

266 Effects of temperature-humidity index on pregnancy rate in beef cattle. J. L. Amundson*¹, T. L. Mader¹, and R. J. Rasby¹, ¹ *University of Nebraska-Lincoln.*

Cows exposed to adverse weather during the breeding season are assumed to have decreased fertility and pregnancy rates. The objective of this study was to quantify the effect of temperature-humidity index (THI) on pregnancy rate (PR) of cattle. Eleven years of breeding data were examined from a herd of commercial, *Bos taurus*, crossbred cows (n~180/y) from the University of Nebraska Dalbey-Hallack Research Farm in Virginia, Nebraska. Data included cow number, calf identification, calf sex, and calving date. All cows were bred by natural service, beginning in late-May, with a typical breeding season of 60 to 75 days. The bull to female ratio was approximately 1:25. Spring calving dates were recorded and used to calculate approximate breeding date. For standardization purposes, gestation length was 283 days in length. Relationships were determined between the proportion of cows bred in the first 30 days of the breeding season and mean temperature and THI during those 30 days. Weather data were compiled from the Great Plains Climate Center Weather Archives for a weather station located approximately 20 km from the research site. Average daily temperature and relative humidity were used to calculate daily THI for determining average THI for the first 30 days of the breeding period. The mean 30-day temperature and THI were 20.0 °C and 66.3, respectively. The change in PR, in the first 30 days of breeding, based on the entire breeding season or only the first 60 days were found to be -1.5% (R²=0.30;P<0.1) and -1.6% (R²=0.47;P<0.05), respectively, per °C increase in mean temperature, and -1.1% (R²=0.33;P<0.1) and -1.1% (R²=0.49;P<0.05), respectively, per unit increase in mean THI. Preliminary analysis indicated a PR threshold existed at THI=65. For the six years THI > 65, the change in 30-day PR, based on the entire breeding season or only the first 60 days were found to be -2.1% (R²=0.53;P<0.1) and -1.8% (R²=0.72;P<0.05), respectively, per °C increase in mean temperature, and -1.6% (R²=0.64;P<0.06) and -1.4% (R²=0.81;P<0.05), respectively, per unit increase in mean THI above 65. For the five years THI<65 slopes were not significant and R² were less than .12. Within a 30-day period, PR declines 1.4 to 1.6% for each unit increase in mean THI above 65.

Key Words: Beef Cattle, Pregnancy Rate, Heat Stress

267 Pregnancy status of beef heifers immunized against luteinizing hormone and luteinizing hormone-releasing hormone. C. D. Holladay*, A. W. Thompson, D.R. Eborn, and D.M. Grieger, *Kansas State University.*

Immunization against reproductive hormones is a promising method of preventing heifers from entering the feedlot pregnant due to accidental bull exposure. Previous studies have successfully vaccinated against luteinizing hormone (LH) and luteinizing hormone-releasing hormone (LHRH) by linking these hormones to carrier proteins. The objective of this study was to develop a vaccine against LHRH and/or the β subunit of bovine LH (LH β) using recombinant DNA methods. Glutathione-S-transferase (GST) coded for by the commercial expression vector pGEX-4T-3 (Pharmacia), served as the antigen of the control group, as well as the carrier protein for the three test groups. Three plasmids were constructed to encode for recombinant fusion proteins GST-LH β , GST-LHRH, and GST-LHRH-LH β . Protein was produced by a bacterial expression system and purified by GST affinity columns. Twenty yearling

beef heifers were immunized against GST (n=5), GST-LH β (n=5), GST-LHRH (n=5) or GST-LHRH-LH β (n=5). Three injections were given at two-week intervals with an equal volume of Freund's complete adjuvant for the primary immunization and Freund's incomplete adjuvant for both booster immunizations. A fertile bull was placed with the heifers one week after the final immunization. Pregnancy status was determined using rectal palpation and ultrasonography 15 weeks after first bull exposure. The pregnancy rate of heifers immunized against LHRH (20%) was reduced when compared to the other treatment groups (p=0.01). All 5 heifers in the GST and GST-LH β were pregnant compared to only 2 of 5 in the GST-LHRH-LH β and 1 of 5 in the GST-LHRH treatment groups. Of the four nonpregnant heifers in the LHRH immunized group, three possessed infantile reproductive tracts. This study suggests that the combination of immunizing against both LH and LHRH was not more effective than LHRH alone, however, the recombinant LHRH treatment could have potential as a sterilization vaccine.

