one of four treatments: controls (C), estradiol (E), 200 mg genistein (200), and 400 mg genistein (400). E pigs were injected with 2 mg of estradiol-17β i.m., while the 200 and 400 groups were injected with either 200 mg or 400 mg of 99% pure genistein i.m., respectively, for 15 d beginning on day 1. Blood was collected via jugular venipuncture on days 0, 3, 6, 9, and 12. Blood and AP were collected at slaughter on day 15. Serum and AP concentrations of IGF-I were determined by RIA. Relative amounts of serum IGFBP were determined by Western ligand blot analysis. Serum concentrations of IGF-I did not differ among groups (P>.05) throughout the 15 d experiment. AP concentrations of IGF-I were greatest in E pigs (P<.05), while the 400 pigs had greater (P<.05) AP concentrations than C pigs. No difference was detected (P>.05) in AP concentrations of IGF-I between the 200 pigs and the C pigs. Relative amounts of serum IGFBP-2 and the 46 and 41 kDa forms of IGFBP-3 did not differ (P>.05) among groups throughout the experiment. These preliminary data provide evidence that genistein affects the AP IGF system in the pig. Even though the estrogenic potency of genistein is far less than that of estradiol, it is still able to trigger biological responses that are caused by physiological estrogens.

Key Words: Genistein, IGF, IGF binding proteins

227 Parturition and Mycobacterium avium subsp. paratuberculosis: a potential interface for the pathogenesis of Johne's disease. E. L. Karcher*[1], D. C. Beitz[1], and J. R. Stabel[2], [1]*Iowa State University, Ames,* [2]*USDA-ARS-National Animal Disease Center, Ames, IA.*

Mycobacterium avium subsp. paratuberculosis (MAP), the causative agent of Johne's disease (JD), is estimated to infect more than 22% of US dairy herds and cost the industry $250 million annually. One major period of stress for dairy cows is the periparturient period, and field observations suggest that MAP-infected cows may advance to the clinical stage of the disease during the early post-partum period. Research on what prompts the progression of disease during this time period is lacking. Therefore, our overall objective was to gain a better understanding of the host immune response to MAP infection during the periparturient period. In the first study, we characterized cytokine gene expression and secretion in periparturient dairy cows naturally infected with MAP. Peripheral blood lymphocyte percentages also were analyzed with flow cytometry. Cell populations were further delineated by staining for CD5. Infection with MAP did not significantly alter cytokine gene expression. The periparturient period mediated gene expression of IFN-γ, IL-4, and IL-10 regardless of cow infection status. The percentages of lymphocyte subsets were modulated by MAP infection and by the periparturient period. These factors also influenced the expression of CD5 on T-cell subpopulations and on B-cells. The second study was designed to determine the role of osteopontin (Opn) on disease progression in periparturient MAP-infected cows. Investigation of the role of Opn in JD is of interest because Opn can influence cytokine expression and improve host defense against mycobacterial infections. Results revealed that Opn expression and protein abundance in PBMCs isolated from periparturient cows are modulated by both MAP infection status and parturition. We present here the first known data investigating Opn gene and protein expression in MAP-infected cows. The results of our various studies contribute to a small body of literature focusing on the progression of JD during the early postparturient time period.

Key Words: Cytokines, Periparturient, M. avium subsp. paratuberculosis

228 Automated body condition scoring: Technical and economic feasibility. J. M. Bewley*[1,2] and M. M. Schutz[1], [1]*Purdue University, West Lafayette, IN,* [2]*University of Kentucky, Lexington.*

Although the benefits of body condition scoring (BCS) are intuitive to most dairy industry professionals; relatively few dairy farms have incorporated it as part of their routine management strategy. The lack of adoption of this technique is largely attributable to subjectivity and time requirements. An automated BCS system would be less demanding of time by trained personnel, less stressful to cattle, more objective and consistent, and possibly more cost effective. The technical feasibility of utilizing digital images (IceScore™, Ice Robotics Ltd., Midlothian, UK) to determine BCS was assessed for lactating dairy cows at the SAC Crichton Royal Farm. Up to 23 anatomical points were manually identified on dorsal images (N=3332) captured automatically from above as cows passed through a weigh station. All identifiable points were utilized to define and formulate measures describing the cow's contour. Hook angle and posterior hook angle were significant predictors of BCS (P<0.05) and 100% of predicted BCS were within 0.50 points of actual BCS and 93% were within 0.25 points. The economic feasibility of investment in an automated BCS system was also explored using a dynamic, stochastic simulation dairy model designed to examine investments in dairy intervention technologies. The model was created in Microsoft Excel using the @Risk add-in to consider the stochastic nature of key variables with Monte Carlo simulation. Benefits of the BCS system were considered by estimating potential improvements resulting from technology adoption through reduced disease incidence, reduced days open, and increased energy efficiency. The simulation resulted in a series of net present values used to identify the probability of observing a positive net present value. Future efforts should explore ways to facilitate extraction of information from images automatically using a larger number of animals to accurately predict scores of cows across all levels of BCS. With further development and refinement, automated BCS may become an integral part of decision making on modern dairy farms with applications in nutrition, genetics, and animal well-being.

Key Words: Body condition scoring, Intervention technology, Investment analysis

229 Regulatory role of the novel oocyte specific gene JY-1 in control of granulosa cell function and early embryonic development in cattle. A Bettegowda* and G. W. Smith, *Michigan State University, East Lansing.*

Reproductive inefficiency is one of the key obstacles to the economic success of the dairy industry, but the physiological mechanisms impeding reproductive success are unknown. A growing body of evidence indicates genes expressed in the oocyte are important for ovarian follicular and early embryonic development and thus play a key role in regulation of fertility. However, identification of the key oocyte expressed genes regulating above processes in livestock species including cattle is far from complete. During analysis of a bovine oocyte cDNA library, an abundant cDNA encoding for a totally novel oocyte expressed mRNA transcript (designated as JY-1) was identified and we hypothesized that JY-1 may play an important regulatory role. Thus, the objectives of studies described here were to characterize JY-1 and investigate its role in folliculogenesis and early embryogenesis in cattle. The JY-1 gene has multiple mRNA transcripts of differing length all encoding for an identical secreted protein. JY-1 mRNA and protein are oocyte specific and detectable throughout folliculogenesis. Treatment of ovarian granulosa cells with recombinant JY-1 protein stimulated progesterone synthesis, but decreased the follicle stimulating hormone stimulated increase in cell numbers and estradiol production, suggestive of regulatory role for JY-1 in granulosa cell function. JY-1 mRNA of maternal origin is present in early embryos and temporally regulated during meiotic maturation through embryonic genome activation. Ablation of JY-1 protein in early embryos by siRNA mediated gene knockdown blocked embryo development to the blastocyst stage. We conclude that JY-1 is a novel maternal effect gene with important roles in regulation of folliculogenesis and early embryogenesis. An increased understanding of the basic mechanisms regulating ovarian follicle and early embryonic development is critical to development of new strategies to increase reproductive efficiency in dairy cattle.

Key Words: Oocyte, Embryo, Granulosa cell

230 WITHDRAWN.

231 Association between age and ovarian morphology in crossbred beef cows. R. A. Cushman*, *USDA, ARS, U.S. Meat Animal Research Center*.

Depletion of the ovarian reserve is associated with reproductive senescence in mammalian females. In women, the number of antral follicles detectable by ultrasound varies greatly, but decreases with age, resulting in decreased fertility. Similarly, the number of follicles present in the bovine ovary varies greatly among cows at all ages, and a large ovarian reserve positively influences calving interval and ovulatory response to exogenous gonadotropins. The present study tested the hypothesis that antral follicle counts (AFC) decrease as beef cows age. Pairs of ovaries were collected from crossbred beef cows (n = 176; 0 to 9 years of age) at necropsy, all visible antral follicles were counted, and the ovaries were weighed. Antral follicle counts and total ovarian weight (TOW), defined as the sum of the weight in grams of the two ovaries, were regressed on age. There was a quadratic effect of age on AFC such that AFC increased until 5 years of age and decreased thereafter (AFC = 16.7 + 11.5(year) - 1.28(year^2); $P < 0.001$, r-square = 0.20). In contrast, total ovarian weight continued to increase linearly through 9 years of age (TOW = 2.37 +2.4(year); $P < 0.001$, r-square = 0.63). There was a positive relationship between follicle count and ovarian weight ($P < 0.001$; r-square = 0.26). Within an animal, ovarian phenotypes were highly correlated, resulting in a strong positive relationship between the number of follicles in the left ovary and the number of follicles in the right ovary ($P < 0.001$, r-square = 0.89). The weight of the left ovary was also highly correlated with the weight of the right ovary ($P < 0.001$, r-square = 0.78). Therefore in beef cows, antral follicles begin to decline at 5 years of age. The continued increase in ovarian weight through 9 years of age suggests either that ovarian mass continues to increase with age, or that cows with larger ovaries remain in the production herd longer, possibly due to a larger ovarian cortical mass and a greater number of follicles at a young age.

Key Words: Beef cow, Follicle number, Stayability

232 Associations between birth weight and fetal programming in commercial sows. G. Foxcroft*, M. Hahn, J. Patterson, S. Sarmento, M. Smit, S. Town, and W. Dixon, *Swine Research & Technolgy Centre, University of Alberta, Edmonton, Alberta, Canada.*

In a litter-bearing domestic species like the pig, the number of offspring born is an important economic trait. The components of litter size (ovulation rate, embryonic survival and uterine capacity), and effects on prenatal development and variation in postnatal growth performance, are of considerable interest to the pork industry. It has been suggested that when the number of embryos exceeds 14, intrauterine crowding is a limiting factor for litter size born and the birth weight of the litter. Intrauterine growth retardation (IUGR) in the pig also has important consequences for lifetime health outcomes and early postnatal survival. In a recent study, total litter size, litter sex ratio and individual pig weights were measured in 586 multiparous litters on a commercial farrow to wean facility. Stillborn pigs from a subset of litters (n=52) in the midrange of litter sizes (10-15 total pigs born) were subjected to necropsy to obtain data on body weight, and weight of the semitendinosus muscle (STM), heart, liver and small intestine. These data were used to estimate brain sparing effects as a measure of prenatal programming. The body weight of the stillborn pig dissected represented the average weight of the birth litter ($r = 0.80$; $P < 0.001$). Liver ($r = 0.89$), STM ($r = 0.80$) and small intestine ($r = 0.87$) weights were highly correlated to body weight ($P < 0.001$). In contrast, brain weight was less affected by body weight ($r = 0.57$; $P < 0.001$). This suggests that at lower mean litter birth weights (1.0 kg) brain sparing occurs, with potential negative consequences on post-natal growth as measured by lower STM and small intestine weights. These data provide further support for the suggestion that one of the major causes of variation in postnatal growth performance is between-litter variation in average birth weight.

Key Words: Pig, Birth weight, Fetal programming

233 Conceptus development during embryo elongation in lines of pigs selected for ovulation rate or uterine capacity. J. R. Miles*[1], B. A. Freking[1], L. A. Blomberg[2], and J. L. Vallet[1], [1]*USDA-ARS, US Meat Animal Research Center, Clay Center, NE,* [2]*USDA-ARS, Beltsville Agricultural Research Center, Beltsville, MD.*

The pig embryo undergoes a dramatic morphological transition between Day 10 and 12 of gestation, elongating from a spherical structure to a long, thin filament. Lines of pigs selected for increased uterine capac-

ity (UC) have improved conceptus survival while pigs selected for increased ovulation rate (OR) have decreased conceptus survival relative to an unselected control line (CO). The objective of this study was to evaluate development during embryo elongation as a contributing factor to differences in conceptus survival rates among these pig lines. Conceptuses were recovered by flushing each uterine horn of pregnant gilts with 25 ml of PBS at Day 10 (n = 13, 13, and 13) or 12 (n = 9, 14, and 14) of gestation from CO, UC, and OR gilts, respectively. At Day 10 of gestation, conceptus diameter was determined and the standard deviation within individual gilts was used to assess conceptus morphologic diversity. Uterine flushings were assayed for total protein and estradiol-17beta at Day 10 and 12 of gestation. Morphological data were analyzed for analysis of variance with the fixed effects of line, season, and the interactions of fixed effects. Flushing data were analyzed for analysis of variance with the fixed effects of line, day, season, and the interactions of fixed effects. There were no significant line effects on conceptus diameter means or within-litter standard deviations at Day 10 of gestation. Furthermore, total protein or estradiol-17beta levels in uterine flushing at Day 10 and 12 of gestation were not different between the lines. Day effects were detected for total uterine luminal protein ($P < 0.0001$; 13.3 ± 0.6 and 28.8 ± 1.4 mg) and total uterine luminal estradiol-17beta ($P < 0.0001$; 1.2 ± 0.1 and 7.5 ± 0.9 ng) for Day 10 and 12, respectively. These findings indicate limited deviations in conceptus development during embryo elongation between these lines of pigs.

Key Words: Pig, Uterine capacity, Conceptus elongation

234 Maternal plasma progesterone and estradiol concentrations prior to farrowing are not associated with either birth intervals or stillbirth rates in pigs. J. L. Vallet*, J. A. Nienaber, T. M. Brown-Brandl, and J. R. Miles, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Prolonged birth intervals are associated with stillbirth in pigs. Average birth intervals decrease as litter size increases, suggesting a cumulative negative effect of fetuses, placentas or both on average birth interval. Late gestation maternal plasma estrogen concentrations increase with litter size, suggesting that the litter size effect on farrowing interval might be estrogen mediated. The objective of this experiment was to determine associations between plasma progesterone or estradiol with gilt average birth interval and stillbirth rate. BX gilts (150) were mated at estrus and farrowing was monitored using cameras and videotaping equipment. The number of live and dead piglets born was recorded for each gilt. On d 110 and 113 of gestation, heparinized-citrated jugular blood samples were collected from each gilt and plasma was collected and frozen. Progesterone and estradiol were measured in each sample using radioimmunoassay. The average birth interval and stillbirth rate was calculated for each gilt, and relationships with plasma hormone concentrations were examined using PROC MIXED. After adjustment for the actual day of farrowing (range d 114 to 120), plasma progesterone concentrations began decreasing 3 days before farrowing, and estradiol concentrations increased linearly during the 10 days prior to farrowing. Plasma estradiol increased as litter size increased from 2 to 8 fully formed piglets, but did not change as litter size increased from 8 to 17 piglets. There were no significant relationships between plasma progesterone or plasma estradiol concentrations and either average birth interval or stillbirth rate. In addition, the significant relationship between average birth interval and litter size remained, even when plasma estradiol was simultaneously fit with litter size. These results indicate that progesterone or estradiol concentrations near the time of farrowing are unrelated to average farrowing intervals or stillbirth rate of gilts.

Key Words: Farrowing, Placenta, Fetus

235 Gilt development traits associated with whether a gilt farrows a litter. M. T. Knauer*[1], M. T. See[1], and D. W. Newcom[2], [1]*North Carolina State University, Raleigh,* [2]*Genetic Improvement Services, Newton Grove, NC.*

The objective of this study was to identify gilt development traits associated with whether a gilt farrowed a litter. Landrace-Large White gilts, (n=142, GIS of NC), were selected and subsequently developed at the NC Swine Evaluation Station (NCSES), Clayton, NC. After leaving the NCSES, the gilts entered a commercial farm where 83% farrowed a litter (n=118). Gilts entered the NCSES at an average age of 140 d, were penned in groups of 3, and fed ad libitum. Gilts were heat-checked twice daily with boars. Gilts were penned with a boar for 5 m in the AM and boars were used to fenceline heat-checked in the PM. Subjective measures of estrus behavior were visual vulva swelling/coloring, maximum strength of standing reflex without boar, total strength of standing reflex without boar, and overall estrus behavior. Objective estrus traits included vulva width, vulva width 10 d after estrus, vulva swelling, vulva Minolta colorimeter, vulva Minolta colorimeter 10 d after estrus, vulva color change, length of standing reflex, length of standing reflex without boar, and urine estradiol. Body composition traits were real-time ultrasound 10th rib backfat and 10th rib loin eye area at 114 kg and puberty. Growth and age related traits included selection weight, age at selection, puberty weight, age at puberty, and days to 114 kg. Subjective scores of structural soundness included rib width, front leg side view, rear leg side view, front view, rear view, and locomotion. All traits were analyzed in SAS using PROC MIXED with gilts farrowing a litter (0 or 1) as a fixed effect. Gilts producing a litter had greater ($P < 0.05$) visual vulva swelling/coloring and wider ($P < 0.05$) vulvas during estrus (37.4 vs. 34.6 mm) than gilts that did not farrow. Females producing a litter were also slower ($P < 0.05$) growing to 114 kg (163.7 vs. 158.8 d) than gilts not farrowing a litter. Gilts producing a litter had better ($P < 0.01$) front leg side views and superior ($P < 0.01$) locomotion scores in comparison to gilts not farrowing. Genetic selection for larger vulvas during estrus and improved structural correctness may increase the number of gilts entering the herd that farrow a litter.

Key Words: Pigs, Estrus, Reproduction

236 Evaluation of feeding BIG BEEF ™ in a calf milk replacer on health and performance. M. Yang*[1], B. Renk[1], D. Shields[2], and J. Coalson[2], [1]*Aova Technologies, Madison, WI*, [2]*Merricks Inc., Union Center, WI*.

The inflammatory response in the gut due to ingestion of feed can account for 10-20% of the energy consumed to mount the animal's immune responses. The objective of this study was to evaluate the efficacy of BIG BEEF ™(anti-phospholipase A_2) to modulate this inflammatory response, promote growth and health in young dairy calves. Holstein bull calves (n=72, ±2 d of age) were stratified by weight and assigned to 1) Control, 20/20 all milk replacer medicated with 400 g Neomycin and 200 g Oxytetracyline, 2) Control plus 0.7% BIG BEEF™, 3) Control plus 1.4% BIG BEEF™. For this 56-day study all calves were fed 454 grams of milk replacer per day and 18% protein texturized calf starter feed ad lib. After 42 days calves were weaned if they had consumed 454 grams of starter feed for 3 consectitive days; if calves were not weaned the calves were reduced to one feeding of milk daily to promote an increase in starter feed intake. Parameters measured in this study were: fecal scores, growth (calves were weighed weekly), daily starter intake and morbidity. During this study there was 0% death loss. Although, no statistical differences were found in growth, starter intake, morbidity or fecal scores, the calves with 1.4% BIG BEEF™ added in the milk replacer did have the highest weight gain, the fewest calves treated and the highest starter feed intake for the study. At the end of the 8-week study, calves in the 1.4% BIG BEEF ™group were 2.9 kg heavier, had taken in 13.5% more feed and required 33% less treatment versus the control animals. Results provide evidence that the inclusion of BIG BEEF ™in a calf milk replacer may play a role in reduction of the inflammatory response due to ingestion of a calf milk replacer. The 1.4% inclusion rate may not be the optimal inclusion rate and additional levels may need to be tested.

Table 1.

	Total Gain, kg	Starter Intake, kg	Calves Treated
Control	34.7	53.9	45
0.7% BIG BEEF™	33.8	52.6	57
1.4% BIG BEEF™	37.6	61.2	30

Key Words: Calf, Performance, Anti-phospholipase A_2

237 Effects of time of soybean oil supplementation on diurnal rumen activity and total tract nutrient digestibility in lambs fed a high forage diet. Q. S. Baptiste*, J. Gulas, M. Packard, S. Chavez, and E. E. D. Felton, *West Virginia University, Morgantown*.

The effects of delayed supplementation of a soybean oil and soybean meal supplement on diurnal rumen activity and total tract nutrient digestion of lambs fed orchard grass hay were investigated. Three Dorset × Suffolk ruminally fistulated lambs (58.33 ± 3.5 kg) were assigned to one of three treatments in a 3 × 3 Latin Square design. Experimental periods (15 to 17 d), included a 10 to 12-d diet adaptation period and a 5-d sampling period. Lambs were fed at 0600 for all treatments and supplemented at 0600 (AM), 1800 (PM), or one half of daily allotment at both times (AP). Feed, fecal and urine samples were collected daily throughout the sampling period. Daily hay intake, fecal output, urine and urine NH_3-N output were measured. Nutrient digestibility was determined. Rumen fluid was collected and processed to determine diurnal variations in VFA, total VFA, ammonia nitrogen concentrations and pH. Ytterbium labeled orchardgrass hay and Co-EDTA were dosed into the rumen of each lamb for estimation of solid and liquid digesta passage rates. There were significant differences in rumen concentrations of VFA, rumen NH_3-N concentration and pH within all treatments and a treatment by time interaction effect on these variables across all treatments ($P < 0.01$). Average rumen VFA, total VFA concentrations, and pH did not differ across treatment but average rumen NH_3-N concentrations were higher ($P < 0.05$) in the PM and AP than in the AM lambs (21.00, 21.91, and 18.97 ± 0.16 mg/dl). Numerically higher liquid passage rates were observed in PM and AP compared to the AM lambs (8.69, 8.48, 7.60 ± 0.65 %/h) and PM lambs had a slower solids passage rate ($P < 0.05$) than the AM and AP groups (8.13, 9.83 and 9.70 ± 0.24 %/h). Treatment did not affect differences in hay intake, urine production, urine ammonia nitrogen, or nutrient digestibility. Therefore, time of supplementation affected rumen kinetics and digestion but not total tract digestibility.

Key Words: Fat, Lamb, Rumen metabolism

238 Effect of length of time between maternal separation and shipping on post-weaning growth and health of beef calves weaned during the summer. J. W. Bolte*, K. C. Olson, J. R. Jaeger, B. J. White, R. L. Larson, G. A. Milliken, N. A. Sproul, and M. D. Thomas, *Kansas State University, Manhattan*.

Ranch-of-origin weaning periods of between 30 and 60 d are suggested for preconditioning beef calves prior to sale. Our objective was to test the validity of these suggestions for calves aged 100 to 160 d and weaned during the summer. Angus x calves (n= 400) were stratified by age and assigned randomly to 1 of 5 weaning periods that corresponded to the length of time between separation from the dam and shipping to an auction market: –60, –45, –30, –15, or 0 days. Calves were vaccinated against common diseases 14 d before maternal separation and again on the day of maternal separation. On a common shipping date (d 0; August 24), calves were transported 3 h to a commercial auction market and held for 14 h. Calves were then transported 1 h to a feedlot. All calves were fed the same diet ad libitum throughout the trial; they were also monitored 2 × daily for symptoms of respiratory disease. Body condition of dams was assessed -60 and +60 d relative to shipping. Calf BW at maternal separation and ADG from maternal separation to shipping decreased linearly ($P < 0.03$) with successively earlier weaning dates. Consequently, calf BW at shipping tended to decrease linearly ($P = 0.06$) with successively earlier weaning dates. Incidence of undifferentiated fever was similar ($P = 0.18$) between treatments prior to shipping. Intake of DM during the first 30 d following shipping increased linearly ($P = 0.02$) as the length of the ranch-of-origin weaning period increased; however, ADG, G:F, and incidence of undifferentiated fever were similar ($P > 0.12$) between treatments. Body condition score of cows was similar ($P = 0.94$) at the outset of the trial and increased linearly ($P = 0.03$) during the trial with successively earlier weaning dates. Under the conditions of our study, ranch-of-origin weaning periods of between

15 and 60 d did not improve calf health or growth performance relative to shipping calves immediately after maternal separation.

Key Words: Preconditioning, Weaning, Beef calves

239 Supplemental trace minerals (Zn, Cu, Mn, and Co) as Availa®4 or inorganic sources for shipping-stressed cattle. M. Pass[1], J. C. Moore*[1], E. B. Kegley[1], and C. K. Larson[2], [1]*University of Arkansas, Fayetteville,* [2]*Zinpro Corp., Eden Prairie, MN.*

Male beef calves (n = 288; 77 steers and 211 bulls) averaging 239 kg were obtained from salebarns, shipped to the research facility and arrived in 3 sets on Jan 10 (n = 96), Jan 31 (n = 98), and March 8, 2006 (n = 94). Following arrival, calves received viral respiratory and clostridial vaccinations, were dewormed, and bulls were castrated by banding. Within each set, calves were allocated randomly within 4 weight blocks to pen (2 pens/weight block; 11 to 13 calves/pen). Pens within block were randomly assigned to treatment. During the 42-d backgrounding period, calves were housed on 0.41-ha grass paddocks, had ad libitum access to bermudagrass hay, and were fed corn-soybean meal supplements (1.8 kg/d) that served as the carrier for treatments. Treatments consisted of supplemental Zn (360 mg/d), Cu (125 mg/d), Mn (200 mg/d), and Co (12 mg/d) from inorganic (Zn sulfate, Mn sulfate, Cu sulfate, and Co carbonate) or organic (Zn amino acid complex, Mn amino acid complex, Cu amino acid complex, and Co glucoheptonate; Availa-4, Zinpro Corp.) sources. Pen was the experimental unit for growth performance, medication costs, and blood data. Calf was the experimental unit for percent morbidity data. Calves supplemented with organic trace mineral sources had a greater final weight (271 vs. 267 kg for organic and inorganic, respectively; $P = 0.04$) and ADG (0.77 vs. 0.68 kg/d for organic and inorganic, respectively; $P = 0.04$) than calves supplemented with isolevels of trace minerals from inorganic sources. There was no effect ($P = 0.46$) of supplemental trace mineral source on the percentage of calves that had to be treated for bovine respiratory disease (63%). However, there was a tendency (($P = 0.09$) for supplementation with organic trace minerals to reduce the percentage of calves that received a second treatment. Organic trace mineral supplementation of Zn, Cu, Mn, and Co, improved growth performance of calves backgrounded 42 d compared to those fed equivalent levels of inorganic sources.

Key Words: Beef cattle, Trace minerals, Backgrounding cattle

240 Effects of dietary ingredients composition on plasma ghrelin concentrations of beef cattle in negative energy balance. J. S. Jennings*, A. E. Wertz-Lutz, and J. A. Clapper, *South Dakota State University, Brookings.*

Previous research demonstrated that ingredient composition and quantity of DMI did not influence plasma ghrelin concentrations of steers that are in positive energy balance, provided that caloric intake was similar. To determine whether dietary ingredient composition influenced plasma ghrelin, NEFA, and GH concentrations of steers in negative energy balance, five steers (BW 761 ± 15.7 kg) were used in a crossover design. Dietary treatments, 50% hay-50% concentrate (HAY) or 10% hay-90% concentrate (CONC), were offered at an amount that would supply 80% of the steer maintenance requirement. On d 21 following initiation of the dietary treatment, serial blood samples were collected via indwelling jugular catheter at 15-min intervals. Following period 1, steers were weighed, dietary treatments were switched between steer groups, and feed intake amounts were recalculated. Sampling period 2 was initiated as described for period 1. Plasma samples were assayed for ghrelin, NEFA, and GH, and subsequent to analyses, data were pooled by hour for statistical analyses. Hormone data were analyzed statistically as repeated measures in time using the MIXED procedure of SAS. The NEm intake was similar (P=0.68) between treatment groups (8.56 ± 0.46 Mcal/d). However, DMI to achieve a similar caloric intake was higher (P<0.001) for HAY compared with CONC treatment (5.36 vs. 4.30 ± 0.12 kg/d, respectively). Nutrient restriction resulted in a similar BW loss for HAY compared with CONC (-24.6 vs. -22.8 ± 12.1 kg). Plasma ghrelin (113.34 vs. 115.20 ± 3.43 pg/mL), NEFA (147.45 vs. 129.42 ± 8.51 μEq/L), and GH (2.34 vs. 2.38 ± 0.28 ng/mL) concentrations were similar for HAY compared with CONC steers, respectively. These data are consistent with the hypothesis that plasma ghrelin concentrations are similar regardless of ingredient composition for steers consuming a similar amount of energy but in negative energy balance.

Key Words: Ghrelin, Cattle, Negative energy balance

241 Phosphorus concentrations of forage selected by grazing beef cattle. D. Assman*, M. M. Haan, and J. R. Russell, *Iowa State University, Ames.*

Phosphorus (P) is an essential nutrient for beef cattle, but over-supplementation of P may have negative environmental and economic impacts. The P concentration in forage selected by grazing cattle may be sufficient to meet the nutritional requirements without supplementation. This study was conducted to determine the P concentration of forage selected by beef cattle grazing cool-season grass pastures. Fifteen fall-calving Angus cows were managed by either continuous or rotational stocking (5 paddocks) in 12.1-ha smooth bromegrass pastures, replicated twice. In July and August, one ruminally fistulated steer was placed in each pasture for one week. On two consecutive days at the end of each week, fistulated steers were ruminally evacuated, allowed to graze for 2 h, and sampled for forage selected during grazing. While steers were grazing forage, samples were hand-clipped at ground level and from the upper half of the forage sward in pasture areas adjacent to the areas being grazed. Ground-clipped samples represented available forage and forage from the top half of the sward was sorted into live and dead material. A subsample of the ground-clipped forage was placed in the rumen and allowed to soak for 2 h following sampling of selected forage to correct the P concentrations in the selected forage for salivary P absorbed by selected forage. Hand-clipped and selected forage samples were analyzed for P concentration. Phosphorus concentrations in the available forage did not differ by month. However, P concentrations of available forage in continuously stocked pastures (0.22%) tended to be greater than in rotationally stocked pastures (0.20%). In the selected forage, there was no difference in the corrected P concentration between months or treatments. The corrected P concentration of selected forage (0.39%) was almost twice as high as the available forage and was higher than live forage clipped from the top half of the sward (0.29%). Results of this study show that cattle grazing cool-season grass pastures are able to select forage with an adequate P content to meet their P requirement without supplementation.

Key Words: Grazing, Phosphorus, Selected forage

242 Effects of source of energy on performance, ultrasonic, carcass, and economic characteristics of early-weaned heifers. P. S. Bedwell, D. W. Shike*, F. A. Ireland, T. G. Nash, and D. B. Faulkner, *University of Illinois, Urbana*.

Angus x Simmental heifer calves (n=192, BW=253 ± 2 kg) were utilized to evaluate the effects of source of energy on performance, carcass, and economic traits of early-weaned heifers. After weaning (77 d), heifers consumed high concentrate creep to initiate marbling for 146 d before starting the trial. Treatments investigated were: 1) high starch (HS); 2) intermediate starch (IS); 3) low starch (LS); 4) pasture (P). After the 73 d experimental period, P heifers were placed on the IS treatment; HS and LS remained on respective treatments. The finishing period was 103 d for the HS, IS, and LS heifers and 131 d for the P heifers. Ultrasonic measurements were taken at the initiation of trial and after the 73 d growing period. Gain and intake during the growing, finishing, and overall period increased linearly (P<0.01) as level of starch decreased. There was a curvilinear (P<0.01) response for feed efficiency during the growing period (IS most efficient). During the finishing and overall period there was a quadratic (P<0.05) effect for feed efficiency (IS most efficient). The IS heifers gained faster (P<0.01) than P heifers during the growing and overall periods (1.21 kg/d and 0.28 kg/d, respectively). During the finishing period, P heifers gained 0.26 kg/d faster, ate 0.99 kg/d more feed, and were 5% more efficient (P<0.05) than IS heifers. IS heifers had 0.38 cm more back fat, 13.2 cm^2 larger ribeye areas, and 57 units higher marbling scores (P<0.01) than P heifers after the growing period. IS heifers also deposited more (P<0.01) marbling per day than P heifers during the growing, finishing, and overall period (0.52, 0.39, and 0.43 units/d, respectively). At harvest, as starch level increased, hot carcass weight and yield grade linearly decreased and the percentage of carcasses ≤272 kg linearly increased (P<0.05). Total cost, carcass value, and profit increased linearly (P<0.01) as starch level decreased. IS heifers had $32.99 higher (P<0.01) carcass values and were $41.30 more (P<0.01) profitable than P heifers. Low starch diets can be fed during the finishing period in long fed heifers without reducing quality grade.

Key Words: Heifers, Starch, Marbling

243 Effects of distillers dried grains supplementation of smooth bromegrass hay on hay intake and diet digestibility. P. W. Lasley* and J. R. Russell, *Iowa State University, Ames*.

In order to determine the effectiveness of distillers dried grains (DDG) to extend grazing of pastures, it is necessary to understand how this feed affects the intake and digestibility of forages. In fall 2006, a digestion trial was conducted to evaluate the effects of feeding increasing amounts of DDG on DMI and digestibility of smooth bromegrass hay. Three steers (334 kg) were placed in metabolism stalls in an environment controlled room and fed smooth bromegrass hay with DDG at 0, 0.5, 1.0 and 1.5% BW in successive periods. Each period consisted of 10-d adjustment and 5-d collection phases. During the adjustment and collection phases, smooth bromegrass hay was fed at 110 and 100% of ad libitum intake, respectively with water available at all times. During collection, feeds, total feces, and urine were collected and sub-sampled. Three days were provided between each period for rest and acclimation to the new diet. Total DMI were 4.2, 5.3, 5.8, and 7.1 kg/d for steers fed DDG at 0, 0.5, 1.0, and 1.5% BW, respectively (P<0.01). The substitution rate of DDG for smooth bromegrass hay (kg hay/kg DDG) was: $y=-0.0017 + 0.9812x - 0.4582x^2$ ($r^2 = 0.76$), where x was the DDG intake, as a percentage of BW in the diet. Dry matter digestibility of diets in which DDG were fed at 0, 0.5, 1.0, and 1.5% BW were 54.9, 63.6, 65.8, and 67.0 (P<0.01) and were predicted as: $y = 55.2 + 18.86x - 7.43x^2$ ($r^2 = 0.95$) where x was the DDG intake, as a percentage of BW. Total digestible dry matter intake as a percent of BW was 1.7 on average and did not differ between treatments (P=0.26). Increasing DDG intake increased NDF intake as a percent of BW ($y = 0.8501 + 0.0877x$; $r^2 = 0.28$), but did not affect ADF intake as a percent of BW (y = 0.482 â€“ 0.0213x; $r^2 = 0.07$). Supplementation of DDG to steers fed smooth bromegrass hay increased total DM digestibility and DMI of the diet while causing small reductions in hay consumption.

Key Words: Distillers dried grains, Forage, Intake

244 Pasture and natural finishing influences performance, carcass, and economic characteristics of early-weaned steers. D. B. Faulkner*, D. Shike, and F. A. Irealnd, *University of Illinois, Urbana*.

Two hundred eight Angus × Simmental steer calves (BW=114 ± 2.7 kg) were utilized to evaluate the effects of confinement vs. pasture and traditional vs. natural finishing (2 × 2 factorial arrangement of treatments) on performance, carcass, and economic characteristics. The 208 steers were randomly allotted to 16 groups (four replications for each of four treatments). The diets were high corn and were the same for all treatments except the diets for the natural cattle had no Rumensin or Tylan and the 10% hay was removed from the diets for the pasture cattle. Five year average prices and carcass values were used for economic calculations. No interactions (P>.05) were found for most traits. The pasture cattle required 10.5 more days on feed, were 5 kg lighter, ate .32 kg/d less (with no roughage), were more efficient, had $36.5 lower feed costs, had $74 lower total cost, had 4.5 kg lower carcass weights, had .25 cm less backfat, had 28% more yield grade 1 and 2 carcasses, had 61 units less marbling, had 13% less premium carcasses, had 20.5% fewer choice carcasses, had $25.5 less carcass value and returned $49.5 more (P<.05) than confinement steers. Natural cattle required 3.5 more days on feed, were 39 kg lighter, ate .5 kg/d more, were less efficient, had $20.5 higher feed costs, had $21 higher total cost, had 26.5 kg lower carcass weights, had 8.1 sq. cm less rib eye area, had 64 units more marbling, had 20% more premium carcasses, had 24.5% more choice carcasses, had $45.5 less carcass value and returned $88.5 less (P<.05) than traditional steers. Natural cattle can be produced effectively in either confinement or with a pasture finishing system, but they require a substantial premium ($88.5) to justify the costs and returns. This premium would need to increase to $98.5 using current high feed costs.

Key Words: Natural, Finishing, Pasture

245 Supplementing beef cows grazing constalk residue with a distillers grains based cube during late gestation. Z. C. Hall*, R. J. Rasby, L. M. Kovarik, and D. A. McGee, *University of Nebraska, Lincoln*.

The effects of undegradable intake protein (UIP) supplementation were evaluated using multiparous Simmental × Angus × MARC II (1/4 each Hereford, Angus, Simmental, and Gelbvieh) composite spring-calving beef cows. In each of three yrs, cows were blocked by age, body condition score (BCS), body wt (BW), and calving date and assigned randomly to one of two trts: 1) supplemented (SUPP; n = 247) with protein while grazing cornstalk residue in the last trimester of pregnancy, or 2) not supplemented (CON; n = 247) with protein while grazing cornstalk residue. Cornstalk residue was grazed for an average of 89 d. Average

supplement intake was 1.1 kg/d and the average length of the supplementation period was 107 d. SUPP and CON cows were managed together from the onset of calving until cornstalk grazing began. Cow BW was similar at initiation of supplementation (Oct), at the end of cornstalk grazing (Feb), and prior to the breeding season (May). SUPP cows had a greater (P = 0.008) change in BW from Oct to Feb but the change in BW from Feb to May was not different. Cow BCS was similar in Oct, but was greater (P < 0.001) for SUPP cows in Feb and May. Calf birth wt, actual weaning wt (WW), and adjusted WW were unaffected by dam trt. More SUPP (84.5%) compared to CON (76.0%) cows tended (P = 0.06) to resume cyclic activity prior to the breeding season but calving interval and pregnancy rate (SUPP = 94.1%; CON = 94.0%) were similar. Heifers from SUPP and CON dams did not differ in WW but there was a yr effect (P < 0.01) on final wt (pre-breeding), initial BCS, final BCS, and ADG. Heifers from SUPP dams tended (P = 0.08) to reach puberty earlier than heifers from CON dams. In yr 1, AI conception rate was not different between groups but greater for SUPP heifers. In yr 2, AI conception rate was greater for CON heifers. Overall pregnancy rate was not different between trts. DDG supplementation improves cow BCS in the last trimester without influencing calf birth wt or WW.

Key Words: Beef cows, Beef heifers, Protein supplementation

246 Effects of increasing the dietary energy density by replacing grass hay with soybean hulls and dried distillers grains with solubles on nutrient digestibility and rumen function. R. D. Zelinsky*, A. E. Wertz-Lutz, and J. E. Held, *South Dakota State University, Brookings*.

We hypothesize that soybean hulls (SH) and dried distillers grains with solubles (DDGS) can be used to increase dietary energy density compared with traditional grass hay (GH) and soybean meal (SBM) diet without causing adverse effects on nutrient digestibility and rumen function. To test this hypothesis, four ruminally-cannulated wethers were used in a 4x4 Latin square design. Dietary roughage source varied from completely GH to completely SH, and SBM was replaced by DDGS as a protein source. The positive control diet for this experiment was composed of 60% GH and 11.6% SBM (GH-SBM). Treatment diets were 60% GH and 25.4% DDGS (GH-DDGS); 20% GH, 40% SH, 15.3% DDGS (SH40-DDGS); and no GH, 60% SH, 10% DDGS (SH60-DDGS). This trial was divided into 4 periods: 14-d adaptation and 4-d total fecal and urine collection. During the 4-d collection period, feed refusals, fecal, and urine samples were collected and weighed. A 10% aliquot of from each of the 4 sample collection days was composited for fecal, and urine samples. Increasing SH to 40 or 60 percent of the dietary DM when using DDGS as the protein source improved DM digestibility (P≤0.02) and digestible energy content of the diet (P≤0.05). Nitrogen (N) digestibility was decreased (P≤0.02) by replacing hay with SH. Decreased N digestibility along with elevated rumen ammonia concentrations (P≤0.01) for SH-based diets, indicate a mis-match of dietary protein source and site of digestion. These data indicate that DDGS and SH can be used to increase the digestible energy content and DM digestibility of lamb diets; however N-digestibility may be compromised. Replacing GH with SH resulted in a lower rumen pH (P≤0.01) post-feeding. These data are consistent with the hypothesis that SH and DDGS can be used to increase dietary energy density compared with traditional GH and SBM diet without causing adverse effects on nutrient digestibility and rumen function of wethers.

Key Words: Lamb, Nutrient digestibility

247 Replacing grass hay with soybean hulls and dried distillers grains with solubles alters ewe milk composition and lamb performance. R. D. Zelinsky*, A. E. Wertz-Lutz, and J. E. Held, *South Dakota State University, Brookings*.

The objective of this experiment was to determine the effects of increasing the energy density of a lactating ewe diet by replacing grass hay (GH) with soybean hulls (SH) and replacing soybean meal (SBM) with dried distillers grains with solubles (DDGS). Ewe BW, body condition score (BCS), milk production and composition, and lamb growth performance were monitored. Sixteen 2-year-old Polypay-sired ewes were selected based on a common lambing date. Diets were formulated to have a similar amount of roughage; however roughage source was varying amounts of GH or SH. The positive control diet for this experiment was composed of 60% GH and SBM as a protein source (GH-SBM). Treatment diets were 60% GH and 25.4% DDGS (GH-DDGS); 20% GH, 40% SH, 15.3% DDGS (SH40-DDGS); and no GH, 60% SH, 10% DDGS (SH60-DDGS). Diets were offered at 3.5% of the ewe′s BW. Dietary treatment resulted in similar change BW and BCS during lactation. Substituting GH and SBM with SH and DDGS resulted in increased milk production (P≤0.001) with similar change BCS and BW of the ewe. Although nutritional value of the milk was decreased as indicated by decreasing milk protein (P≤0.001), total milk solids (P≤0.001) and milk fat percentage (P≤0.001), the additional quantity of milk produced was sufficient to overcome differences in nutrient composition, as lambs gained (P≤0.01) better as GH and SBM were replaced with SH and DDGS. Lactating ewe diets composed of SH and DDGS are a comparable substitute for a GH-SBM diet when evaluating ewe BW, BCS, milk production, and lamb growth during lactation. However, nutrient composition of milk is altered when GH and SBM are replaced with SH and DDGS.