Key Words: LHRH, Immunization, Heifer

268 A timed artificial insemination (TAI) protocol for synchronizing two inseminations within a 32-d period in dairy cows and heifers. J. P. Meyer*, S. J. Kolath, R. P. Radcliff, M. L. Rhoads, B. L. McCormack, and M. C. Lucy, *University of Missouri-Columbia.*

An estrous synchronization TAI protocol (PGPG with rapid resynchronization) that enables TAI of first and second (repeat service in cattle diagnosed nonpregnant) inseminations was tested in Holstein dairy cows (Exp. 1; n=80) and heifers (Exp. 2; n=51). The PGPG cattle were treated as follows: PGF_{2 α} (25 mg Lutalyse), 3 d, GnRH (100 μ g Cystorelin), 8 d, PGF_{2 α} , 2 d, GnRH, 4 h (heifers) or 8 h (cows), TAI. Control (PP) cattle were injected with PGF_{2 α} as above but were injected with saline (2 ml) in place of GnRH and were AI following estrus after the second PGF_{2 α} . Blood for progesterone analysis was collected immediately before each injection. Pregnancy was detected by ultrasonography 30 d after AI. Dairy cows (Exp. 1) treated with PGPG had greater insemination rates [IR; 36/36 (100%); P<.001], equivalent conception rates [CR; 14/36 (39%)], and greater pregnancy rates [PR; 14/36 (39%); P<.01] compared to PP cows [15/44 (34%), 4/15 (27%), and 4/44 (9%), respectively]. Heifers (Exp. 2) treated with PGPG had greater IR [26/26 (100%); P<.05], and equivalent CR [16/26 (62%)], and PR [16/26 (62%)] compared to PP heifers [21/25 (84%), 11/21 (52%), and 11/25 (44%), respectively]. Conception rates for cows and heifers with luteolysis after the second PGF_{2 α} were greater for PGPG compared to PP [27/41 (66%) and 9/25 (36%); PGPG and PP, respectively; P<.05]. The PGPG cows (n = 34) and heifers (n=8) diagnosed nonpregnant at 30-d pregnancy exam underwent rapid resynchronization TAI [PGF_{2 α} , 2 d, GnRH, 4 h (heifers) or 8 h (cows), TAI]. Pregnancy rates for cows and heifers after rapid resynchronization TAI [11/34 (32%) and 5/8 (63%), respectively] were similar to first TAI. We conclude that PGPG is a TAI protocol that can be used in dairy cows and heifers that achieves greater (cows) or equivalent (heifers) pregnancy rates compared to PP and AI at estrus. Cows and heifers treated with PGPG and diagnosed nonpregnant can be resynchronized and TAI within 2 d after a 30-d pregnancy exam.

Key Words: Estrous Synchronization, Dairy, AI

Ruminant Nutrition and Forages

271 Ruminant ammonia load does not impact histidine utilization by growing steers. K. C. Candler*, E. C. Titgemeyer, M. S. Awawdeh, and D. P. Gnad, *Kansas State University.*

Six ruminally cannulated Holstein steers (144 kg) housed in metabolism crates were used in a 6 x 6 Latin square to determine effects of rumen ammonia load on utilization of histidine (His). The basal diet (83% soybean hulls, 8% wheat straw, 0.4% urea, DM basis) was fed twice daily to provide 2.5 kg DM/d. Experimental periods were 6 d, with 2 d for adaptation to treatment and 4 d for total fecal and urinary collection for N balance. Basal abomasal infusions contained: 250 g/d amino acids, which supplied adequate amounts of all essential amino acids except His; 10 mg/d vitamin B-6, 10 mg/d folic acid, and 0.1 mg/d vitamin