Key Words: Lactating ewe, Soybean hulls, Dried distillers grains with solubles

248 Effects of rumen-protected Ca salts of conjugated linoleic acid (CLA) and previous rate of gain on fatty acid composition. J. W. S. Yancey*, H. Flórez-Díaz, E. B. Kegley, and J. K. Apple, *University of Arkansas, Fayetteville*.

Crossbred steers (n = 35; initial BW = 402 kg) were utilized to determine the effects of previous rate of gain and rumen-protected Ca salts of CLA on fatty acid composition of s.c fat and LM. Growing diets were formulated for a low (LRG; 0.68 kg/d) or a high rate of gain (HRG; 1.36 kg/d) and contained either 4% Ca salts of palm oil or 4% Ca salts of CLA. After 56 d, cattle were transferred to finishing diets with a consistent goal for rate of gain, but remained on their treatment fat sources throughout the finishing period (56 to 113 d). Samples were removed 7 d postmortem from the s.c. fat and LM, and fatty acid composition was determined using transesterification and analysis on the gas chromatograph. The CLA treatment increased the concentration of CLA in both the s.c. fat and LM. In the s.c. fat, the HRG diet increased ($P < 0.03$) CLAc9,t11 and total n-3 fatty acids. Feeding CLA salts resulted in a greater ($P < 0.02$) percentage of C14:0, and lower ($P < 0.03$) percentages of C18:1c9, total MUFA, and C18:2 acids; however, had no effect ($P > 0.05$) on the percentages of C16:0, C18:0, total SFA, C18:3n3, total PUFA, or n-6:n-3 in the s.c. fat. In the LM, the HRG diet increased proportions of C14:0, C20:0, C14:1, and CLA c9, t11; whereas, it decreased ($P < 0.05$) concentrations of C18:2, C18:3, C20:4, total PUFA, and n-6:n-3. CLA-fed cattle had greater ($P < 0.05$) LM percentages of C16:1t, C18:1t,

and total n-3 fatty acids; whereas CLA-feeding decreased ($P < 0.05$) C14:1, C16:1, C18:1c9, C20:3n6, and n-6:n-3. Feeding CLA salts did not affect ($P > 0.05$) the LM concentrations of C16:0, C18:0, total SFA, total MUFA, C18:2, or total PUFA. In conclusion, previous rate of gain did not have a large effect on the fatty acid composition of s.c. fat, but cattle fed to achieve a higher rate of gain had lower concentrations of unsaturated fatty acids in the LM. The inclusion of CLA salts was effective at increasing CLA in the s.c. fat and LM, but decreased MUFA in the s.c. fat and increased trans fatty acid concentrations in the LM.

Key Words: Beef, Conjugated linoleic acid, Fatty acid composition

249 Effects of rumen-protected Ca salts of conjugated linoleic acid (CLA) and previous rate of gain on visual display, and sensory characteristics of beef steaks. J. W. S. Yancey*, H. Flórez-Díaz, E. B. Kegley, and J. K. Apple, *University of Arkansas, Fayetteville.*

Thirty five crossbred beef steers (initial BW = 402 kg) were fed growing diets formulated for a high (HRG; 1.36 kg/d) or a low (LRG; 0.68 kg/d) rate of gain and supplemented with either 4% Ca salts of palm oil or Ca salts of CLA. After 56 d, steers were transferred to finishing diets formulated for similar rates of gain, but remained on their fat source treatments. Cattle were fed to an average slaughter weight of 564 kg (56 to 113 d on finishing diets), and rib sections were collected at 3 d postmortem. After 7 d of aging, 2.54-cm thick steaks were cut and placed in simulated retail display for instrumental measurements, trained visual panel, and oxidative rancidity (TBARS). Steaks to be used for Warner-Bratzler shear force (WBSF) and trained taste panels were aged to 14 d and cooked to 71° C. Overall color score and worst point color decreased over the 7 d of display, but were not affected ($P > 0.05$) by previous rate of gain or CLA feeding. Steaks from steers fed CLA were less ($P < 0.05$) discolored after 7 d of display (CLA × display day interaction, $P = 0.02$). For cattle on the HRG diet, those fed CLA had darker ($P < 0.05$) steaks; however, for cattle on the LRG diet, feeding CLA resulted in lighter ($P < 0.05$) steaks (rate of gain × CLA interaction, $P < 0.001$). Rate of gain had no effect ($P > 0.05$) on TBARS; yet, steaks from cattle fed CLA had lower ($P < 0.05$) TBARS after 7 d of display even though steaks from cattle fed different fats were similar ($P > 0.05$) at d 0 (CLA × display day interaction, $P = 0.02$). Although the HRG and CLA diets increased ($P < 0.05$) cooking losses, neither factor affected ($P > 0.05$) WBSF or trained taste panel measurements. Rate of gain during the growing phase did not have an adverse effect on visual display or sensory characteristics. Although feeding CLA resulted in greater cooking loss, discoloration and oxidative rancidity development during display were improved without detrimental effects on sensory characteristics.

Key Words: Beef, Conjugated linoleic acid, Sensory

250 Effect of dietary cation-anion difference on intake and urinary pH in high concentrate diets. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, and N. F. Meyer, *University of Nebraska, Lincoln.*

Fifteen wether lambs (33.5 ± 3.0 kg) were used in five 3×3 latin squares and eight Holstein steers (312 ± 24 kg) were used in two 4×4 latin squares to determine the influence of dietary cation-anion difference (DCAD) on urinary and fecal pH, and DMI in high concentrate diets. Urine samples were collected three times daily for 3 d in both experiments. Lambs were fed a basal concentrate diet (DCAD=8 mEq) with levels of DCAD adjusted using ammonium chloride, ammonium sulfate, calcium chloride, sodium bicarbonate, and potassium carbonate to DCAD levels of 40, 32, 24, 16, 0, -8, -16, -24, and -45 mEq with the basal diet included in every square. Urinary pH decreased for lambs ($P = 0.03$) from 7.36 to 7.18 throughout the 12 h sampling day. Urinary pH increased linearly with DCAD level ($P < 0.01$) in all squares for the lambs. Combined DMI from all lamb squares increased linearly ($P = 0.02$) from 1.04 kg to 1.54 kg with DCAD level for lambs. Basal diets in the two squares for steers were either a concentrate diet (DCAD = 8 mEq) or a diet with 20% (DM basis) wet distillers grains (WDG; DCAD= -2 mEq). Calcium chloride and sodium bicarbonate were used to adjust DCAD for steers to -12, -22, -32 mEq in the WDG square, and -2, -12, -22 mEq in the concentrate square. Urinary pH decreased ($P < 0.01$) for steers throughout the 12 h sampling day from 6.45 to 6.24. Urinary pH increased linearly ($P < 0.01$) with DCAD level for the steers in both squares. Dry matter intake decreased linearly with DCAD level ($P = 0.01$) for the concentrate steers but was not different ($P = 0.54$) in the WDG square. Fecal pH was not different ($P = 0.15$) among DCAD levels in the steer experiments. Lowering DCAD in high concentrate diets with or without WDGS decreased urinary pH which may reduce ammonia losses from steers or lambs fed negative DCAD diets if manure pH is decreased.

Key Words: Ruminants, Acid base equilibrium, pH

251 The effect of mineral supplement delivery system on behavior of beef cows grazing topographically rugged native range. N. A. Sproul*, K. C. Olson, J. S. Drouillard, J. R. Jaeger, J. W. Bolte, D. R. Linden, R. A. Kreikemeier, L. A. Pacheco, M. D. Thomas, and J. J. Higgins, *Kansas State University, Manhattan.*

The objective was to determine the effect of mineral supplement delivery system on behavior and forage use by grazing cows. The study was conducted on 4 pastures (122 ha) from February to May. Each pasture was grazed by 60 mature beef cows (BW = 562 ± 38 kg) during the experiment. Treatments were mineral delivered in dry granular form (DRY) or mineral delivered in a low-protein, cooked molasses-based block (BLOCK); both were fed to cattle ad libitum. DRY was supplied to cattle via 1 covered mineral feeder. BLOCK was supplied via 4 open-topped barrels spaced within 3 m of one another. Both DRY and BLOCK were deployed in each pasture; pasture was considered the experimental unit. No additional NaCl was supplied to cattle. Forage utilization in the vicinity of each supplement and the frequency and duration of herd visits to the vicinity of each supplement were measured during 4 14-d periods. Supplements were moved to new locations for each period. BLOCK consumption was greater ($P < 0.01$) than DRY over the course of the trial (0.19 vs. 0.06 kg / cow / d, respectively). Increased consumption of BLOCK translated to greater frequency of herd visits compared to DRY (2.82 vs. 2.47 herd visits / d; $P < 0.02$) and longer herd visits compared to DRY (125.7 vs. 54.9 min / herd visit; $P < 0.01$). Herds tended ($P = 0.16$) to spend more time in the vicinity of BLOCK at night (1800 to 0600) compared to DRY, whereas herd visits to DRY tended ($P < 0.15$) to occur more often during the day. The duration of herd visits to both supplements decreased in cubic fashion as the trial advanced ($P < 0.01$). Standing forage biomass around supplement deployment sites was similar for BLOCK and DRY ($P = 0.54$); measurement of forage utilization was complicated by rapidly growing range forage during the latter half

of the trial. We interpret these data to suggest that BLOCK influences the behavior of grazing cattle more strongly than DRY.

Key Words: Beef cattle, Grazing behavior, Native range

252 Effects of WDGS or DDGS inclusion in medium concentrate receiving diets fed to beef calves on intake, average daily gain, and gain efficiency. B. W. Neville*[1], M. L. Bauer[1], K. Karges[2], M. Gibson[2], and G. P. Lardy[1], [1]*North Dakota State University, Fargo,* [2]*Poet Nutrition, Sioux Falls, SD.*

The effect of form (wet, WDGS; dry, DDGS) and level (0, 20 or 40%; DM basis) of corn distillers grains with solubles inclusion on DMI, ADG, and G:F of newly received calves fed medium concentrate diets was determined using 50 (47 steer and 3 bull) male calves and 50 heifer calves which were blocked by initial weight and sex, and assigned randomly to one of five treatments (4 pens per treatment). Dietary treatments were fed for 28 d and the control diet (**CON**) contained 47% hay, 43% ground corn, 5% concentrated separator byproduct, and 5% supplement (DM basis) while WDGS and DDGS replaced corn and soybean meal to form the remaining treatments; (**D20**) 20% DDGS, (**D40**) 40% DDGS, (**W20**) 20% WDGS, and (**W40**) 40%WDGS. Diets were formulated to contain a minimum of 13% CP, 0.6% Ca, and 0.3% P; or a Ca:P of 1.5:1 when P was in excess. Calves were weighed for 3 consecutive d at the beginning and end of this study. A mixed model was used to analyze data and included fixed effects of treatment, sex, and an interaction of treatment and sex; the random effect was weight block. Contrasts were analyzed for form and level of distillers grains, as well as a form by level interaction. No main effect interactions for DMI, ADG, or G:F were detected ($P \geq 0.26$). Dry matter intake decreased linearly ($P = 0.01$) and quadratically ($P = 0.06$) with increasing level of DDGS and WDGS, respectively. Dry matter intake for CON, D20, D40, W20, and W40 fed calves were 7.86, 7.41, 7.25, 7.77, and 6.95 ± 0.53 kg^{-1}d, respectively. There was no effect ($P = 0.13$) of treatment on ADG. Increasing level of DDGS or WDGS improved ($P = 0.07$ and $P = 0.01$) G:F over CON fed claves. Gain:feed values were (202, 233, 227, 237, and 240 ± 14 g Gain/kg Feed) for CON, D20, D40, W20, and W40, respectively. Feeding increased levels of corn distillers grains in medium concentrate receiving diets improved G:F, did not affect ADG, and decreased DMI when compared to control fed calves.

Key Words: Beef calves, Distillers grains, Medium concentrate diets

253 Effects of prepartum whole cottonseed or whole raw soybean supplementation on response to estrus synchronization and timed AI by suckled mature beef cows. M. D. Thomas*, K. C. Olson, J. S. Stevenson, J. R. Jaeger, J. W. Bolte, N. A. Sproul, and D. R. Linden, *Kansas State University, Manhattan.*

Prepartum fat supplementation has been associated with improved reproductive performance by cows managed for AI breeding. Our objective was to evaluate the effects of supplementing whole fuzzy cottonseed or whole raw soybeans on response to estrus synchronization and timed AI by mature beef cows. Cows (n = 188; average initial BW = 579 ± 54 kg) were stratified by body condition score (BCS) and BW and assigned randomly to 1 of 3 supplementation treatments: whole raw soybeans (SOY), whole fuzzy cottonseed (CTN), or a mixture of 50% ground corn and 50% soybean meal (CON). Supplements were hand fed at 1.8 kg per animal daily for 45 d prior to the first projected calving date (April 1). Supplementation was continued until each cow calved; thereafter, all cows received CON until May 1. Cows were synchronized with the CoSynch + CIDR method and bred via AI on June 21. Ten d after AI, cows were exposed for natural service breeding for 50 d. Conception to AI and overall pregnancy were assessed 33 d and 66 d, respectively, after AI. Body weight and BCS of cows fed CON or oilseed supplements was similar ($P > 0.5$) at calving; however, CTN lost more BW and more BCS from the beginning of the trial to calving ($P < 0.03$) than SOY. Proportion of cycling cows, ascertained 21 and 10 d prior to AI, was similar ($P = 0.85$) between treatments. Conversely, supplementation with CTN was associated with increased AI conception compared to SOY ($P = 0.05$) but not compared to CON ($P = 0.58$; 49, 39, and 54% for CON, SOY, and CTN, respectively). Final pregnancy rates were similar ($P=0.74$) between treatments; moreover, there were no treatment differences ($P > 0.28$) in cow BW or BCS by the end of the natural-service breeding season. Calf birth weights and weaning weights were also similar ($P > 0.37$) between treatments. The effects of CTN and SOY supplementation on response to estrus synchronization and timed AI by beef cows warrant further study.

Key Words: Timed AI, Beef cows, Oilseed supplementation

254 Effect of Optaflexx inclusion on feedlot performance and carcass characteristics of yearling steers. C. R. Dahlen*[1], G. I. Crawford[2], and A. DiCostanzo[3], [1]*Northwest Research and Outreach Center, University of Minnesota, Crookston,* [2]*Extension Regional Center, Hutchinson, MN,* [3]*University of Minnesota, St. Paul.*

One-hundred sixty crossbred yearling steers (Initial BW = 413 ± 35 kg) were used to determine the effect of feeding Ractopamine Hydrochloride (Optaflexx) at the end of the feeding period to cattle of varying feedlot entrance weights. Steers were grouped into four blocks by weight and randomly assigned within block to one of four pens (4 pens/block, 16 pens total, 10 steers/pen). Pens were randomly assigned to one of two treatments; 1) no Optaflexx supplementation (CON); or 2) Optaflexx supplemented at 200 mg/steer daily (OPTA). All steers received an implant containing 100 mg trenbolone acetate and 14 mg estradiol benzoate on the first day of the feeding period. Treatments were applied during the final 28 d for blocks 1 and 2 and during the final 37 d for blocks 3 and 4, respectively. Total days on feed were 69 and 96 for blocks 1 and 2 and blocks 3 and 4, respectively. Diets (1.39 Mcal NEg/kg DM, 12.5% CP, 0.7% Ca, and 0.35% P) were delivered once daily and consisted of 58% high-moisture corn, 19% dry-rolled corn, 19% corn silage, and 4% supplement containing monensin sodium. Overall DMI ($P = 0.70$) and ADG ($P = 0.13$) did not differ between treatments; however, overall gain:feed was greater ($P = 0.02$) with OPTA than CON, measuring 0.165 and 0.157, respectively. During the Optaflexx feeding period, DMI did not differ ($P = 0.56$) between treatments. Average daily gain ($P < 0.01$) and gain:feed ($P < 0.01$) were both greater with OPTA than CON during the Optaflexx feeding period, with improvements of 22.7% and 25.9% in ADG and gain:feed, respectively. Carcass-adjusted final BW averaged 547 and 553 kg for CON and OPTA, respectively, and did not differ ($P = 0.13$). No treatment differences ($P \geq 0.13$) were observed for marbling score, 12th rib backfat, LM area, or yield grade. Results of this experiment indicate that Optaflexx can be effectively utilized in a feedlot situation with cattle of varying weights and marketing dates.

Key Words: Feed efficiency, Feedlot cattle, Optaflexx

255 Effect of water consumption on rumen temperature. T. K. Dye and C. J. Richards*, *Oklahoma State University, Stillwater*.

This experiment evaluated the ability of remote, continuous rumen temperature measurements to determine quantity of water consumed by calves. Four Angus crossbred steers (BW=511 ± 33 kg) were housed in individual stalls with individual watering units. Rumen temperature boluses programmed to transmit temperature once per minute were administered (SmartStock, LLC) to monitor rumen temperature. A water flow meter (Blue-White Industries, Ltd.) was connected to each watering unit to determine water flow and temperature during a drinking event. Flow of water meters was calibrated prior to data collection and verified after the experiment. Data was collected continuously for 72 h. Mean, minimum and maximum rumen temperature was 38.5°C, 31.0°C and 39.5°C, respectively. Mean, minimum and maximum water volume consumption (n=82) resulting in a rumen temperature change was 2.85 L, 0.83 L and 14.2 L, respectively. Rumen temperature decrease caused by a water event averaged 1.9°C with a minimum of 0.5°C and a maximum of 7.5°C. Not all drinking events led to a decrease in normal rumen temperature. Mean, minimum and maximum water volume consumed not resulting in a rumen temperature change was 0.25 L, 0.01 L and 1.02 L, respectively. Length of a rumen water event was determined to be the duration at which rumen temperature was below the individual animal's normal rumen temperature. An average rumen water event was 56.7 minutes long and the average time below 37.8°C was 11.4 minutes. Time below 37.8°C had the best individual positive correlation to water volume consumed with a R^2=0.70 (P<0.01). Length of water event x rumen temperature change had a positive correlation to water volume consumed with a R^2=0.77 (P<0.01). Determining length of a water event per unit of body weight resulted in a R^2=0.50 (P<0.01). Volume of water consumed x water temperature (16.2°C to 23.0°C) was highly correlated to rumen temperature change (R^2=0.74; P<0.01). Remote monitored rumen temperature boluses can detect a decrease in rumen temperature caused by consumption of water. However, a water event of less than 1.0 L may not be detected by changes in rumen temperature.

Key Words: Water intake, Rumen temperature, Cattle

256 Effects of advancing gestation and lactation on dry matter intake by primiparous beef heifers fed warm-season grass hay. D. R. Linden*, K. C. Olson, D. E. Anderson, J. R. Jaeger, L. A. Pacheco, K. E. Holcomb, J. W. Bolte, N. A. Sproul, and M. D. Thomas, *Kansas State University, Manhattan*.

Forage DMI by mature cows typically decreases during the final 4 to 8 wk of gestation and then increases dramatically during the first 4 to 8 wk of lactation. Little research has focused on forage intake patterns by primiparous heifers during late gestation and early lactation. The objective of our study was to measure the effects of advancing gestation and lactation on DMI by primiparous heifers. Angus × heifers (n = 11; average initial BW = 525 ± 53 kg) were individually fed chopped (approximate particle size = 10 cm) warm-season grass hay for 137 d (i.e., d 68 prepartum to d 68 postpartum). Heifers were housed indoors in individual tie-stalls (1.9 × 0.9 m) in an environmentally controlled barn throughout the study period. Treatments were based on pregnancy status: 6 heifers were pregnant or lactating and 5 heifers were non-pregnant and non-lactating. The average calving date was d 69 of the study. Hay was fed to heifers ad libitum; hay offered and hay refused were recorded daily. Hay DMI by both treatment groups increased (P < 0.01) during the course of the study; however, pregnant and lactating heifers had lesser DMI (P < 0.01) than non-pregnant, non lactating heifers. Pregnant and lactating beef heifers had lesser DMI than non-pregnant, non-lactating beef heifers for the duration of our experiment. These data were interpreted to suggest that the dramatic increase in DMI characteristic of beef cows in early lactation may be absent in beef heifers.

Key Words: Beef heifers, Intake, Lactation

257 Distillers grains in flaked corn diets. L. E. Sims*[1], R. B. Hicks[1], D. L. OverOverbeke[1], P. K. Camfield[2], J. J. Martin[2], T. K. Dye[1], B. P. Holland[1], C. L. Maxwell[1], C. R. Krehbiel[1], and C. J. Richards[1], [1]*Oklahoma State University, Stillwater,* [2]*Oklahoma Panhandle State Universiy, Goodwell*.

One hundred and eighty mixed steer calves (408 ± 28 kg) were blocked by weight (six blocks) and randomly allotted into six head pens to evaluate inclusion of distillers grains in flaked corn finishing diets. Treatments were: 1) steam flaked corn control finishing diet, or inclusion of 2) 10% dry distillers grains, 3) 10% wet distillers grains, 4) 20% wet distillers grains, or 5) 30% wet distillers grains. All diets contained 8.0% chopped alfalfa and inclusions replaced flaked corn. All diets were balanced to contain a minimum of 13% crude protein and meet 105% of the estimated degradable intake protein requirement. Cattle averaged 123 days on feed with a range of 101 to 143. There was no difference (P>0.11) in final body weight, average daily gain, or dry matter intake which averaged 620.6 kg, 1.74 kg/d, and 10.46 kg, respectively. There was no difference (P>0.12) in carcass weight, dressing percentage, fat thickness, kidney pelvic heart fat, rib eye area, or yield grade which averaged 403 kg, 64.96%, 1.32 cm, 2.36%, 90.64 sq cm, and 3.15, respectively. Feed efficiency calculated with final live weights shrunk 4% resulted in a treatment tendency (P=0.07) with a linear decrease (P=0.04) as level of wet distillers grains increased. Feed efficiency calculated with carcass adjusted final weights resulted in no treatment affect (P=0.29) with an average of 0.166 kg of gain per kg of dry matter intake. Marbling score resulted in a treatment difference (P=0.03) where the contrast of control diet (384) vs inclusion of 10% dry distillers grains (416) was significant (P<0.02). For marbling score, contrast of inclusion of 10% dry vs 10% wet distillers grains, linear wet distillers grains level and quadratic wet distillers grains level were not significant (P>0.23). The average marbling score was 392. This experiment indicates that inclusion of up to 10% dry or 30% wet distillers grains into steam flaked corn finishing diets did not result in any consistently detectable influence on animal performance or carcass characteristics.

Key Words: Feedlot cattle, Distillers grains, Flaked corn

258 Rumen temperature monitoring for determination of health. L. E. Sims*, T. K. Dye, B. P. Holland, L. O. Burciaga-Robles, D. L. Step, R. W. Fulton, C. R. Krehbiel, and C. J. Richards, *Oklahoma State University, Stillwater*.

Three hundred and fifty heifer calves were purchased and comingled in western Kentucky, and then delivered to the Oklahoma State University Willard Sparks Beef Research Center. Prior to being delivered, calves were dosed with a remote monitoring rumen temperature bolus (SmartStock, LLC). Rumen temperatures were monitored for the first 21 days after arrival. Calves were then classified into one of four categories

based on their health history. The categories were: 1) never pulled or treated (NP; n=52), 2) pulled, but not treated (PNT; n=18), 3) pulled and treated (PT; n=222), or 4) never pulled, but had a sustained high rumen temperature (RT; n=58). Calves were also categorized by the number of times treated with one hundred and eleven calves treated only once, 44 calves treated twice, and 81 calves treated 3 or more times. Calves were evaluated each morning by two trained individuals to assess calves for signs of respiratory and other diseases. Each calf was given a visual severity score of: 0) normal, 1) mild, 2) moderate, 3) severe, or 4) morbid based on clinical signs. Any animal scored 1 or higher was transferred to the processing facility (pulled) for further examination. At the processing facility, if the rectal temperature was greater than 40°C, the calf was treated according to a predetermined antimicrobial regimen. Calves that had rumen temperatures of greater than 40°C for two hours were determined to have a sustained high rumen temperature. Both average and maximum rumen temperatures increased ($P<0.05$) from NP to PNT to PT categories, but were not different ($P>0.05$) between PT and RT. Calves treated only once had lower ($P<0.05$) average rumen temperatures than calves treated more times, but there was no difference ($P>0.05$) in maximum rumen temperature. Evaluation of data by time of day (6 to 10 am, 10 am to 2 pm, and 2 to 6 pm) indicated that average and maximum rumen temperatures were the highest from 2 to 6 pm. This data suggests that rumen temperature boluses may be an effective diagnostic tool for calf health detection.

Key Words: Beef cattle, Health, Temperature

259 Effects of dietary fat and crude protein on feedlot performance and carcass characteristics in steers fed differing levels of distiller's dried grains with solubles. P. Gunn*, S. Lake, M. Claeys, and R. Lemenager, *Purdue University, West Lafayette, IN*.

The objective of this study was to evaluate the influence of dietary protein and fat in distillers dried grains with solubles (DDGS) based diets on feedlot performance and carcass characteristics in finishing steers. One hundred five Angus-cross steers (443 ± 31 kg initial BW) were blocked by weight and assigned randomly to one of five dietary treatments (7 steers/pen; 3 pens/treatment): 1) a corn based diet with DDGS included to meet CP requirements (25% of DM; CON), 2) CON with DDGS included at twice the amount of CON (50% of DM; 50DDGS), 3) CON with added protein to equal the CP in the 50DDGS diet (CON+CP), 4) CON with added vegetable oil to equal the fat in the 50DDGS diet (CON+VO), and 5) CON with protein and fat added to equal the CP and fat in the 50DDGS diet (CON+CPVO). Steers were weighed at 28-d intervals and fed to a common 12th rib fat depth endpoint (1.3 ± 0.2 cm; 68 to 125-d on trial). Following a 24-h chill, carcass measurements and marbling data were collected. Orthogonal contrasts were preplanned between CON vs. elevated CP diets and CON vs. elevated fat diets. There were no differences among treatments for days on feed ($P = 0.71$) or DMI ($P = 0.39$). Final BW was greater ($P = 0.04$) for CON vs. elevated CP diets, whereas both elevated CP and elevated fat diets had a decreased ADG ($P < 0.03$) compared with CON. There was a tendency for decreased G:F ($P = 0.11$) in elevated CP diets vs. CON. Dressing percent ($P = 0.77$), HCW ($P = 0.08$), 12th rib fat depth ($P =0.12$), LM area ($P = 0.99$), KPH ($P = 0.86$) and yield grade ($P = 0.20$) were not affected by treatment. Elevated CP and elevated fat diets had decreased marbling scores ($P = 0.03$) and quality grades ($P = 0.02$) compared with CON. These data imply that decreased performance and poorer carcass quality associated with increased levels of DDGS in the diet may be attributed to an additive effect of elevated levels of CP and fat found in DDGS.

Key Words: Distiller's grain, Marbling, Performance

260 Increasing range capacity with the use of wet distillers grains. B. L. Nuttelman*, T. J. Klopfenstein, W. H. Schacht, L. A. Stalker, J. A. Musgrave, and J. D. Volesky, *University of Nebraksa, Lincoln*.

A 56-d grazing study was conducted to quantify the effect of supplementing cows with wet distillers grains mixed with grass hay during the summer grazing season on 1) grazed forage intake and 2) cow and calf performance. The study was conducted at the University of Nebraska Gudmundsen Sandhills Laboratory from June to August 2007. Cows and calves were supplemented 55% wet distillers grains plus solubles and 45% grass hay that was mixed and stored for forty-five days (MIX). Twenty-four three year old lactating, non-gestating cows were randomly assigned to one of three treatments: 1) grazing upland range at the recommended stocking rate of 1.48 AUM/ha with no supplementation (CON), 2) grazing upland range at double the recommended stocking rate (2.96 AUM/ha) and supplemented 6.64 kg/hd daily of MIX to replace 50% of daily intake (SUPP), and 3) grazing upland range at double the recommended stocking rate (2.96 AUM/ha) with no supplementation (2X). Cattle were rotated through seven paddocks. Forage utilization was determined by clipping twenty, 1-m2 quadrats pre- and post-grazing. Forage IVOMD, CP, and NDF were determined from masticate diet samples collected at grazing period mid-point using esophageally fistulated cows. There was no difference in cow ADG between CON and 2X ($P = 0.29$) (–0.45 and –0.52 kg/d); however, SUPP had higher ADG (0.25 kg/d; $P < 0.01$) than non-supplemented groups. Supplemented calves had higher ADG (1.07 kg/d; $P < 0.01$) than CON or 2X; CON tended to gain more than 2X calves (0.82 vs. 0.75 kg/d; $P = 0.07$). Forage utilization (% standing green) was 18.3% less for CON than for SUPP ($P < 0.01$) and 24.0% less for CON than 2X ($P < 0.01$). The IVOMD was 57.26%, 52.47%, and 50.54% for CON, SUPP, and 2X, respectively. Supplemented cows and calves grazing Sandhills rangeland during the summer gained more weight than the non-supplemented cattle; however, MIX did not replace grazed forage such that range conditions can be positively maintained at double stocking rate.

Key Words: Grazing, Stocking rate, Wet distillers grains

261 Feeding wet distillers grains and wheat straw to growing calves. B. L. Nuttelman*, T. J. Klopfenstein, G. E. Erickson, and M. K. Luebbe, *University of Nebraksa, Lincoln*.

Two growing experiments were conducted to study feeding wet distillers grains (WDGS) after being mixed and stored with wheat straw. In exp. 1, 93 crossbred steer calves (268 ±14 kg) were individually fed to evaluate performance between different types of distillers grains. Treatments included dried distillers grains (DDGS), wet distillers grains (WDGS), and 67% WDGS and 33% ground wheat straw mixed and stored in silo bags for 30 d prior to initiation of the trial (MIX). Within treatments, steers were supplemented one of four levels of byproduct: 0.00, 0.91, 1.82, or 2.70 kg of distillers grains/hd daily. The base diet consisted of 60% sorghum silage and 40% alfalfa hay with supplement top-dressed. Gain increased linearly with increasing level of byproduct supplementa-

tion (0.69 to 1.19 kg/hd daily; P < 0.01). Steers supplemented MIX had lower DMI compared to DDGS and WDGS (P = 0.05) because of the straw; however, G:F was not reduced (P = 0.32). In exp. 2, 96 steers (286 ± 18 kg) were used to determine palatability of WDGS mixed with wheat straw. Steers were fed either 50% WDGS and 50% wheat straw mix, or 60% WDGS and 40% wheat straw mix. A base diet containing 60% sorghum silage and 40% alfalfa hay was also fed either simultaneously or a minimum of four hours post feeding the assigned level of WDGS and wheat straw mix. Calves fed base diet late were offered the mix at an estimated 50% of DMI. Calves fed diets simultaneously were allowed ad libitum access to base diet and WDGS and wheat straw mix. There were no WDGS level by time of feeding interactions. Calves fed 60% WDGS had higher ADG compared to calves fed 50% WDGS (0.99 vs. 0.90 kg/d; P<0.01). Time of feeding had no effect on percent of forage consumed (P = 0.38), however the lower level of WDGS tended to increase forage intake (P = 0.15). Data from both trials suggest that mixes of WDGS and straw from 33% to 67% will store, be palatable, and reduce intake of forage that is equivalent in quality to grazed forage.

Key Words: Growing calves, Supplementation, Wet distillers grains

262 Dried distiller's grains in steam-flaked corn finishing diets with alfalfa hay or corn silage. S. Uwituze*[1], G. L . Parsons[1], M. K. Shelor[1], B. E. Depenbusch[1], K. K. Karges[2], M. L. Gibson[2], and J. S. Drouillard[1], [1]*Kansas State University, Manhattan,* [2]*Poet Nutrition, Sioux Falls,SD.*

A finishing trial was conducted to investigate the use of corn dried distiller's grains with solubles (DGS) in steam-flaked corn (SFC) diets, and to compare corn silage (CS) and alfalfa hay (AH) as roughage sources. The study was conducted as a randomized complete block design with a 2 × 2 factorial arrangement of treatments. Factors consisted of DGS level (0 or 25% on dry matter basis) and roughage source (alfalfa hay or corn silage). AH was included at 6% of diet DM, and CS was included at 10% of diet DM. Crossbred heifers (n=358; BW = 353 ±13 kg) were individually weighed, stratified by weight, and randomly assigned (within strata) to 24 dirt-surfaced pens containing 14 to 15 animals each, with six pens per treatment. Heifers had *ad libitum* access to feed and were fed once daily for 97 d. Partial replacement of SFC with DGS did not affect DMI, ADG, or G:F (P > 0.10). Within roughage source, heifers fed CS had greater DMI than those fed AH (P < 0.05), but ADG and G:F were not affected (P > 0.10). There were no differences among treatments with respect to carcass weight, dressing percentage, or 12th rib fat thickness (P> 0.20). Carcasses from heifers fed CS tended to have greater marbling scores than those fed AH (P = 0.10), but there were no notable differences in quality grade (P > 0.10). There was an interaction between roughage source and DDG level with respect to incidence of liver abscess (P = 0.02). Liver abscess rates were higher for cattle fed 25% DDG compared to those fed 0% DDG when AH was the roughage source, but were higher for cattle fed 0% DDG when CS was the roughage source (interaction effect; P = 0.02). When fed to provide comparable levels of NDF, corn silage and alfalfa hay are comparable as roughage sources for feedlot heifers. Additionally, feeding 0 or 25% DGS in steam-flaked corn finishing diets resulted in similar feedlot performance and carcass characteristics.

Key Words: Steam-flaked corn, Dried distiller's grains, Roughage

263 Nutrient composition and variation among wet and modified distillers grains plus solubles. C.D. Buckner*, S.J. Vanness, G.E. Erickson, T.J. Klopfenstein, and J.R. Benton, *University of Nebraska, Lincoln.*

Average nutrient composition and variation has not been well documented for corn wet and modified distillers grains plus solubles (WDGS and MDGS). Dry matter, crude protein (CP), fat, phosphorus (P), and sulfur (S) were measured on 50 WDGS or MDGS samples per ethanol plant (6 plants in NE) with 10 samples*d^{-1}, 5 consecutive d, and repeated over 4 separate months (periods) throughout the year. Multiple samples were taken from a semi-truck or the area of distillers grains that was loaded onto a truck, mixed, and sub-sampled. Therefore, each sample represented a potential load that a livestock producer would receive. Samples were then shipped frozen and nutrients analyzed in duplicate. Because DM averages varied across ethanol plants, each plant′s average was indexed to 100%. Coefficients of variation (CV) for DM were higher for some plants than others, were consistent across periods, and variation appeared to be less within d than across d. Composition for these samples across the 6 plants averaged 31.0% CP, 11.9% fat, 0.83% P, and 0.77% S. Plant averages for fat within period for these samples ranged from 10.2 to 13.3%, with ranges of 2 to 5 percentage units for plants within period. Period did not seem to have an effect on CV for fat, but CV were not consistent across plants and variation within d was lower than the variation among all samples within a period for fat. The CV for S appeared less within d than across d, differed across plants, and appeared to decrease across periods. The CV for S was mostly 4 to 9% and averaged 7.4%, but the highest CV within a plant within period was 36%. The variation in CP and P were minimal as CV averaged 1.9 and 2.8%, respectively. These values serve as a database for nutrient composition of WDGS and MDGS for livestock producers and what variation they can expect. We recommend testing with the specific ethanol plant providing distillers grains to ensure DM, fat, and S are known by the end-user.

Key Words: Distillers grains, Nutrient composition, Variation

264 Effect of distiller's grains composition on digestibility in growing steers. M. E. Corrigan*, T. J. Klopfenstein, G. E. Erickson, and N. F. Meyer, *Univesity of Nebraska, Lincoln.*

Four steers were used in a three period switchback design to determine effects of dry distiller's grains composition on total tract digestibility of DM, OM, NDF, and ether extract. All steers were fed a basal diet at 95% of ad libitum intake that consisted of 58.8% alfalfa hay, 39.2% brome hay, and 2% vitamin and mineral supplement. Treatments consisted of two types of distiller's grains supplemented at 1% of BW. The first type was distiller's grains without solubles (DDG) and the second type was distiller's grains that consisted of 21.3% solubles (DM basis, DDGS). Percentage of DM, OM, NDF, and ether extract were 96.0, 97.5, 45.8, and 6.6% for DDG, and 92.6, 96.7, 34.0, and 12.3% for DDGS, respectively. The amount of solubles in DDGS was calculated using the ether extract percentages of DDG and a sample of the solubles. It was hypothesized that the higher concentration of ether extract in the DDGS would negatively impact NDF digestibility. Intake and digestibility of DM and OM did not differ between treatments (P ≥ 0.46). Total NDF intake and NDF intake from distiller's grains were greater (3.72 vs. 3.49 kg, P = 0.02 and 1.32 vs. 1.09 kg, P < 0.01, respectively) for steers supplemented with DDG compared to DDGS supplemented steers. Digestibility of NDF was also 3% greater (62.6 vs. 59.6%) for

DDG supplemented steers compared to DDGS supplemented steers, although this difference was not significant (P = 0.14). Steers supplemented with DDG had less total ether extract intake (0.27 vs. 0.44 kg, P < 0.01), ether extract intake from distiller's grains (0.20 vs. 0.37 kg, P < 0.01), and digestibility of ether extract (79.0 vs. 86.3%, P = 0.02) compared to DDGS supplemented steers. Despite differing compositions of the two distiller's grains types used in this trial, the only difference in digestibility observed was for ether extract.

Key Words: Digestibility, Distiller's grains, Growing steers

265 Distillers dried grains supplementation of stockpiled forage for fall-calving cows or calves over winter on performance of cows and calves. P. W. Lasley*, J. R. Russell, D. G. Morrical, D. R. Strohbehn, and J. D. Lawrence, *Iowa State University, Ames*.

In two consecutive years, 4 fall-calving cows with calves were allotted to each of six 4.04-ha pastures containing stockpiled "Fawn" endophyte-free tall fescue to strip-graze (8 paddocks) from mid-November through March. Cows in two of the pastures received distillers dried grains (DDG) only if snow and ice prevented grazing and calves were not supplemented (Minimal treatment). Cows in two of the pastures received equal amounts of DDG as cows in the Minimal treatment and calves were fed a DDG and soy hull-based supplement at an ad libitum level (Creep treatment). Cows in the remaining two pastures were fed DDG to maintain a BCS of 5 and the calves were not supplemented (DDG treatment). Cow and calf BW were measured monthly and cow BCS (9-point scale) measured biweekly over the season. Forage was sampled by hand clipping two 0.25-m^2 squares in each grazed and ungrazed paddock monthly. Over the two grazing seasons, calves in the Creep treatment had greater ADG (1.40 kg/day) than the DDG treatment (1.08 kg/day), which were also greater than calves in the Minimal treatment (0.94 kg/day) treatment (P < 0.01). This difference in ADG resulted in seasonal calf BW gains of 187.7, 145.8, and 126.5 kg for Creep, DDG, and Minimal treatments respectively. Cows in the DDG treatment (–25.4 kg) had less (P<0.02) seasonal BW loss than did the Creep (–58.8 kg) and Minimal treatments (–57.0 kg). Cows in the Minimal treatment tended (P=0.11) to have a greater seasonal BCS change (–1.64) than did Creep (–1.35) or DDG treatment (–1.35) cows. Initial and seasonal changes in forage mass and composition did not differ between supplementation treatments. While supplementation of cows with DDG or calves with a DDG-based creep feed increased calf ADG, supplementation did not significantly affect grazing efficiency (P > 0.10). These results imply that either DDG substitution for forage was not large or any effects of DDG on forage use were masked by weather losses of the forage.

Key Words: Beef cows, Stockpiled forage, Distillers dried grains

266 Effects of distillers dried grains supplementation of fall-calving cows or their calves grazing stockpiled forage over winter on calf performance in a pasture-based finishing program in the subsequent summer. P. W. Lasley*, J. R. Russell, D. G. Morrical, D. R. Strohbehn, and J. D. Lawrence, *Iowa State University, Ames*.

In April 2006, 24 weaned fall calves from cows that grazed stockpiled forage with minimal supplementation of the cows or calves, minimal supplementation of the cows, but supplementation of the calves with a distillers dried grains (DDG) and soy hull-based creep feed, or supplementation of the cows with DDG to maintain a BCS of 5 were moved to a 16.2-ha smooth bromegrass pasture divided into eight 2.02 ha paddocks. Calves were rotationally stocked as one group with daily movement for the first 28 d and moved after a total forage removal of 50% in a first-last grazing system with their dams for an additional 28 d. At this time, steers were separated into the original treatment groups, allotted to six of the 2.02-ha paddocks to graze by continuous stocking, and supplemented with DDG-based supplement at up to 7.3 kg/hd/d. When forage became deficient in December, steers were moved into six pens in a feedlot and fed the DDG-based supplement at 7.3 kg/hd/d and smooth bromegrass hay at an ad libitum level. Steers were harvested when 50% of the steers in each pen were estimated to achieve a choice quality grade with ultrasound. Average daily gains in the pasture were not affected by winter supplementation treatment, but were greater (P < 0.10) in the feedlot for creep-fed calves than for calves from the other winter treatments. There were no differences in the number of days during the pasture or feedlot phases or in the efficiency of DDG utilization between calves from the winter supplementation treatments. Mean carcass weights, fat cover, ribeye area, and marbling score were 356 kg, 0.97 cm, 80.0 cm^2, and Small[20], which did not differ between treatments. Results imply that fall-calving cows grazing stockpiled forage may receive minimal supplementation during the winter without adversely affecting subsequent performance of their calves in a growing-finishing system.