B-12; and 300 g/d glucose. Basal ruminal infusions contained 180 g/d acetate, 180 g/d propionate, and 45 g/d butyrate to supply energy without increasing microbial protein supply. Treatments were continuously infused, arranged as a 3 x 2 factorial, and included: 0, 1.5, or 3 g/d L-His infused abomasally; and 0 or 80 g/d urea infused ruminally to supply a metabolic ammonia load. Total N intake increased from 89.5 g/d for steers receiving no urea to 126.6 g/d for steers receiving 80 g/d urea. Urea infusions increased (P < 0.01) rumen ammonia concentration from 8.6 to 19.7 mM and plasma urea from 2.7 to 5.1 mM. No change in N retention occurred in response to urea (35.1 and 37.1 g/d for 0 and 80 g/d urea, respectively, P = 0.15). There also was no His x urea interaction for N retention (P = 0.64). Retained N increased linearly (P < 0.01) with His (31.5, 37.8, and 39.0 g/d for 0, 1.5, and 3 g/d L-His, respectively). Fecal N was similar among all treatments, so change in

N retention resulted from relative changes in N intake and urinary N excretion. Efficiency of deposition of supplemental His between 0 and 1.5 g/d was 50% when steers received no urea and 81% for steers receiving 80 g/d urea. In our model with growing steers, increases in the ammonia load did not demonstrate a metabolic cost in terms of whole body protein deposition, regardless of whether His was limiting.

Key Words: Histidine, Ammonia, Growth

272 Effect of urea concentration in steam-flaked corn diets on nutrient digestion and ruminal kinetics. S.S. Swanek^{*1}, C.R. Krehbiel¹, and D.R. Gill¹, ¹Oklahoma State University.

Increasing urea concentration in isonitrogenous steam-flaked corn diets was investigated. Five ruminally and duodenally cannulated steers (initial BW 37534 kg; 1.160.13 kg ADG) were used in a 5 x 5 Latin square design experiment to determine the effects of urea concentration on intake, nutrient digestion, and ruminal kinetics. Isocaloric ($NE_m = 2.08$ Mcal/kg; $NE_g = 1.31$ Mcal/kg) and isonitrogenous (2.24% N) steam-flaked corn diets with urea concentrations of 0, 0.8, 1.2, 1.6, or 2.0% (DM basis) were offered ad libitum to steers. Following nine days of diet adaptation total urine and feces were collected for four days. On d 14, ruminal fluid was collected at 0, 3, 6, 9, 12, 15, 18, 21, and 24 h after pulse dosing with Co-EDTA. Dietary urea concentration did not affect ($P > 0.10$) DM intake. Steers consuming diets containing 1.6% urea had the lowest ($P < 0.05$) ADF intake, while steers consuming 0.8 and 2.0% urea diets had the greatest ($P < 0.05$) ADF intake. Steers consuming diets containing 0% urea had lower ($P < 0.05$) starch intake than steers consuming 2.0% urea diets, and tended ($P = 0.06$) to have lower starch consumptions than steers containing 0.8% urea diets. Urea concentration had no effect ($P > 0.10$) on fecal output of DM, OM, and starch, or DM, OM, N, and starch digestibility. Steers consuming diets containing 1.6% urea had lower ($P < 0.05$) ADF digestibility than steers consuming 0 or 0.8% urea diets. Urea concentration did not influence fecal N output, total N balance, or N balance as a percent of N intake. Similarly, liquid dilution rate and pH were not affected ($P > 0.05$) by urea concentration. Our data suggests that high urea concentrations can be utilized in steam-flaked corn finishing diets without altering intake, nutrient digestion, or ruminal kinetics.

Key Words: Ruminal Metabolism, Urea, Degradable Intake Protein

273 Effect of compensatory growth on net metabolite and hormone flux across splanchnic tissues during adaptation to a high-grain diet in beef steers. M. J. Hersom^{*1}, C. R. Krehbiel¹, G. W. Horn¹, J. G. Kirkpatrick¹, R. P. Wettemann¹, and D. H. Keisler², ¹Oklahoma State University, ²University of Missouri.