Key Words: Fall calves, Distillers dried grains, Finishing system

267 Feeding solubles or wet distillers grains plus solubles and corn stalks to growing calves. M. F. Wilken*, M. K. Luebbe, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska, Lincoln*.

One-hundred twenty individually fed growing steers (BW=314 ± 21 kg) were used to compare corn distillers solubles (SOL) to corn wet distillers grains plus solubles (WDGS) when ensiled with corn stalks. In addition, the effect of feeding ensiled WDGS and stalks was compared to feeding the mix of WDGS and stalks fresh daily. The byproducts and stalks were mixed and bagged in a 50:50 ratio (DM basis) and fed to provide byproduct level in the diet of 15, 20, 25, and 30% DM. The byproduct mix was blended with grass hay at feeding time to achieve the desired levels of byproduct in the diet. A 2 × 4 factorial treatment design was used with factors of byproduct type (solubles and WDGS) fed at 4 levels (15, 20, 25, 30). An additional treatment was included where 30% WDGS was fed fresh daily to compare performance of ensiled vs. non-ensiled WDGS and stalks. Steers were assigned randomly to treatments with 11 steers per treatment for the 2 × 4 factorial treatment design. However, 22 steers were fed ensiled WDGS fed at 30 % and 21 steers fed 30% WDGS that was fed fresh daily (non-ensiled). Excluding non-ensiled diets, there were no type by level interactions for final BW (P=0.90), ADG (P=0.97), and G:F (P=0.24). There were linear increases in ADG and G:F with increasing levels of byproduct (P<0.05). Calves fed SOL diets gained less (0.47 vs. 0.57 kg/d) and had lower G:F (0.064 vs. 0.080) compared to calves fed WDGS diets. Diets mixed at feeding had lower DMI (5.5 kg/d), ADG (0.46 kg/d), and G:F (0.084) than ensiled WDGS diets (6.4, 0.65, and 0.102, respectively). Feeding ensiled byproducts, solubles or WDGS, with stalks can be effective when backgrounding calves, and WDGS have higher feeding values than SOL. Ensiling WDGS with corn stalks appears to be better than mixing fresh daily, as DMI and ADG were improved.

Key Words: Calves, Forages, Ethanol byproducts

268 Dried distillers grains substitute for forage and nitrogen in smooth bromegrass pastures. M. A. Greenquist*, T. J. Klopfenstein, W. H. Schacht, G. E. Erickson, M. K. Luebbe, K. J. Vander Pol, and A. K. Schwarz, *University of Nebraska, Lincoln*.

A three year study evaluated the use of dried distillers grains with solubles (DDGS) as a substitute for forage and nitrogen fertilizer in steers grazing smooth bromegrass from late April to late September. One hundred and thirty-five steers (332 ± 10 kg) were used in a randomized complete block design to measure animal and pasture performance, nitrogen dynamics, and the economic impact of supplementation and management strategies. Steers were initially stocked at 6.8 AUM/ha on non-fertilized smooth bromegrass (CONT), 9.9 AUM/ha on smooth bromegrass fertilized with 88 kg N/ha (FERT), or 9.9 AUM/ha on non-fertilized smooth bromegrass with 2.3 kg (DM) of DDGS supplemented daily (SUPP). Pasture was the experimental unit and was replicated three times within year. Pastures were strip-grazed within each of the 5 cycles while put and take cattle and days within each strip were adjusted to maintain similar grazing pressure among treatments. Nitrogen accretion was estimated using NRC (1996) equations. Steers on CONT gained the same as FERT (0.70 kg/d and 0.67 kg/d, respectively) but had greater cost gain ($1.76/kg vs. $1.52/kg) because of the cost of additional acres at the reduced stocking rate. Steers supplemented with DDGS gained (0.92 kg/d) more (P<0.01) and had lower cost of gain ($1.28/kg) than CONT and FERT steers (DDGS was priced at $0.143/kg, delivered). Feedlot performance and carcass characteristics were not affected by grazing treatment (P>0.10). Forage utilization over the entire season (measured as AUM's removed) was improved (P<0.01) from 8.18 AUM/ha in the CONT to 13.03 AUM/ha in the SUPP pastures. Nitrogen accretion per ha for FERT (8.18 kg N/ha) was 49% greater (P<0.01) than CONT (5.49 kg N/ha) and nitrogen accretion per ha for SUPP steers (10.74 kg N/ha) was 96% greater (P<0.01) than CONT. Nitrogen use efficiency (calculated as Σ N outputs / Σ N inputs * 100) was improved by 149% for SUPP compared to FERT pastures (22.14% vs. 8.88%, respectively). Dried distillers grains can be used as a substitute for forage and N fertilizer by improving animal performance, and reducing cost of gains in smooth bromegrass pastures.

Key Words: Dried distillers grains, Fertilizer, Forage

269 Effect of inclusion level of modified wet distillers grains plus solubles on feedlot performance and carcass characteristics. T. J. Huls*, M. K. Luebbe, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska, Lincoln*.

An experiment was conducted to determine the performance and carcass characteristics of feedlot steers fed 0 to 50% modified wet distillers grains plus solubles (MDGS; DM basis). MDGS is partially dried wet distillers grains with all distillers solubles included back on. Two hundred eighty eight yearling steers (initial BW = 332 ± 17 kg) were blocked by BW, stratified within block, and assigned randomly to pens (8 steers/pen; 6 pens/treatment). Treatments included a control with 0% MDGS, 10% MDGS, 20% MDGS, 30% MDGS, 40% MDGS, and 50% MDGS (DM basis). All diets included 7.5% alfalfa hay and 5% supplement with the remaining as a 1:1 ratio of dry rolled corn and high moisture corn. Data were analyzed using Proc MIXED procedure of SAS and orthogonal polynomial contrasts were used to evaluate a response curve for MDGS level. Final BW, ADG, and DMI responded quadratically (P < 0.01) as MDGS inclusion increased from 0 to 50% of the diet, with 20% MDGS having the greatest DMI and ADG. A linear increase (P < 0.01) was observed for G:F as MDGS increased. HCW and calculated USDA Yield Grade responded quadratically (P < 0.05) with 20% MDGS inclusion having the greatest HCW and USDA Yield Grade. Differences were not observed (P > 0.10) across MDGS level for fat depth and marbling score. The calculated feeding value of MDGS was 123 to 109% the value of corn and decreased as MDGS inclusion increased from 10 to 50% of the diet DM. Finishing diets may include MDGS up to 50% of the diet DM; however, optimal performance is likely between 20 to 40% of the diet DM.

Key Words: Beef cattle, Finishing performance, Modified wet distillers grains

270 Energy balance, immune system function, and susceptibility to mastitis in dairy cows. K. M. Moyes*, J. J. Loor, and J. K. Drackley, *University of Illinois, Urbana*.

During the transition period, cows are at risk for development of mastitis, the most costly of all diseases in the dairy industry. A better understanding of risk factors for mastitis will improve animal welfare, which in turn may increase milk yield and profitability to dairy farmers. Evidence indicates that severity of negative energy balance (NEB) during the transition period, characterized by increased concentrations of NEFA and BHBA and decreased glucose in plasma, appear to contribute to immune system (IS) dysfunction in vitro. However, studies in vivo have proven difficult due to individual variation in NEB associated with adaptations to physiological changes as well as increased glucocorticoid concentrations in plasma that contribute to immunosuppression during the transition period. Several studies have used dietary-induced NEB models in mid-lactating dairy cows to mimic postpartal NEB while negating hormonal and physiological changes that contribute to immunosuppression. However, these studies have shown negligible effects of NEB on IS function. Studies examining postpartal NEB and the incidence of mastitis have revealed that severity of NEB is associated with increased incidence of mastitis during early lactation. The mechanistic link between postpartal NEB and increased susceptibility to mastitis remains unknown. Our studies have used dietary-induced NEB in mid-lactating cows administered an intramammary mastitis challenge. We have utilized recent technological advances in immunology and bovine functional genomics tools to determine the effect of NEB on IS responses in Holstein cows. Gene expression analyses suggest relationships between genes associated with IS response and those associated with energy metabolism. Data from an epidemiological study indicate that cows with clinical mastitis during early lactation had higher NEFA than healthy cows, suggesting that severe postpartal NEB may increase mastitis risk. Results from our studies provide important insights on mechanisms linking peripartal NEB with increased incidence of mastitis.

Key Words: Energy balance, Mastitis, Dairy cattle

271 WITHDRAWN.

272 Effects of feeding three types of corn milling co-products to Holstein dairy cattle. J. M. Kelzer*[1], P. J. Kononoff[1], A. M. Gehman[1], K. Karges[2], and M. L. Gibson[2], [1]*University of Nebraska, Lincoln,* [2]*Dakota Gold Research Association, Sioux Falls, SD.*

Corn milling co-products may differ in chemical composition and nutrient availability. Three co-products were fed at 15% DM to 28 multiparous Holstein cows averaging (mean ± SD) 625 ± 81 kg BW and 116 ± 33 days in milk to determine effects on dry matter intake and milk production. Animals were randomly assigned to one of seven 4 x 4 Latin squares. Treatments were randomly assigned within square over four, 21-d periods. Treatments included: 1) 0% DM co-product (control), 2) 15% DM dried distillers grains + solubles (DDGS), 3) 15% DM dehydrated corn germ meal (Germ), and 4) 15% DM high protein dried distillers grains (HPDDG). Crude protein and neutral detergent fiber contents (% DM) were 30.4 and 30.0, 16.1 and 24.2, and 45.4 and 30.5 for DDGS, Germ, and HPDDG, respectively. Treatments were formulated using the CPM-Dairy model (Version 3.0) to be isonitrogenous (18% CP) and chemically similar (21 kg dry matter intake, 34 kg metabolizable energy and protein allowable milk, 3.5% fat, and 3.1% protein). Cows were housed in individual stalls, milked at 0730 and 1930 h, and fed at 0900 h to allow for ad libitum intake. Feed intake was recorded daily, and milk samples were collected on d 19-21 of each period for analysis of major components. Feed intake tended to be different (P = 0.10) and was highest for Germ (24.6 kg/d) and lowest for HPDDG (22.7 kg/d). Milk production and components were not different across treatments. Milk yield (P = 0.56) averaged (mean ± SEM) 31.3 ± 1.3 kg/d, 3.5% fat-corrected milk (P = 0.96) averaged 31.7 ± 1.3 kg/d, fat (P = 0.46) averaged 3.8 ± 0.1%, protein (P = 0.74) averaged 3.0 ± 0.03%, solids non-fat (P = 0.97) averaged 8.6 ± 0.1%, and milk urea nitrogen (P = 0.19) averaged 15.3 ± 0.4 mg/dL. Rations were successfully formulated to include corn milling co-products at 15% DM to maintain milk production and composition.

Key Words: Dairy, Co-products, Milk production

273 Evaluation of distillers grains as a source of rumen-undegradable protein for lactating dairy cows. B. W. Pamp* and K. F. Kalscheur, *South Dakota State University, Brookings.*

Research has demonstrated that in high producing dairy cows, the demand for metabolizable protein absorbed in the small intestine is greater than what ruminal microbial protein can provide alone. Therefore, in order to meet the requirements of high milk production, a source of dietary RUP is needed. In most Midwestern dairy operations, distillers grains are an available and attractive source of escape protein. Previous research conducted on this topic has often studied the effects of increasing RUP in the diet by increasing not only CP but RDP as well. Very little research focusing on the impact of increasing RUP while holding RDP concentrations constant has been done. By keeping the RDP concentrations constant across all diets, we may gain a better idea of the quality and degradability of protein contained in DDGS when compared to more traditional protein sources such as soy proteins and its effect on not only milk production and milk composition but bacterial N, out flow of N from the rumen, microbial efficiency, and ruminal fermentation as well. Current research has focused on incremental replacement of dietary soybean protein with that of DDGS and the subsequent effects on production and digestibility. Research has demonstrated that supplementing lactating dairy cow diets with DDGS tended to increase the production of milk and milk components compared with the supplementation of soybean protein. It may be possible to successfully replace soybean protein in the diet of lactating dairy cows with protein from DDGS while either maintaining or increasing production. This research may indicate that additional RUP supplemented to lactating dairy cows in mid to late lactation can improve milk yield when compared to a control diet without additional RUP. Our results may also suggest that the conventional thinking that feeding too much corn products in the dairy cow diet may cause a lysine deficiency and limit production may be incorrect.

Key Words: Dried distillers grains, Soybean protein, Rumen-undegraded protein

274 Effect of forage quality on dairy cow performance, diet digestibility and rumen parameters. M. L. Raeth-Knight*[1], J. G. Linn[1], H. G. Jung[1,2], D. R. Mertens[2,3], and P. R. Peterson[1], [1]*University of Minnesota, St. Paul,* [2]*USDA Agricultural Research Service,* [3]*US Dairy Forage Research Center, Madison, WI.*

In most dairy rations forages comprise at least 40% of the total dry matter (DM). Therefore, forage quality can significantly impact milk production, ration cost and animal health. The concentration and digestibility of neutral detergent fiber (NDF) are important factors used to establish forage quality. Following the inclusion of NDF digestibility in the 2001 Dairy NRC and the new hay quality index (RFQ), interest in quantifying the impact of NDF digestibility on dairy cow performance increased. Previous research often confounded forage NDF digestibility with the level of NDF in the diet. Therefore, our objectives were to determine the effect of alfalfa NDF digestibility, when compared within relatively high and low NDF concentration hays, on dairy cow performance, diet digestibility and rumen parameters. Studies were conducted at the University of Minnesota and US Dairy Forage Research Center. Cows were fed one of four diets, containing alfalfa hays selected for low (L) and high (H) NDF concentration and low (l) or high (h) 48-h in vitro NDF digestibility (IVNDFD) within NDF levels. Alfalfa hay was included at 15% or 30% of the diet DM for the lactation and rumen fermentation studies and digestibility measurements. Diet digestibility was also determined for 96% alfalfa hay diets. Alfalfa hay NDF or IVNDFD did not impact lactation performance. There was no difference in in-vivo DM and NDF digestibility when alfalfa hay was included at 15% of the diet DM. At 96% of the diet DM there was an interaction between hay NDF and IVNDFD. The utilization of high quality alfalfa hay and inclusion rates of 15 and 30% of the diet DM reflect current industry practices, therefore our findings will be particularly relevant to the dairy industry. Our studies illustrate the challenge of characterizing alfalfa hay on IVNDFD and measuring an impact on performance when forages with small differences in IVNDFD are included in a total mixed ration.

Table 1. Treatments

	Lh	Ll	Hh	Hl
NDF, % DM	37	36	42	41
IVNDFD, % of NDF	41	38	45	41

Key Words: NDF digestibility, Forage fiber

275 Dietary starch particle size influences lactation performance of dairy cows. A. Zwald*, A. E. Dorshorst, P. C. Hoffman, L. M. Bauman, and M. G. Bertram, *University of Wisconsin, Madison*.

Dietary starch particle size influences lactation performance of dairy cows. Measuring starch particle size within corn silage is challenging because starch particle size determination requires drying, separation through multiple screens using a vertical shaker and subsequent starch determination of DM remaining on each vertical shaker screen to uncouple starch particles from forage particles. Direct prediction of starch particle size within corn silage was attempted using a near infrared reflectance spectrophotometer fit with a natural product cell. Starch particle size of 81 diverse corn silages was determined via vertical shaking through 10 screens with nominal square apertures of 19.0, 13.2, 9.5, 6.7, 4.75, 3.35, 2.36, 1.18, 0.6 and 0.8 mm and a pan. Starch content of DM remaining on each screen for each corn silage was determined and mean particle size (MPS), kernel processing score (KPS) and starch (% of starch) remaining on each screen of the vertical shaker were calculated. Near infrared reflectance spectra were obtained from 1 mm dried ground corn silage, whole un-dried, un-ground corn silage scanned using a natural product cell and un-dried un-ground corn silage passing through a 19 mm screen prior to scanning using a natural product cell. Calibrations to predict starch particle size characteristics of corn silage were attempted for each spectral origin. Near infrared reflectance spectroscopy (NIRS) calibrations to predict starch MPS, KPS or the percentage of starch retained on screens of the vertical shaker were unattainable ($R^2 < 0.48$) when spectra were obtained from 1 mm dried ground corn silage or whole un-dried, un-ground corn silage using a natural product cell. Efficient NIRS equations ($R^2 > 0.84$) for starch MPS, and KPS were developed from spectra that were obtained from un-dried, un-ground corn silage passing through a 19 mm screen prior to scanning via a natural product cell. Utilizing a 19 mm screen to remove long forage particles prior to scanning un-dried, un-ground corn silage is an efficient NIRS method to determine starch particle size characteristics in corn silage without having to employ drying and vertical shaking methods.

Key Words: Starch, Particle size, NIRS

276 Performance of lactating dairy cows fed corn as whole plant silage and grain produced from a genetically modified event DAS-59122-7 or a nontransgenic, near isogenic control. M. Brouk*[1], B. Cvetkovic[1], D. Rice[2], B. Smith[2], M. Hinds[2], F. Owens[2], and T. Sauber[2], [1]*Kansas State University, Manhattan*, [2]*Pioneer Hi-Bred, Johnston, IA*.

Lactating dairy cows were utilized to assess the nutritional equivalency of corn grain and whole plant corn silage from genetically modified maize plants containing the DAS-59122-7 (59122) event expressing the Cry34/35Ab1 proteins on feed intake, milk production and milk composition as compared to a near isogenic control (Control) hybrid. 59122 maize plants are resistant to western corn rootworm and tolerant to the herbicidal active ingredient glufosinate-ammonium. The 59122 grain and Control grain were grown in 2005 in isolated plots (201m) near Richland, Iowa. Whole plant corn silage for the 59122 and Control treatments were grown in isolated plots (201m) at the KSU Dairy Unit and ensiled in Ag-Bags. Thirty lactating Holstein cows were blocked by lactation number, DIM and energy corrected milk and utilized in a switchback design. Cattle were assigned a diet containing 22.7% grain and 21.3% whole plant silage (dry matter [DM] basis) from either 59122 or Control hybrid, 21% wet corn gluten feed, 12.3% protein mix, 8.0% whole cottonseed and 14.8% alfalfa hay. Periods consisted of 2 wk of adjustment followed by 4 wk of data collection. Milk samples (am and pm) were collected at two consecutive milkings and analyzed for fat, protein, lactose, SNF, MUN and SCC each collection week. Percentages of milk fat, protein, lactose and solids-not-fat were unaffected by treatment (P>0.1). Yields of milk, 4% fat-corrected milk (FCM), energy-corrected milk (ECM), solids-corrected milk (SCM), milk fat, milk protein, milk solids and milk lactose were similar (P>0.1) for both treatments. Efficiency of milk, FCM, ECM and SCM production was not different (P>0.1) between 59122 and the control groups. Milk production efficiency averaged 1.5 kg/kg of DM intake for both treatments. These data indicated feeding a diet containing grain and whole plant corn silage produced from a 59122 corn hybrid did not affect it′s nutritional value (as measured by milk production, efficiency of production, and milk composition) for lactating dairy cows compared to the Control hybrid.

Key Words: Corn rootworm protection, Corn hybrids, Dairy cows

277 Effects of roughage source and dried distiller's grains on ruminal fermentation and apparent total tract digestibility of finishing diets. S. Uwituze*[1], G. L . Parsons[1], M. K. Shelor[1], B. E. Depenbusch[1], K. K. Karges[2], M. L. Gibson[2], and J. S. Drouillard[1], [1]*Kansas State University, Manhattan*, [2]*Poet Nutrition, Sioux Falls,SD*.