Ten multicatherized steers were used in a completely random design to determine the effect of previous rate of gain on metabolite and hormone flux across total splanchnic tissues (TST) of beef steers fed a high-grain diet. Treatments were high (HG; 1.25 ± 0.14 kg/d; BW = 341 ± 27 kg) or low (LG; 0.73 ± 0.13 kg/d; BW = 265 ± 11 kg) daily gain while grazing winter wheat pasture. After steers were grazed for 69 d, chronic indwelling catheters were surgically placed in the portal vein, a hepatic vein, and a mesenteric artery and vein. Blood flow (BF) and oxygen consumption by portal-drained viscera (PDV) and liver were measured on d 0, 14, 28, 42, 64, and 92 of a high-grain feeding period following priming (20 mL) and continuous infusion of p-aminohippuric acid. Compensatory growth was evident in LG steers (30% compensation by d 28); ADG (2.13 vs 1.31 kg/d; $P = 0.01$) and ADG:DMI (0.221 vs 0.103 ; $P = 0.005$) were greater from d 0 through 28. Across the 92-d experiment, mean OM digestibility was greater ($P = 0.01$) in HG than LG steers, but N digestibility did not differ ($P = 0.20$). Portal BF increased ($P < 0.001$) with days on feed (DOF), but did not differ ($P = 0.51$; 664 L/h) among treatments. Hepatic BF in LG was greater ($P = 0.05$) than HG steers ($756 > 603 \pm 40$ L/h) and increased ($P < 0.001$) with increasing DOF. Ammonia, urea-N, and α -amino N flux across TST did not differ ($P > 0.30$) among treatments. Release of glucose from TST did not differ ($P = 0.47$) among treatments, but increased with increasing DOF ($P < 0.001$). Insulin PDV release increased ($P < 0.001$) and hepatic removal of insulin decreased ($P = 0.08$) in both HG and LG with DOF. Net insulin release from TST increased ($P = 0.06$) with DOF in both HG and LG steers. Leptin ($P > 0.39$) and IGF-I ($P > 0.29$) TST flux did not differ among treatments. Steers that had lower BW gains (0.73 kg/d)

prior to high-grain feeding had increased finishing performance early in the finishing period compared with HG steers. However, performance was not related to nutrient and hormone flux across TST during compensatory growth early in the feeding period.

Key Words: Cattle, Compensatory Growth, Nutrient Flux

274 Effects of roughage level and calcium magnesium carbonate buffer on ruminal metabolism and site and extent of digestion in beef steers fed a high-grain diet. C. D. Keeler^{*1}, C. R. Krehbiel¹, and J. J. Wagner², ¹Oklahoma State University Stillwater, OK, ²ContiBeef, LLC Lamar, CO.

Five crossbred steers (initial BW = 263 ± 9 kg) fitted with ruminal and duodenal cannulas were used in a 5 x 5 Latin square design to evaluate the effects of roughage level and calcium magnesium carbonate buffer on ruminal metabolism and site and extent of digestion in beef steers. Steers were allowed ad libitum access to a 90% concentrate feedlot diet consisting of steam-flaked corn and corn silage. Steers were randomly allotted to one of five treatments: 1) 3.8% roughage and 0% buffer; 2) 7.5% roughage and 0% buffer; 3) 11.3% roughage and 0% buffer; 4) 3.8% roughage and 1.5% buffer; and 5) 7.5% roughage and 1.5% buffer. Each period included 16 d for adaptation and 5 d for sampling. Water intake was lower ($P < 0.05$) when 7.5% roughage and 1.5% buffer were fed compared with the other treatments. Dry matter intake did not differ ($P = 0.21$) among treatments, although DMI numerically increased as roughage level increased (6.2, 6.9, and 7.5 0.6 kg/d for 3.8, 7.5, and 11.3% roughage, respectively). Duodenal flow of OM followed a similar trend as intake, and was greater ($P < 0.05$) when 11.3% roughage was fed compared with 3.8 or 7.5% roughage. Neutral detergent fiber ($P = 0.09$), ADF ($P = 0.01$) and N ($P = 0.06$) intake increased as dietary roughage increased, although ruminal and total tract digestibility of these response variables did not differ ($P > 0.10$) among treatments. Ruminal fluid volume and turnover time was not influenced ($P > 0.10$) by roughage level or buffer. Feeding buffer decreased ($P = 0.07$) fluid flow rate out of the rumen. Ruminal fluid pH was not ($P > 0.10$) affected by roughage level or buffer. In our experiment, feeding calcium magnesium carbonate buffer did not appear to influence site and extent of digestion.

Key Words: Roughage Level, Buffers, Digestion

275 Relationship between feeding behavior and performance of feedlot cattle. D. D. Hickman^{*1}, T. A. McAllister², K. S. Schwartzkopf-Genswei³, D. H. Crews, Jr.², and C. R. Krehbiel¹, ¹Oklahoma State University, Stillwater, Oklahoma, ²Agriculture and Agrifood Canada, Lethbridge, Alberta Canada, ³Alberta Agriculture Food and Rural Development, Lethbridge, Alberta, Canada.

The relationship between eating patterns and performance of feedlot steers was evaluated using 74 Charolais sired steers (initial BW = 277 ± 111 kg) blocked by BW and assigned to two feedlot pens equipped with a radio frequency identification system (GrowSafe Systems). Each pen featured five feeding stalls that allowed single animal access to a feed tub suspended on load cells. The system recorded animal ID, time, duration and amount of feed consumed during each bunk visit. Barley silage/barley grain backgrounding diets were delivered over an 87-d backgrounding phase and barley grain/barley silage finishing diets were delivered 2 to 3X/d to meet ad libitum intake over the experiment. Steers were weighed every 14 d. To relate feeding behavior to performance, steers were grouped by their DMI, daily intake variation (DV), number of visits to the bunk, duration of visits, ADG, and DMI:ADG and categorized (mean \pm SD) as average, high or low. The system allowed for calculation of DV and eating rate (ER). Overall, high ADG steers (1.79 ± 0.11 kg) had the greatest ($P < 0.001$) daily DMI ($8.69 > 8.04 > 7.66 \pm 0.21$ kg/d), the greatest ($P < 0.001$) DV ($3.08 > 2.94 > 2.72 \pm 0.13$ kg/d) and spent the least ($P < 0.001$) amount of time at the bunk (99.99 ± 1.21 min/d) compared with average or low steers, respectively. Similarly, when classifying steers according to DMI:ADG, the most efficient steers (5.35 ± 1.18 kg/kg) had the greatest ($P < 0.001$) DV (3.28 ± 0.12 kg/d), the greatest ADG (1.73 ± 0.81 kg) and spent the least ($P < 0.001$) amount of time at the bunk (91.59 ± 2.23 min/d). Steers classified as high ER had the greatest ($P < 0.001$) overall DMI ($8,562 \pm 269$ kg), least ($P < 0.001$) bunk visits (5.56 ± 0.33), spent the least amount of time at the bunk (75.21 ± 2.79 min/d), were the most efficient (6.65 ± 0.16 kg/kg) and had the greatest ($P < 0.001$) ADG (1.40

± 0.03 kg/d) compared with average or low ER steers. When classifying steers, response variables seemed to follow a similar trend in each category. Steers with the greatest performance had the most variable eating patterns. The eating pattern portrayed by the high - performing steers included short visits to the bunk, and the greatest DMI with the greatest variation in day to day intake.

Key Words: Feedlot, Behavior, Performance

276 Tympanic temperature and behavior associated with moving feedlot cattle. T. L. Mader*¹, M. S. Davis², and W. M. Kreikemeier¹, ¹University of Nebraska, ²Koers-Turgeon Consulting Service, Inc..

The effect of activity on body temperature is particularly important when body temperature is used as an indicator of health status or when environmental conditions exist which could contribute to heat stress. In two winter and two summer studies, tympanic temperature (TT), an indicator of body temperature, was obtained in unrestrained yearling, feedlot cattle. The objectives of these studies were to evaluate effects of cattle movement in the feedyard and quantify TT of animals moved various distances and at different times during the year. Groups of cattle (four to six head) were moved through working facilities a total distance of 150m (January), 300m (February), 150 or 600m (August), and 1,000, 2,000 or 3,000m (June). Baseline TT was determined on non-moved days. During the winter and summer studies, TT were recorded every 15 minutes and 2 minutes, respectively. Moving cattle elevated mean TT between 0.3 and 0.8°C ($P < 0.05$), with individual animals displaying TT increases of over 1.5°C. Season effects were not apparent. During these studies, climatic conditions were near normal in the summer, while ambient temperatures were slightly above normal in the winter. Peak TT usually occurred between 15 and 30 minutes after initiation of cattle movement; an additional 1 to 4 hours were required for TT to return to normal levels. Only in August was a change in TT closely related to total distance moved (.3 and .7°C for 150 and 600m move, respectively; $P < 0.05$). In the June study, moving cattle resulted in fewer ($P < 0.1$) cattle at the bunk, in the morning, and more ($P < 0.05$) cattle standing in both morning and afternoon. Effects of cattle movement and handling on body temperature need to be taken into account when evaluating animal health studies. Furthermore, minimal handling of cattle during hot days is recommended for promoting and maintaining animal comfort.