Ruminal fermentation characteristics and diet digestibility were examined in cannulated Holstein steers (n=12; BW 487±18 kg) fed steam-flaked corn finishing diets with 0 or 25% dried distiller's grains with solubles (DGS), using alfalfa hay (AH) or corn silage (CS) as roughage sources. The study was a randomized incomplete block design with a 2 × 2 factorial arrangement of treatments. Factors were DGS level (0 or 25% DM) and roughage source (6% AH or 10% CS DM). The study used two periods, each consisting of a 17-d adaptation phase and 3-d collection phase, with 3 animals assigned to each treatment in each period. Ruminal digesta samples were collected at 2-h intervals post feeding during the collection phase, and were used to determine ruminal pH and ruminal concentrations of ammonia, VFA, and lactate. Fecal samples were collected at each sampling point, pooled within animal and period, and used to determine total fecal output and apparent total tract digestibility of DM, OM, NDF, CP, starch, and ether extract. One animal became ill during the experiment, and was removed from all analyses. Ruminal pH was higher for steers fed 25% DGS when CS was the roughage source, but was not affected by roughage source in diets containing 0% DGS (interaction, P<0.05). Steers fed 0% DGS had higher ruminal acetate (P<0.05), propionate (P<0.10), and A/P ratio (P<0.05) compared to steers fed 25% DGS. Conversely, cattle fed 25% DGS had higher ruminal concentrations of lactate (P<0.05) than cattle fed 0% DGS. Ruminal ammonia concentrations were lower in cattle fed diets with 25% DGS compared to steers fed 0% DGS (P<0.01). Digestibility of DM, OM, starch, and CP was greater for cattle fed 0% DGS compared to steers fed 25% DGS (P<0.05). Substituting steam-flaked corn with distiller′s grains alters ruminal fermentation and diet digestibility, but the effects of roughage source are not notable.

Key Words: Dried distiller's grains, Roughage, Digestibility

278 Correlation of insulin (I), glucose (G), and insulin-like growth factor-1 (IGF-1) to residual feed intake (RFI), average daily gain (ADG) and feed intake (FI) in beef steers. M. P. Davis*, J. W. Golden, J. H. Porter, M. S. Kerley, and D. H. Keisler, *University of Missouri*.

Blood samples were collected from 81 crossbred steers before weaning and on d 84 of a feeding trial to determine the correlation between blood metabolites (G, I, and IGF-1) and performance measures (RFI, ADG, and FI). The RFI was calculated for each animal during the 84 d feeding period. Average daily gain of the steers was calculated using gain from 0 to 84 d. Separate regression analyses were done for I, G, and IGF-1 concentrations prior to weaning and at d 84 on feed. Steers were also assigned to five RFI groups (1≈ -1.56 to -0.46, 2 ≈-0.45 to -0.1, 3 ≈ -0.09 to 0.2, 4 ≈ 0.22 to 0.55, 5 ≈0.56 to 1.69). The preweaning regression analysis for RFI yielded nonsignificant ($P \geq 0.05$) relationships for I, G, and IGF-1. The correlation coefficients for the G, I and IGF-1 to RFI was -0.20, -0.05, and -0.16, respectively. The preweaning regression analysis using the average daily feed intake for d 0 to 84 yielded significant ($P \leq 0.05$) correlations for G (r≈-0.36), I (r≈0.24), and IGF-1 (r≈-0.30) to feed intake. The I, G, and IGF-1 concentrations measured at 84 d on feed were not correlated ($P \geq 0.05$) to RFI. Feed intake was significantly correlated to ADG (r≈0.60; $P \leq 0.05$) but not ($P \geq 0.05$) to G, I, and IGF-1 concentrations collected at d 84. The results from the preweaning analysis failed to show a correlation between G, I and IGF-1 and RFI, but feed intake was correlated to G, I and IGF-1. After 84 d on feed RFI was not correlated to I, G, or IGF-1 while feed intake was only correlated to ADG. Therefore our conclusion from this study was that selection for concentrations of G, I, and IGF-1 in serum at weaning may influence feed intake but not RFI. When steers were grouped according to RFI the only significant difference among groups occurred for serum G concentrations sampled preweaning. However there was no order to G concentrations and RFI rank.

Key Words: Residual feed intake, Blood metabolites, Animal performance

279 Ruminal and abomasal infusion of starch hydrolysate differentially decreases expression of cationic amino acid transporter (CAAT) mRNA by small intestinal epithelia of forage-fed beef steers. S. F. Liao*, E. S. Vanzant, D. L. Harmon, K. R. McLeod, J. A. Boling, and J. C. Matthews, *University of Kentucky, Lexington*.

This experiment was carried out to determine if expression of CAAT mRNA by duodenal (**D**), jejunal (**J**), and ileal (**I**) epithelia responds to increased abomasal supply of rumen-derived microbes (hence, AA substrates), energy, or both. Eighteen ruminally and abomasally catheterized Angus steers (BW ≈ 260 kg) were assigned (n = 6) to either water (control) or ruminal or abomasal corn starch (α-amylase hydrolysate, at 20% of ME intake) infusion treatment and fed an alfalfa-cube based diet at 1.3× NE_m requirement. After a 14 or 16-d infusion period, steers were killed, and total RNA extracted from harvested epithelia. Real-time RT-PCR analyses were conducted to quantify the relative expression of seven mRNA (CAAT:18S) that are associated with the four known mammalian CAAT activities (y^+, $B^{0,+}$, $b^{0,+}$, and y^+L). From the results (Table 1), we conclude that all these CAAT associated mRNA were differentially expressed by duodenal, jejunal, and ileal epithelia and that four mRNA expressed by jejunal epithelium were down-regulated in the presence of increased luminal supply of microbial-AA (CAT1, 27%; rBAT, 41%; y^+LAT2, 35%; and 4F2hc, 39%) or increased luminal supply of energy (y^+LAT2, 32%, and 4F2hc, 25%) to growing steers.

Table 1. Basal and regulated CAAT mRNA expression by small intestinal epithelia

Activity	mRNA	Basal expression[1]	Starch infusion effect[2]
y^+	CAT1	D>J=I	J decreased by R**
$B^{0,+}$	$ATB^{0,+}$	D>J=I	No effect
$b^{0,+}$	$b^{0,+}AT$	D=J< I	No effect
	rBAT	D=J< I	J decreased by R*
y^+L	y^+LAT1	D=J, D< I, J=I	No effect
	y^+LAT2	D=J=I	J decreased by R** or A**
	4F2hc	D=J=I	J decreased by R** or A*

Key Words: Bovine, Gene expression, Small intestine

280 Effects of crude glycerin on performance and carcass traits of finishing heifers. G. L. Parsons*, M. K. Shelor, and J. S. Drouillard, *Kansas State University, Manhattan*.

The objectives of this study were to determine the effects of glycerin on performance, carcass traits, and to establish an optimal feeding level in finishing heifers. Crossbred heifers (n=373; 413 kg ± 28.4) were fed finishing diets containing 0, 2, 4, 8, 12, or 16% crude glycerin. Diets consisted of steam-flaked corn with 6% alfalfa hay and 1.2% urea, and provided 300 mg monensin, 90 mg tylosin, and 0.5 mg melengestrol acetate per animal daily. Cattle were stratified by body weight and allocated randomly, within strata, to concrete-surfaced feedlot pens containing 6 to 7 heifers each with 9 pens per dietary treatment. Cattle were transitioned from the control diet to diets containing increasing proportions of glycerin over a period of 10 days. Cattle had *ad libitum* access to feed, and diets were delivered once daily throughout the 85-d trial period. DMI decreased linearly as the level of glycerin increased ($P < 0.01$). ADG were 1.19, 1.34, 1.29, 1.25, 1.17, and 1.03 kg/d for heifers fed 0, 2, 4, 8, 12, and 16% glycerin, respectively (Lin, $P < 0.01$; Quad, $P < 0.01$). Feeding glycerin had a quadratic effect on efficiency of gain, and was optimal at the 2% level (Quad; $P < 0.01$). Glycerin increased final body weights by 12.7, 8.1, and 5.3 kg when fed at 2, 4, and 8% of the diet, respectively, but reduced final body weights by 1.9 and 14.3 kg when included at 12 and 16% of the diet (Lin, $P < 0.01$; and Quad, $P < 0.01$). Similarly, HCW increased by 8.1, 5.1, and 3.3 kg when glycerin was added at 2, 4, and 8% of the diet respectively, but were 1.2 and 9.1 kg less than controls when glycerin was fed at 12 and 16%, respectively (Lin, $P < 0.01$; and Quad, $P < 0.01$). Longissimus muscle area decreased linearly as glycerin levels increased ($P < 0.05$). Feeding glycerin resulted in less subcutaneous fat over the 12th rib and lower marbling scores ($P < 0.01$). Glycerin tended to decrease the percentage of cattle grading USDA Choice ($P < 0.10$) and increased the percentage of cattle grading USDA Select. Adding glycerin to cattle finishing diets improved weight gain and efficiency, particularly when added at levels of 8% or less of the diet dry matter.

Key Words: Glycerin, Heifers, Steam-flaked corn

281 Comparison of two calf wintering systems utilizing cornstalk grazing and dry lotting. W. A. Griffin*, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraksa, Lincoln*.

Four years of data from the University of Nebraska wintering systems were used to determine the performance and economic differences between season long cornstalk grazing (CS) and partial season cornstalk grazing with an added dry lot period (CD). Steers (n = 1360) were received during the fall of each year and placed on cornstalks. The wintering period lasted until April. Steers in the CS treatment grazed cornstalks from December until April (d = 152). Steers in the CD treatment grazed cornstalks from December until February (d = 80). In February, CD steers were fed brome hay ad-libitum in dry lot until April (n = 61). Steers in each treatment were supplemented wet corn gluten feed at a rate of 2.27 kg /hd daily for the entire wintering period. Initial BW (243 vs. 246 kg; P = 0.67), final BW (344 vs. 340 kg; P = 0.59) and ADG (0.70 vs. 0.64 kg/d; P = 0.49) were not different across treatments. When comparing economics across wintering treatment initial steer value (634.32 vs. 627.52 $/hd; P = 0.67) and steer value after wintering (754.27 vs. 745.08 $/hd; P = 0.58) were not different. System feed costs were $30.04 higher (P = 0.03) for CD when compared with CS. Additionally, costs associated with animal management were $13.31 higher (P = 0.01) for CD compared to CS. Breakevens were not different for CD and CS, even though CS had a numerically lower cost of gain when compared to CD (1.15 vs. 1.50 $/kg; P = 0.15). Profit was $31.66 higher for CS however, this was not statistically different (P = 0.34). Overall steer performance was similar for both wintering systems. When comparing economics CD had greater feed and management cost compared to CS. Because of year to year variation profitability was not different between systems even though CS was $31.66/hd more profitable than CD.

Key Words: Dry lot, Steers, Wintering system

282 Restricted feeding does not impact performance of growing steers during the subsequent grazing phase. C. O. Anglin*, D. A. Blasi, M. P. Epp, K. C. Olson, C. D. Reinhardt, and R. L. Derstein, *Kansas State University, Manhattan*.

Rising feed costs have forced beef stocker operators to evaluate alternative feeding practices which may reduce their costs of gain. Limit-feeding prior to a period of grazing may provide an opportunity for cost reduction. Highly stressed, crossbred beef steers (n = 329; BW = 191 kg) were fed a high concentrate diet (NEG = 1.12 Mcal/kg; CP = 14%) in a drylot at DMI of ad-libitum (AL), 2.50%, 2.25%, or 2.00% BW. Steers were weighed at 14-d intervals. Intakes of restricted treatments were adjusted accordingly at those times. When compared to restricted treatments, ADG for AL steers was higher (P < 0.05) than all other treatments. Feed efficiency (F:G) was improved (P < 0.05) by 6% for steers whose intakes were restricted to 2.50% or 2.25% BW. After 45-d of restricted feeding in a drylot and conclusion of the grazing phase, all treatments were fed a common diet at 2.00% of BW for 5-d to ensure a common gut-fill. Steers were randomly allotted by weight and treatment and placed on replicated native tallgrass pastures with equal stocking densities for 90-d. Compared to AL steers, ADG was higher (P < 0.05) during the first 45-d on pasture for all drylot-restricted treatments. Off-pasture BW for AL, 2.50%, and 2.25% treatments were similar (P > 0.05). However, the 2.00% restricted treatment weighed significantly less (P < 0.01) than all other treatments. Restricted feeding practices reduced ADG and improved feed efficiency during the drylot phase. This research suggests that previously restricted growing steers do express compensatory growth during subsequent grazing at a lower cost. The integration of restricted feeding prior to grazing resulted in an approximate savings of $20 per head in terms of cost of gain over the combined drylot and pasture phases.

Key Words: Limit-feeding, Growing steers, Grazing

283 Effect of dietary cation-anion difference on feedlot performance, N mass balance, and manure pH. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, M. A. Greenquist, and J. R. Benton, *University of Nebraska, Lincoln*.

A winter feedlot trial was conducted to evaluate the impact of dietary cation-anion difference on performance and N mass balance. Ninety-six steer calves (260 ± 22 kg) were stratified by BW and assigned randomly to 12 pens (6 pens/treatment). Calves were fed for 196 d from November to May. Basal diets consisted of high-moisture and dry-rolled corn, fed at a constant 1:1 ratio (DM basis), 20% wet distillers grains, 7.5% alfalfa, and 5% supplement. Calcium chloride and sodium bicarbonate were included in the supplement to adjust dietary cation-anion difference (DCAD) to 20 mEq for the positive (POS) diet and –16 mEq for the negative (NEG) diet. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Total N lost was calculated by subtracting manure and runoff N from excreted N. Dry matter intake was not different (P = 0.12) among treatments and was 8.8, and 9.1 kg for NEG and POS, respectively. Average daily gain was not different among treatments and was 1.56, and 1.53 kg for NEG and POS, respectively. Gain efficiency was greater (P = 0.05) for NEG compared with POS (0.179, and 0.167, respectively). Final BW and carcass characteristics were not different (P > 0.10) among treatments. Intake, retention, and excretion of N was not different (P > 0.20) among treatments. Manure N was not different (P = 0.73) among treatments (17.7 and 18.8 kg for POS and NEG, respectively). Amount of N lost was similar (P = 0.59) among treatments (14.0 and 12.9 kg for POS and NEG, respectively). Manure pH was greater (P<0.01) for POS than NEG (8.80 and 8.52, respectively). Pen surface soil core pH change (initial and final) was greater (P < 0.01) for POS than NEG (0.31 and -0.005, respectively). Amount of DM and OM removed from pens was similar (P > 0.20) among treatments. Altering DCAD in diets with wet distillers grains does not change manure and pen surface pH enough to improve N mass balance in open dirt feedlot pens.

Key Words: Acid base equilibrium, Nitrogen, Cattle

284 Effect of finishing ration protein reduction on performance and carcass characteristics of feedlot steers. J. J. Wagner[1], K. L. Neuhold*[1], T. C. Bryant[2], T. E. Engle[1], and S. L. Archibeque[1], [1]*Colorado State University, Fort Collins*, [2]*Five Rivers Ranch Cattle Feeding, Loveland, CO*.

Two-hundred and eighty-eight yearling steers (338 kg) were used to evaluate the effects of crude protein (CP) withdrawal from steam-flaked corn (SFC) based diets on performance and carcass merit. Treatments were generated by reducing CP of the finishing diet from 13.5 to 12.5,

10.5, or 8.8% from d57 through harvest. Control steers were fed the 13.5 diet for the entire study. To reduce CP from 13.5 to 12.5, part of the soybean meal (SBM, 1.23 % of DM) and urea (0.13 % of DM) were removed and replaced with SFC. To reduce CP from 12.5 to 10.5, the remaining SBM (1.0 % of DM) and part (0.57 % of DM) of the remaining urea were removed and replaced with SFC. The 8.8 diet contained no CP from SBM or urea. Data were evaluated using regression procedures. Reducing CP from d57 through harvest reduced final weight by 3.58 kg ($P < 0.02$) and hot carcass weight (HCW) by 3.38 kg ($P < 0.002$) for each percentage unit reduction from 13.5. From d57 through finish, each percentage unit reduction from 13.5 reduced average daily gain (ADG) by 54 g ($P = 0.0001$), DM intake by 145 g ($P < 0.06$) per head daily, and gain efficiency by 3.2% ($P < 0.03$). For each percentage unit reduction from 13.5, feed cost of gain was increased ($P < 0.06$) by $1.23 per 45.4 kg gain from d57 through finish, dressing percentage was reduced ($P < 0.02$) by 0.18 percentage units, fat depth was reduced ($P < 0.08$) by 0.02 cm, and yield grade was reduced ($P < 0.04$) by 0.05 units. Marbling score and percentage Choice carcasses were not impacted by diet CP from d57 through finish. These data suggest that decreasing CP below 13.5 from d57 through harvest reduces DM intake, ADG, gain efficiency, and HCW. Additional research examining interactions between the timing and type of crude protein withdrawal (DIP versus UIP) and type and weight of cattle fed is warranted.

Key Words: Crude protein, Phase feeding, Nitrogen

285 The effect of organic trace minerals on feedyard performance and carcass merit in crossbred yearling steers. J. J. Wagner, J. L. Lacey*, and T. E. Engle, *Colorado State University, Fort Collins.*

One hundred and forty four crossbred yearling steers (367 kg) were used to evaluate the effects of liquid organic Zn, Mn, and Cu on performance and carcass characteristics of feedlot steers. Cattle were stratified by weight and assigned within weight stratification group to two treatments. Treatments were: 1) inorganic trace mineral control (CON) providing 100, 40, and 15 mg of elemental Zn, Mn, and Cu per kg diet dry matter from zinc sulfate, manganese sulfate, and copper sulfate, respectively and 2) organic trace mineral (LIQ) that provided 40, 20, and 10 mg of elemental Zn, Mn, and Cu per kg of diet dry matter from ZinMet® brand zinc methionine, ManMet® brand manganese methionine, and CuBet® brand copper betaine, respectively. Trace mineral sources and concentrations used for the CON treatment were based on the sources and concentrations typically recommended by feedlot consulting nutritionists. Steers were harvested after d 139 of the experiment. Live weight (LW) was not effected ($P > 0.25$) by treatment. Finished weight was similar ($P > 0.25$) for CON and LIQ treatments (582 and 578 kg, respectively, SEM = 2.82 kg). Average daily gain differences associated with treatment were not significant ($P > 0.25$) and averaged 1.69 and 1.65 kg (SEM = 0.05) per head daily for the CON and LIQ treatments, respectively, from day 1 through slaughter. Treatment was not a significant ($P > 0.25$) source of variation for dry matter intake. Treatment had no effect ($P > 0.20$) on gain to feed ratio. Carcass characteristics were similar across treatments. These data indicate that providing Zn, Mn, and Cu at lower concentrations than what Zn, Mn, and Cu are typically fed in feedlot finishing diets may result in similar performance with likely less excretion of excess trace minerals into the environment.

Key Words: Trace minerals, Zinc, Copper

286 Post-weaning performance of fall-born beef steers weaned from endophyte-infected tall fescue pastures on different dates in the spring. J. D. Caldwell*[1], K. P. Coffey[1], W. K. Coblentz[2], J. A. Jennings[3], D.S. Hubbell, III[1], D. L. Kreider[1], and C. F. Rosenkrans, Jr.[1], [1]*University of Arkansas, Fayetteville*, [2]*USDA-ARS, Marshfield, WI*, [3]*Cooperative Extension Service, Little Rock, AR.*

Earlier weaning of fall-born calves grazing *Neotyphodium coenophialum*-infected tall fescue (E+) in the spring should reduced exposure of those calves to E+ toxins, resulting in improved long-term animal performance. However, a previous study did not support this hypothesis. A total of 118 Gelbvieh × Angus crossbred steer calves were used in a 3-yr study to determine the optimal time to wean fall-born calves grazing E+ fescue. Fall-calving cow-calf pairs were allocated randomly by weight and age immediately prior to the onset of calving to one of four weaning dates: 1) March 16 (177 d of age; MarW), 2) April 13 (204 d of age; AprW), 3) May 11 (236 d of age; MayW), and 4) June 8 (264 d of age; JuneW). The MarW and AprW calves were moved to wheat pasture whereas MayW and JuneW where moved to bermudagrass pastures following a 14-d fence-line weaning program. Steer BW at weaning increased ($P<0.001$) linearly across weaning dates and tended to increase ($P=0.06$) linearly at the time they were shipped to a feedlot, but steer BW at the end of the feedlot period and average daily gain during the feedlot period did not differ ($P\geq0.19$) across weaning dates (MarW 592, 1.8; AprW 577, 1.8; MayW 597, 1.8; and JuneW 609, 1.9 kg, respectively). Hot carcass weight tended to increase ($P=0.10$) in a linear manner across weaning dates. Quality grade did not differ ($P=0.84$) across weaning dates, with 47% of the steers grading choice and 53% grading select. Yield grade, and during the first 2 yr of the study, ribeye area, and marbling score did not differ ($P\geq0.12$) across weaning dates, but backfat thickness tended to increase ($P=0.09$) linearly across weaning dates. Therefore, weaning of fall-born steer calves from E+ pastures later may have short-term benefits, but those benefits may not persist throughout a feedlot period.

Key Words: Tall fescue, Steers, Feedlot

287 Ruminal fermentation and apparent total tract digestibility of finishing diets containing distiller's dried grains with dry-rolled or steam-flaked corn. M. L. May*, M. L. Hands, M. J Quinn, J. O. Wallace, C. D. Reinhardt, L. Murray, and J. S. Drouillard, *Kansas State University, Manhattan.*

A metabolism study was conducted to determine digestibility characteristics for Holstein steers (n = 16, 351 kg BW) with ruminal cannulae fed 0 or 25% (dry basis) dried corn distiller′s grains with solubles (DDG) with dry-rolled corn (DRC) or steam-flaked corn (SFC). Vegetable oil was added to diets without DDG to balance ether extract. The study was a randomized incomplete block design using a 2 x 2 factorial arrangement of treatments in two periods (8 steers/treatment). Periods included a 14-d adaptation followed by a 3-d collection phase. Chromic oxide was intraruminally dosed before feeding for the final 7 days of each period and used to determine total fecal output. Ruminal digesta and feces were collected at 2-h intervals post-feeding. There were no interactions ($P > 0.10$) between grain source and DDG level in terms of differences in digestibility or ruminal VFA concentrations. Compared to DRC, feeding SFC decreased DMI, ruminal pH, and ruminal concentrations of

ammonia, acetate, butyrate, isobutyrate, and isovalerate, but increased concentrations of lactate and propionate and increased digestion of organic matter, starch, NDF, and ether extract (P < 0.01). Feeding DDG decreased apparent total tract digestion of ether extract (P <0.01) and tended to decrease OM digestion (P <0.10). Ruminal ammonia concentrations were lower for cattle fed diets with DDG (P < 0.05) compared to those without DDG. In general, effects of DDG addition to finishing diets were not markedly influenced by grain processing.

Table 1. Apparent total tract digestibility for steers fed SFC or DRC with DDG

	DRC		SFC					
	0%	25%	0%	25%			P-Values	
Apparent total tract digestibility, %	DDG	DDG	DDG	DDG	SEM	Grain	DDG	Grain* DDG
DM	78.84	77.71	85.30	82.88	1.49	<0.01	0.11	0.56
OM	79.80	78.88	86.88	84.20	1.44	<0.01	0.10	0.43
Starch	88.99	89.60	98.56	98.84	1.57	<0.01	0.94	0.65
NDF	17.09	29.14	47.10	46.42	6.25	<0.01	0.22	0.20
Ether extract	92.27	88.44	93.58	91.60	0.82	<0.01	<0.01	0.20

Key Words: Distiller's grains, Steam-flaked corn, Dry-rolled corn

Undergraduate Student Competitive Research Papers, Oral Division

288 Forage quality and grazing performance of beef cattle grazing brown mid-rib grain sorghum residue. A. K. Schwarz*[1], C. M. Godsey[1], M. K. Luebbe[1], G. E. Erickson[1], T. J. Klopfenstein[1], R. B. Mitchell[2], and J. F. Pedersen[2], [1]*University of Nebraska, Lincoln*, [2]*USDA, ARS, Lincoln, NE*.

Residue from two grain sorghum hybrids, the control AWheatland x RTx430 (CON) and its near-isogenic hybrid containing the brown mid-rib gene bmr12 (BMR), were compared in a 72-d grazing experiment. Forty eight steers (250 ± 23 kg) were stratified by BW and assigned randomly to 2.12 ha paddocks (6 steers/paddock) containing BMR or CON grain sorghum residue. Steers grazed from November 27, 2006 to February 7, 2007. Metal ex-closures were placed in each paddock and sampled to compare residue quality when not grazed. Residue was sampled on day 4, 30, and 60 of the grazing period by collecting all residue from a 92-cm row in each paddock. Samples were separated into leaf and stem fractions, and analyzed for NDF and in-vitro NDF digestibility (IVNDFD). Steers grazing BMR (0.56 kg/d) residue gained more (P<0.01) than CON (0.34 kg/d) and had greater ending BW (P>0.01). No difference in NDF content of the leaf fraction was observed between CON and BMR across date (P=0.41), averaging 67.6% for BMR and 66.9% for CON. Leaves had greater (P<0.01) IVNDFD in BMR than CON with an increase of 6-12% units. A 13-19% unit increase for IVNDFD was observed for BMR compared to CON (P<0.01) in the stem fraction, however, the stem fraction is likely not consumed to the extent of the leaf fraction. IVNDFD decreased over time in the leaf fraction, regardless of treatment, with an 8-12% unit decrease in the grazed areas over the entire grazing period, and a 2-4% unit decrease over time in IVNDFD for the non-grazed ex-closures. An interesting observation was that although there was a significant difference (P<0.01) in IVNDFD between the leaf and stem fractions of the CON treatment, IVNDFD was comparable between the leaf and stem fractions in the BMR hybrid (P>0.05). This suggests cattle could consume the stem residue of the bmr-grain sorghum hybrid and perform similar to grazing the leaf fractions, if stems are palatable. Incorporation of the BMR trait increases gain, by increasing fiber digestibility.

Key Words: Beef cattle, Brown mid-rib, Crop residue

289 Survey of mortality in multi-source nurseries. J. Graham*[1], J. Waddell[2], and K. Bruns[1], [1]*South Dakota State University, Brookings*, [2]*Sutton Veterinary Clinic, Sutton, NE*.

The objective of this survey was to determine current causes of mortality in the nursery phase of a large, multi-sourced system, to create a more accurate decision tree chart for assigning cause of mortality. The survey, conducted in the summer of 2007, included 10 nursery and 4 wean-to-finish sites ranging in size from 4,000 to 15,000 pig capacity. The sites were part of a 45,000 sow system. Post-mortem examinations were conducted daily over each week of the nursery phase providing a cross sectional view of mortality with a total of 347 examinations. Candidates for the survey included euthanized, chronic, and acute death pigs. Prior to necropsy, barn personnel were instructed to assign a cause of death based on clinical presentation. Barn personnel used a list of specific clinical symptoms describing specific pathogens and syndromes to assign cause of death. Technicians conducting necropsies received training from the staff of the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) prior to the study. A comprehensive mortality chart was completed for each necropsy performed. Tissue samples were submitted to the ISU VDL if conformation of diagnosis was desired or if a case of interest could not be diagnosed solely on gross lesions. Of the 347 pigs in the survey, the most common causes of death were as follows: respiratory, 28.5%; torsions/ruptures 15%; and starve outs or "fail to thrive" pigs, 13%. Twenty-three percent were classified as unknown by the necropsy technician due to a lack of gross lesions or inconclusive findings. The findings of this study show that of all acute, chronic, and euthanized pigs, the acute deaths were misdiagnosed over 70% of the time by barn personnel. Of the 40% that were diagnosed properly, starve outs were the most often correctly diagnosed. The data indicate that post-mortem examination should be used to determine cause of death as clinical presentation alone is not an accurate method for determining cause of death.

Key Words: Swine, Health, Mortality

290 Feed value of dry distillers grains plus solubles for feedlot lambs. Y. Diaz*, A. Islas, D. Hallford, and S. A. Soto-Navarro, *Department of Animal and Range Sciences; New Mexico State University, Las Cruces, NM USA.*

Twenty four lambs (27.8 kg initially) were used in a 63 day finishing experiment in order to evaluate the feed value of dry distillers grains plus solubles (DDGS). Four concentrations (8, 16, 24, and 32% of diet DM) of DDGS replaced dry-rolled corn in an 80% corn-based finishing diet. Lambs were housed individually and fed once daily at 0800. Fresh water was always available. Increasing level of DDGS had no effect on ADG (P=0.88; 255, 273, 281 and 273 ± 24.8 g/d for 8, 16, 24 and 32% DDGS, respectively). Dry matter intake was not affected (P=0.85) by increasing DDGS level (1304, 1256, 1326 and 1318 + 74.2 g/d for 8, 16, 24 and 32% DDGS, respectively). Feed efficiency was not affected (P=0.78) by DDGS replacement level. We conclude that lamb growth performance is not affected by level of DDGS replacement. Therefore, DDGS can be used in finishing diets for lambs up to 32% without negatively affecting the feed value of the diet.

Key Words: Distillers grains, Lambs, Feedlot

291 Influence of maternal nutrition on cellular proliferation rates of placental tissues in singleton ovine adolescent pregnancies at Day 50 and 75 of gestation. L. Rensink*[1], R. Aitken[3], J. Milne[3], P. Borowicz[2], A. Scheaffer[1], D. Carlson[2], L. Reynolds[2], J. Wallace[3], and D. Redmer[2], [1]*Northwestern College, Orange City, IA,* [2]*North Dakota State University, Fargo,* [3]*Rowett Research Institute, Brucksburn, Aberdeen, UK.*

Singleton pregnancies to a single sire were established by embryo transfer and thereafter adolescent dams were offered a high (H, n=21) or control (C, n=22) dietary intake. Animals were administered bromodeoxyuridine (BrdU), 1 h before slaughter, on d 50 or 75 of gestation. Placentomes from each ewe were fixed with Carnoy′s solution by perfusion of the main vessel supplying the caruncular (CAR; maternal) or cotyledonary (COT; fetal) tissue. After fixation, tissues were embedded in paraffin, sectioned, BrdU labeled nuclei measured by immunohistochemistry, and stained (hematoxylin and periodic acid-Shiffs). Proliferating cells were quantified by image analysis with number of proliferating cells, non-proliferating cells, total cell number, and hence proliferation rate determined for five fields of view per section. Maternal diet did not affect placentome mass at d 50 (103.2 ± 9.7 vs 94.4 ± 7.6 g in H vs C; P>0.1) or d 75 (537.2 ± 34.9 vs 557.2 ± 30.2 g in H vs C; P>0.1). At d 50, proliferation rate of COT-H was less than COT-C (6.8 ± 1.4 vs.14.4 ± 3.0; P<0.05) and was similarly attenuated in the CAR portion of the placentome (3.8 ± 0.7 vs. 6.7 ± 1.0 in H and C, respectively, P<0.05). At d 75, proliferation rate within the COT (12.1 ± 1.3 vs. 9.4 ± 1.7) and the CAR (8.8 ± 2.2 vs. 5.5 ± 1.2) were equivalent (P>0.1) in the H and C groups. These data indicate that high dietary intakes negatively impact placental proliferation by the end of the first third of gestation and this may ultimately contribute to the reduction in placental mass observed by the final third of gestation in the overnourished adolescent paradigm.

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Key Words: Ovine placenta, Proliferation rate, Nutrient intake

292 Nitrogen utilization in horses fed grass and alfalfa hay. A. L. Minella*, J. Liesman, and N. L. Trottier, *Michigan State University, East Lansing, MI, USA.*

The objective of this study was to compare nitrogen (N) excretion profile in horses fed high quality grass hay (HGH) to that of horses fed either alfalfa hay (AH) or lower quality grass hay (LGH). It was hypothesized that N utilization in horses fed HGH was lower than that of horses fed AH but higher than that of horses fed LGH. Six Arabian geldings (438 ± 14.64 kg BW) were allocated to two 3 × 3 Latin squares design. The HGH, AH and LGH contained 16.4, 17.9, and 10.6% CP, respectively, and were fed at 1.3% of BW (DM basis). Each period was 9 d in length and consisted of 6 d of diet adaptation followed by 3 d of total urine (Ur) and fecal (Fc) collection. For each period, Fc matter and Ur from each horse were pooled and homogenized, and a sub-sample used for N analysis. Compared to HGH, N intake (mg N/kg BW) was higher for AH (370.5 vs 339.3) and lower for LGH (217.3 vs 339.3 ± 0.9) (P < 0.001). Total N excretion did not differ between AH and HGH (250.5 vs 238.5) and was lower for LGH compared to HGH (173.7 vs 238.5 ± 3.9; P < 0.001). Fecal N excretion (mg/kg BW) was lower for both AH and LGH compared to HGH (78.2 vs 105.4 and 73.1 vs 105.4 ± 4.7, respectively; P < 0.001). Urine (L/d) was higher for AH compared to HGH (7.01 vs 4.55; P < 0.01), and not different between LGH and HGH (4.66 and 4.55 ± 0.35). Compared to HGH, Ur N excretion (mg N/kg BW) was higher for AH (172.3 vs 133.1) and lower for LGH (100.6 vs 133.1 ± 5.4) (P < 0.001). Nitrogen digestibility was higher for AH compared to HGH (78.92 vs 68.98; P < 0.01) and not different between LGH and HGH (66.48 vs 68.98 ± 1.60). Compared to HGH, Ur N relative to N absorbed (%) was similar for AH (59.6 vs 57.2) and higher for LGH (71.1 vs 57.2 ± 3.0; P < 0.05). In summary, N contribution was higher from Ur origin in AH and from Fc origin in HGH, with similar utilization of N absorbed between HGH and AH. Nitrogen contributions from both Ur and Fc origin were lower in LGH, with lower utilization of absorbed N. In conclusion, despite lower digestibility in HGH, N is utilized as efficiently as that of AH; on the other hand, while HGH and LGH have similar N digestibility, N of LGH is utilized less efficiently.

Key Words: Nitrogen, Horses, Hay

293 Effects of ergotamine-D tartrate on bovine oocyte maturation: A proposed study. J. M. Douglas* and K. L. Jones, *Southern Illinois University - Animal Science, Food and Nutrition, Cabondale.*

Fescue toxicosis is a livestock disease that results in economic losses through decreased weight gains and reduced reproductive efficiency. While an abundance of research has been conducted on the reproductive consequences of ingesting endophyte- infected fescue, studies have yet to explore what deleterious effects, if any, fescue endotoxins have on oocyte maturation. Preliminary data suggests that meiotic development may be impeded after cattle consume diets composed of endophyte- infected fescue. To investigate the possibility of reduced meiotic competence, bovine oocytes will be collected from a local abattoir and cultured in one of four treatment groups. The control treatment will be comprised of TCM 199 medium with 0.1 U/ml FSH, 0.1 U/ml LH, 10% (v:v) fetal calf serum, and 1% (v:v) pen/strep. Treatment 2, 3, and 4 will consist of control medium with the addition of ergotamine D-tartrate at $1x10^{-11}$, $1x10^{-8}$ or $1x10^{-5}$ M, respectively. Ergotamine is an ergopeptine structurally similar to ergovaline, the most abundant ergopeptine alkaloid produced by the endophyte, *Neotyphodium coenophialum*, in infected

tall fescue. Following 24 hours of culture at 35° C in a humidified atmosphere of 5% carbon dioxide in air, cumulus cells will be removed from each oocyte. Oocytes will be stained with Hoechst 33342 and observed with a microscope equipped with a fluorescent light source. Evidence of completion of meiosis I will be analyzed by determining the presence or absence of the first polar body and metaphase plate. Data will be analyzed by ANOVA followed by LSD. We expect oocytes incubated with ergotamine D-tartrate will be less likely to complete meiosis I.

Key Words: Fescue toxicosis, Oocyte maturation, Ergotamine-D tartrate

294 Ewe nutrition during pregnancy influences offspring wool production and wool follicle development. W.V. Haux*, K.A. Vonnahme, K.C. Kraft, T.L. Neville, J.J. Reed, D.A. Redmer, C.J. Hammer, L.P. Reynolds, J.S. Caton, and J.S. Luther, *Center for Nutrition and Pregnancy, Department of Animal Sciences, North Dakota State University, Fargo, ND, USA.*

The U.S. sheep industry is increasingly pressured to grow finer wool. The effects of dam nutrition on offspring wool production (quality and quantity) were evaluated. Primiparous Rambouillet ewes (n=84) were randomly allocated to one of six treatments in a 2 X 3 factorial design. Selenium treatment [Adequate Se (ASe, 7.4 μg/kg BW) vs. High Se (HSe, 85 μg/kg BW] was initiated at conception, and global nutrition level [control (C, 100% of requirments) vs. restricted (R, 60% of C) vs. overfed (O, 140% of C) was initiated at d 50 of gestation. Lamb birth weight was recorded at delivery and all lambs were placed on the same diet to determine the effects of prenatal nutrition on postnatal wool production and follicle development. At 179 ± 1.4 d of age, lambs were necropsied and pelt weights were recorded. Wool and skin samples were collected from the side and britch of each lamb. Birth weight was reduced (P≤0.01) in R (4.0 ± 0.15 kg) and O (4.2 ± 0.18 kg) versus C (4.6 ± 0.21 kg) nutrition groups, and was positively correlated with pelt weight among all lambs (r=0.25, P≤0.03). Global maternal nutrition did not affect offspring wool staple length, mean fiber diameter or mean fiber curvature, but lambs born to C dams had a higher (P≤0.05) percentage of side fibers ≥30 microns when compared to R and O lambs (8.2 vs. 5.5 and 5.3%, respectively). The latter resulted in R and O lambs having an increased (P≤0.05) side wool comfort factor relative to C lambs (94.5 and 94.7 vs. 91.8%). Maternal Se intake did not affect offspring wool characteristics, however, the ratio of secondary to primary (S:P) wool follicles was reduced (P≤0.02) in lambs born to HSe (17.9 ± 0.92 S:P) versus ASe (21.0 ± 0.97 S:P) dams. In summary, alterations in maternal nutrition during pregnancy resulted in low birth weight lambs with decreased wool yield in later life. However, these changes may actually have beneficial effects on offspring wool quality.

Key Words: wool, nutrition, pregnancy

295 Coat shedding among Angus cows and its correlation among progeny. H. D. Sigal*, K. A. Gray, and J. P. Cassady, *North Carolina State University, Raleigh.*

Losing and re-growing a winter coat is an adaptive trait used by many species to maintain thermo-regularity throughout the seasons. The objective was to estimate differences in hair coat shedding among progeny of different sires. Data were available from 135 registered Angus cows sired by 19 bulls, from the NC State University Historic Angus Herd which is maintained at the Upper Piedmont Research Station in Reidsville, NC. Cows were grazed on pastures which were predominantly endophyte infected fescue. Hair coats were scored by 2 technicians on five predetermined dates beginning in March 2007 and approximately every 30 days there after. Each animal was scored on a scale from 1 to 5. A score of 1 signified a slick, short summer coat, while a 5 signified a full winter coat. A score of 4 indicated an animal whose coat had begun shedding, 3 indicated that half of the winter coat had been shed, and 2 indicated a coat that was mostly shed. Each technician scored the animals independently on the same dates. Data were analyzed using the GLM procedure of SAS. The model included fixed effects of date, technician, sire, and interaction of sire and date. In March all cows had a hair coat score of 5, and March data were not included in the final analysis. Hair coat score was affected by date ($P < 0.01$) technician ($P < 0.01$), sire ($P < 0.01$) and the interaction of sire and date ($P < 0.01$). Least Squares means for sires ranged from 4 to 5, 2.9 to 4.9, 1.8 to 4.4, and 1.7 to 3.4 for April, May, June, and July, respectively. Differences among sires provides evidence that Angus cattle may differ genetically in their ability to shed their winter hair coat. A (co)variance analysis will be done in MTDFREML using a complete animal model to estimate heritability.

Key Words: beef cattle, hair coat, genetics

296 The Effect of Condensed Corn Solubles on In Vitro Dry Matter Disappearance of Low-Quality Forages. T.M. Krafft*, T.T. Marston, and K.W. Harborth, *Kansas State University, Manhattan, Kansas, USA.*

Samples of low-quality forages mixed with differing levels of condensed corn solubles (CCS) were analyzed to determine the effects of CCS on forage IVDMD In experiment 1, samples were analyzed with DM concentrations of 0, 25, 50, and 75% CCS. Forages included: tall fescue straw, native grass prairie hay, wheat straw, USDA Conservation Reserve Program seeded native grass hay, and brome grass hay. Rumen fluid was collected and mixed from three heifers consuming a native grass/brome grass mixed diet. In Experiment 2, forages were mixed on a DM basis with CCS at concentrations of 0, 10, 20, and 30%. Forages analyzed were: corn stalks, tall fescue straw, USDA Conservation Reserve Program seeded native grass hay, wheat straw, and tall grass prairie hay. Rumen fluid was collected and mixed from two steers consuming a diet of forage and concentrate (1:1 ratio). Forty-eight hour incubation period were used for each forage:CCS combination. In both experiments samples were analyzed for dry matter, nitrogen content, ether extract (EE), and IVDMD. The CCS used in these experiments was 41.5% DM, 13.2% CP, and 97% IVDMD. Experiment 1 results indicated that increasing the CCS concentration from 0 to 75% caused a linear ($P<.0001$) and quadratic ($P<.10$) decline in estimated forage IVDMD while mixtures rose in CP, EE and total IVDMD ($P<.0001$). The estimated loss in forage IVDMD were -8.6, -12.7, and -19.7% for 25, 50, and 75% CCS levels, respectively. Results of experiment 2 indicated that increasing the CCS levels from 0 to 30% DM also caused a linear ($P<.0001$) and quadratic ($P<.01$) decline in estimated forage IVDMD. The CP, EE, and total IVDMD increased when CCS level increased from 0 to 30% ($P<.0001$). The estimated losses in forage IVDMD were

-2.5, -4.3, and -4.3% for CCS levels of 10, 20, and 30%, respectively, when compared to 0% CCS. These results indicate that increasing the levels of CCS with a variety of low-quality forages will have a negative effect on forage IVDMD.

Key Words: Condensed corn solubles, IVDMD, low-quality forage

297 Expression of basic fibroblast growth factor (FGF2) and receptor (R) IIIc in uterine tissues during early pregnancy in sheep. M. A. Minten*, L. P. Reynolds, M. L. Johnson, P. P. Borowicz, D. A. Redmer, A. T. Grazul-Bilska, and J. J. Bilski, *Dept. of Anim. Sci. and Center for Nutrition and Pregnancy, Fargo*.

Placental development is critical for normal placental function and thus for normal embryonic/fetal growth and development. To evaluate placental development in compromised pregnancies, a detailed knowledge of the expression of growth factors which regulate tissue growth and remodeling in normal pregnancies is required. Therefore, this study determined the expression patterns of FGF2 and FGFR2 IIIc protein and mRNA within caruncle and/or intercaruncular areas (CAR and ICAR, respectively; maternal placenta) and fetal membranes (FM; fetal placenta) using immunohistochemistry (IHC) and quantitative real time RT-PCR. Uterine tissues were collected on d20, 22, 24, 26 and 30 after mating (n=5-6/d) and on d10 after estrus (n=5; non-pregnant control). For IHC, cross-sections (0.5-cm thick) of uterine tissues containing fetal membranes were fixed in 10% formalin, embedded in paraffin and immunostained to detect FGF2 and FGFR2 IIIc in CAR, ICAR and FM areas. For mRNA expression, snap-frozen samples of CAR and FM were used for RNA extraction. FGF2 and FGFR2 IIIc were immunolocalized in connective tissues of CAR and ICAR, in blood vessels and uterine glands in ICAR and in FM throughout the early pregnancy and in controls. In CAR, FGF2 mRNA expression in controls was similar to pregnant ewes across all days, but was ~1.8-fold greater ($P<0.01$) in pregnant ewes on d20 than on d24-30. FGFR2 IIIc mRNA expression was similar for control and pregnant ewes on d20, and was ~2-fold greater ($P<0.01$) than on days 22-30. Expression of FGF2 and FGFR2 IIIc mRNA in FM did not change throughout early pregnancy. These data suggest that FGF2 and receptor FGFR2 IIIc have a role in regulating early placental growth and will help us to determine which compartments of the placenta are altered in compromised pregnancies. *NIH grant HL64141 to LPR and DAR, USDA grant 2007-01215 to LPR and ATGB, ND EPSCoR AURA grant to ATGB and MAM, and ND Space Grant Fellowship Program award to MAM.*

Key Words: Growth factors, Uterus, Early pregnancy

298 Effects of administration of bovine colostrum extract (First Pulse® D) on growth, livability and acute phase proteins of disadvantaged pigs in a commercial swine production facility. J. M. Pomerenke*[1], J. S. Knott[2], R. W. Fent[2], and G. C. Shurson[1], [1]*University of Minnesota, St. Paul*, [2]*Ralco Nutrition Inc., Marshall, MN*.

The effects of administering a bovine colostrum extract (First Pulse® D; BCE) were investigated on growth, livability, and acute phase proteins of disadvantaged pigs in a commercial swine production facility where 330 disadvantaged pigs (BW > 680 g) from 165 litters were used. The smallest two pigs from each litter (initial BW = 1.14 ± 0.02 kg) were allotted to one of two treatments (control vs. BCE) in a randomized complete block design. The BCE pigs received a 2 mL oral dose of bovine colostrum extract within 24 h of birth. Body weights were collected on d 0 and at weaning (≈ d 18). Additionally, blood samples were collected from 18 pigs (9 littermate pairs, 9 pigs per treatment) on d 0, 7, and weaning, and sera were analyzed for the acute phase proteins, haptoglobin (Hp) and α-1 acid glycoprotein (AGP). Pigs treated with BCE weighed more ($P < 0.04$) at weaning than control pigs (5.32 vs. 5.08 kg), and therefore, had greater ($P < 0.01$) ADG than control pigs (3.93 vs. 4.16 kg) during the nursing period. Mortality was similar ($P > 0.10$) for pigs in the control and treated groups, (7.27 vs. 7.88%). Serum Hp analysis resulted in a time x treatment interaction ($P < 0.05$), where on d 0 and 7, concentrations were similar between the two groups, but at weaning, pigs treated with BCE had higher ($P < 0.01$) Hp concentrations compared to pigs in the control group (647 vs. 180 μg/mL). Serum AGP concentrations changed over time ($P < 0.05$), but were similar ($P > 0.05$) across treatments. These results suggest that administration of bovine colostrum extract (First Pulse® D) to disadvantaged pigs after birth dramatically improves their growth rate and affects serum haptoglobin concentrations at weaning.

Key Words: Piglets, Colostrum, Acute phase proteins

299 Changes in myoblast activity during pig development are not explained by inherent differences in phenotype or global gene expression patterns. B. L. Varnes*, E. E. Helman, C. W. Ernst, J. W. Reum, R. J. Tempelman, A. M. Ramos, and M. E. Doumit, *Michigan State University, East Lansing*.

Myoblast proliferation and differentiation control muscle fiber formation and growth, yet the complex regulation of myoblast activity is poorly understood. Our objectives were to quantify the proportions of proliferating and differentiating myoblasts during pig development, and to determine if isolated myoblasts display unique developmental phenotypes and gene expression patterns when cultured under common conditions. Myoblasts were isolated from longissimus muscle of pigs from 3 litters at 57-, 70-, 90-, and 105-d gestation, and 3 pigs at birth, 1-, 3-, 5-, and 7-wk postnatal. Fluorescent immunostaining for neural cell adhesion molecule (NCAM) was used to identify myoblasts, and proliferating cell nuclear antigen (PCNA) and myogenin were used as indices of cell proliferation and differentiation, respectively. The proportion of PCNA+/NCAM+ cells in freshly isolated cells was high (>70%) and similar in pigs between the ages of 57-d and 3-wk, but was lower (54%; $P < 0.05$) in isolates from 7-wk old pigs. The proportion of myogenin+ myoblasts was similar from 57-d to 105-d, but was markedly lower at birth than at either 105-d or 1-wk (8% vs 27% and 41%, respectively; $P < 0.05$), and also declined from 3- to 7-wk. To compare myogenic cell proliferation and differentiation under common environmental conditions, cells were seeded at clonal density, allowed to attach and grow undisturbed for 7-d, induced to differentiate for 24 h, then fixed and immunostained for myogenin. The number of cells in myogenic colonies and the proportion of myogenin+ cells within colonies did not differ among ages ($P > 0.61$). Mass cultures of undifferentiated myoblasts and differentiating myoblasts and myotubes from these pigs were harvested for transcriptional profiling experiments. Microarray analysis of undifferentiated cells from pigs at 105-d gestation and birth revealed no differences in global gene expression. Collectively, these

data suggest that the in vivo environment, rather than inherent cellular differences, govern the proliferation and differentiation of myogenic cells during development.

Key Words: Porcine, Myogenesis

300 Effects of maternal nutrition and selenium status on offspring muscle growth and quality. E. Harris*, J. Caton, W. Keller, P. Berg, K. Vonnahme, D. Redmer, L. Reynolds, and K. Maddock Carlin, *North Dakota State University, Fargo*.

To determine impacts of maternal undernutrition or overnutrition, high Se, or a combination on muscle growth, fiber type, and meat quality in finished lambs, 82 pregnant Rambouillet ewe lambs were allotted randomly to 1 of 6 treatments in a 3 × 2 factorial design that included plane of nutrition (60% [RES], 100% [CON], and 140% [HIGH]) and dietary levels of Se (adequate Se [ASe; 7.4 μg/kg BW] vs. high Se [HSe; 85 μg/kg BW] from Se enriched yeast). Treatments were initiated at breeding for Se and d 40 of gestation for nutrition. Pelleted diets were fed once daily (36.5% beet pulp, 22.3% alfalfa meal, 16.2% corn, 18% soybean hulls, and 7.0% soybean meal; 14.4% CP, 2.63 Mcal ME/kg; DM basis). Immediately after parturition, all lambs were removed from dams and fed commercial colostrum, and conventionally raised to approximately 60 kg. Harvest carcass measurements, L*, a*, b* measurements, pH at 45 min and 24 h postmortem (PM), and psoas major (PsM) and semimembranosus (SM) wts were recorded. Formalin-fixed, paraffin-embedded longissimus muscle cross sections (5 μm) were stained and analyzed for fiber area. Muscle fiber types were quantified through densitometry of SDS-PAGE separated myosin heavy chain isoforms. No differences were observed for carcass weights or USDA Yield and Quality Grades. However, weights of PsM and SM from HIGH were less than CON or RES ($P < 0.01$). Muscle pH was greater in HSe lambs (6.7 ± 0.03) than in ASe lambs (6.6 ± 0.03; $P < 0.09$) at 45 min PM but not different at 24 h. No differences were measured between treatments for L* values. However, a* and b* values were greater in CON compared with RES (19.9 ± 0.5 vs. 18.6 ± 0.5; $P < 0.06$ and 6.1 ± 0.2 vs. 5.3 ± 0.2; $P < 0.01$, respectively). Muscle fiber area was larger in HSe-treated lambs (831.3 ± 48.6 μm2) than in ASe (716.6 ± 40.2 μm2; $P < 0.08$), and density of type II fibers in HIGH lambs was greater in HSe (71.5 ± 3.0) compared with ASe (65.2 ± 2.8; $P < 0.1$). Results indicate maternal nutrition can influence muscle growth in offspring with effects being measurable at harvest.

Key Words: Selenium, Muscle, Maternal nutrition

Undergraduate Student Competitive Research Papers, Poster Division

301 Evidence for Locally-Produced Prolactin in Equine Ovaries. T Marlo*, KL Jones, D Hastings, H Heath, and SS King, *Southern Illinois University-Carbondale, Carbondale,IL,USA.*

Understanding the mechanism controlling seasonal anestrus is of importance to equine breeders. Foals that compete and are born closer to January 1 have an advantage to foals born later in the year. Our lab is currently investigating the role of prolactin during the Fall transition. Circulating prolactin concentrations decline in association with acyclicity. Our aim is to determine if prolactin could be produced locally within the ovary (from non-pituitary sources).
Ten ovaries were collected summer 2007 for granulosa/theca and luteal tissues samples. Ovaries were collected from light horse mares post mortem. Granulosa/theca (n=20) and luteal samples (n=8) were frozen in liquid nitrogen until further processing. RNA extraction was performed for quantitative polymerase chain reaction analysis using primers and reaction conditions for equine preprolactin as described previously (Clark et al., Dom Anim Endo 24: 367-376). Equine pituitary mRNA was used for the generation of a standard curve. In a second experiment, ovaries were collected from light horse mares in the summer (n=6) and winter (n=5). Immunohistochemistry was performed by fixing tissues in 4% paraformaldehyde, embedded in paraffin and cut into 5 um sections. Tissue sections were incubated with R4 prolactin rabbit anti-porcine antibody (provided by D. Thompson, Louisiana State University) previously shown to detect equine prolactin. The secondary antibody was goat anti-rabbit IgG-biotinylated (avidin-biotin complex) developed with DAB chromagen-Ni and counterstained with nuclear fast red stain.
Equine preprolactin mRNA was detected in all samples. There was no difference in mRNA expression between sample types. There was a correlation in preprolactin concentration in granulosa/theca samples compared to follicle size ($P<0.05$); granulosa/theca cells from larger follicles had fewer transcripts than smaller follicles. Histological preparations revealed prolactin staining associated with follicular, luteal, and vasculature structures. This evidence supports our hypothesis that prolactin is produced in equine ovaries.

302 Efficacy of oral electrolyte supplementation for growth enhancement of weanling piglets. Paula Matuszak* and Gary Onan, *University of Wisconsin-River Falls, River Falls, WI USA.*

The purpose of this study was to examine the effects of oral electrolyte supplementation on growth performance of 17-21 day old weanling pigs. Three trials were conducted over the course of three summer months. For each trial, litters were initially sorted when weaned and placed into one of six tubs or one of two floor pens. Twenty-nine litters (218 total piglets) were used across the three trials of which 15 litters (111 piglets) were given electrolytes and 14 litters (107 piglets) comprised the control group. The electrolyte groups were administered a commercial electrolyte product (Tech-Mix Bluelite Swine Formula) at labeled rates through their water supply via a dosimeter for the first 5 days post-weaning. Initial litter weights were obtained at weaning. Litters were weighed at 7 days post weannng and 7-day feed intake recorded. At the conclusion of the 28-day transition period litter weights were again obtained. The experimental variables were average piglet weight and average gain/piglet during three time periods–days 1-7, days 8-28, and combined performance from day 1 through day 28. There was no difference in average piglet weight between the two groups at weaning (control–no electrolyte = 6.63 kg; electrolyte = 6.20 kg; P = 0.34) or at 7 days (control

= 7.11 kg; elec. = 7.11 kg; P = 0.99), but there was a strong tendency for the electrolyte groups to be heavier at 28 days (control = 13.09 kg; elec. = 15.94 kg; P = 0.0581). Gain/piglet during each time period was significantly higher for the electrolyte group (P < 0.05). During the initial 7 days, the control piglets gained 0.478 kg and electrolyte gained 0.909 kg. During the 7 to 28 day period the control piglets gained 5.98 kg and electrolyte group gained 8.82 kg. Overall gain/piglet was 6.46 kg for control and 9.73 kg for the electrolyte group. There was no difference in feed intake during the initial 7 days post-weaning (control = 2.04 kg; electrolyte = 1.69 kg). Electrolyte supplementation during the initial 5 days post-weaning is likely beneficial for piglet growth performance during the transition phase in a tub-weaning system.

Key Words: Electrolyte, Transition piglets, Growth

303 The effects of extruding distillers grain on particle size and extruder emissions. J.D. Lee*[1], P.M. Walker[1], A.L. Shreck[1], and G.A. Apgar[2], [1]*Illinois State University, Normal, IL USA*, [2]*Southern Illinois University, Carbondale, IL USA.*

Extrusion is a technology that may be able to improve nutrient availability of distillers grains with solubles (DDGS) and to reduce volatile organic compounds (VOC) generated during DDGS drying. As part of a larger project, the objectives of this study were to evaluate the effects of passing DDGS as the sole ingredient or combined with other feedstuffs through a single screw extruder on particle size and VOC emissions generated during extrusion. Five feed combinations were compared: DDGS non-extruded (E1), DDGS extruded (E2), extruded 30% whole soybeans + 70% DDGS (E3), extruded 30% soybean meal + 70% DDGS (E4) and extruded 65% soybean meal + 35% wet distillers grains (47.0% moisture) (E5). Particle size was determined as percent failure to pass (percent retention) through a series of screens (2mm, 1mm, 500 microns, 250 microns, 125 microns and 45 microns) vibrated for 5 min. on a sieve shaker. No feed particles were observed to pass 125 microns. Significantly more feed failed to pass through the 1 mm screen for extruded feeds compared to E1. Order of feed retention on the 1 mm screen was E4=E5>E3=E2>E1 comparing 64.9%, 59.8%, 46.5%, 41.2% to 22.8%, respectively. More (P<0.05) feed failed to pass through the 500 micron screen for extruded feeds compared to E1. Order of feed retention on the 500 micron screen was E5=E4>E3=E2>E1 comparing 86.9%, 83.8%, 78.4%, 73.9% to 67.3%, respectively. Exhaust emissions (CO, SO2, NO, NO2, NOx and Hydrocarbons) were measured using Clean Air Instrumentation ® Palatine, IL. All volatile organics measured were below EPA maximum detection limits (MDL) CO =25.7 ±20.61%, SO2 = 0.8 ±0.77%, NO = 2.1 ±1.49%, NO2 = 0.3 ±0.41%, NOx = 2.5 ±1.61% and hydrocarbon = 0.03 ±0.0055%. In this study extruding DDGS did not increase VOC emissions above EPA, MDL and increased particle size implying greater flowability.

Key Words: Extrusion, DDGS, Particle size

304 Economic analysis of beef cattle finishing diets containing corn and soybean co-products. D.S. Stoner*[1], P.M. Walker[1], and L.A. Forster[2], [1]*Illinois State University, Normal, IL USA*, [2]*Archer Daniels Midland Company, Decatur, IL USA.*

Renewable fuels legislation has resulted in increaesd supplies of dried distiller's grains with solubles (DDGS) and soyhulls (SH), and an opportunity to decrease feed costs through their inclusion in finishing diets. This study consisted of an econonmic analysis (as fed basis) of a feeding trial reported in JAS 85: Suppl 1.348 in which 192 Angus crossbred steers were fed diets containing 0, 25 or 40% DDGS and 44% SH. Steers were fed one of five regimens; 70.7% shelled corn (SC), 13.8% grass hay (GH) and 13.3% soybean meal (SBM) (T1); 59.4% SC, 13.92% GH, 24.46% DDGS (T2); 39.14% DDGS, 44.72% SH and 13.92% GH (T3); T3 fed 28d (T4) or 56d (T5) followed by T2 fed to harvest. Days on feed prior to harvest were 156 for T1 and T2, 187 for T4 and T5, and 232 for T3. Costs of feedstuffs, expressed as cents/kg or lb, were 3.05: kg (6.7 :lb) SC, 2.73: kg (6.0: lb) GH, 6.34: kg (13.94 :lb) SBM, 2.5: kg (5.5: lb) DDGS, 2.5 :kg (5.5: lb) SH, 0.61: kg (1.33: lb) trace mineralized salt, 0.03: kg (0.06: lb) limestone and 1.23: kg (2.71: lb) Rumensin® premix. Costs/kg (lb) of diet were 3.38 (7.43) for T1, 2.81 (6.19) for T2, 2.49 (5.48) for T3, 2.76 (6.08) for T4 and 2.72 (5.98) for T5. Costs/kg (lb) of live wt. gain 28.90 (63.60) for T1, 23.64 (52.00) for T2, 23.66 (52.06) for T3, 25.01 (55.02) for T4 and 24.65 (54.24) for T5. Inclusion of co-products significantly reduced cost/kg of gain compared to the SC-SBM diet. No differences (P>0.05) in cost of gain were observed between diets containing co-products. Total cost of feed to harvest was greatest (P<0.05) for T3 and lowest (P<0.05) for T2. No differences (P>0.05) in total cost of feed to harvest was observed between T1, T4 or T5. Gross dollar return over feed cost was different (P<0.05) as follows: T2>T4=T5>T1>T3. Shelled corn based diets containing 25% DDGS (DM basis) can return more gross dollars over feed cost. Based on the analysis of this study, diets replacing shelled corn with DDGS and SH should be limited to no more than 30% of the feeding period.

Key Words: DDGS, SH, Economic analysis

AUTHOR INDEX

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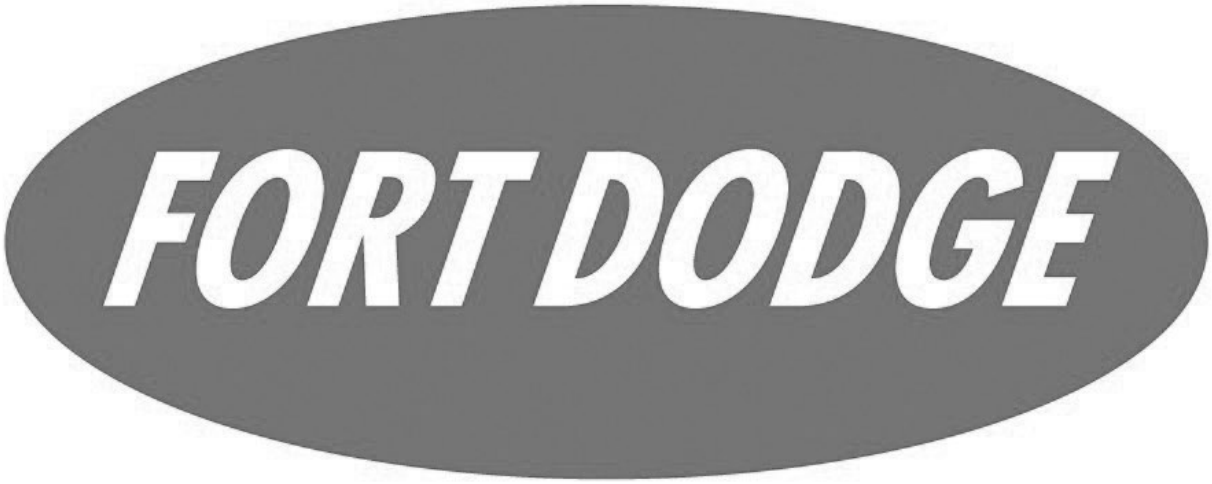

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