Key Words: Beef Cattle, Tympanic Temperature, Processing

277 Vaccination and feeding a competitive exclusion product as intervention strategies to reduce the prevalence of *Escherichia coli* O157:H7 in feedlot cattle. J.D. Folmer*¹, C.N. Macken¹, G.E. Erickson¹, T.J. Klopfenstein¹, M.L. Khaitsa¹, S. Hinkley¹, R.A. Moxley¹, D.R. Smith¹, A.A. Potter², and B. Finlay³, ¹University of Nebraska, ²University of Saskatchewan, ³University of British Columbia.

A clinical trial was conducted to test the effect of vaccination (V) and feeding a competitive exclusion (CE) product on the proportion of feedlot steers shedding *Escherichia coli* O157:H7 (O157) in feces. Three hundred eighty-four steers were blocked by weight, stratified by weight within block and assigned randomly to 48 pens. The finishing diet of 55% high moisture corn, 35% wet corn gluten feed, 5% corn silage, 2% alfalfa hay, 2% supplement, and 1% water was identical for all treatments and contained a minimum of 12.5% CP, 0.7% Ca, 0.65% K, and 0.3% P. CE and V treatments were allocated to pens in a 2 x 2 factorial design with three weight blocks and twelve repetitions per treatment. The V, designed to immunize against secreted proteins of O157, was administered 3 times at 3-week intervals to cattle within assigned pens beginning d-0 of each block. A *Lactobacillus acidophilus* CE product was fed with the ration continuously from d-24 of the trial. Samples of rectal feces were collected for bacterial culture. Each block was sampled every three weeks for the entire 121d (May-September) feeding period resulting in 1 pre-treatment and 5 test-period samplings. Outcome measures were pen-level performance and the proportion of animals per pen culture-positive for O157. Feedlot performance and O157 outcomes were analyzed using MIXED procedures of SAS accounting for repeated sampling for O157. Treatment groups did not differ in performance (ADG, DMI, gain to feed, marbling score, fat thickness, or yield grade). The pre-treatment prevalence of O157 averaged 31%, and did not differ significantly between treatments ($P=0.19$). The average proportion of cattle shedding O157 differed ($P=0.01$) over the 5 test-periods (18.5%,

10.2%, 11.7%, 4.4%, and 18.8%, respectively); however, no interaction was observed between treatments or between treatment and time. The average proportion of cattle shedding O157 for treatments of control, CE alone, V alone, and CE with V were 21.3%, 13.3%, 8.8%, and 7.7%, respectively. Adjusting for the effect of CE and block, the proportion of cattle shedding O157 in V treated pens was significantly less than non-V pens ($P=0.03$). V alone, or possibly in combination with CE feeding, may be useful to reduce prevalence of O157 in feedlot cattle.

Key Words: Feedlot Cattle, Intervention, *E. coli* O157:H7

279 A flow cytometric method for intracellular analysis of glutathione concentration in bovine natural killer cells. L. A. Matulka*¹, L. Wilkie², C. Kuszynski², D. R. Brink¹, and C. L. Kelling¹, ¹University of Nebraska, Lincoln, NE, ²University of Nebraska Medical Center, Omaha, NE.

Glutathione (GSH), a tripeptide composed of glutamic acid, cysteine, and glycine, is an anti-oxidant and an important regulator of cell function. The immune system works best if the lymphocytes have a balanced level of GSH. Cellular GSH concentration may be amenable to nutrition because cysteine availability is markedly influenced by diet. Diseases that are associated with a glutathione deficiency result in impaired immunological function. Measurement of intracellular GSH concentration in bovine natural killer (NK) cells will play an important role in determining the basis for altered NK cell function during infection. The traditional method for GSH measurement is high performance liquid chromatography. In the present study intracellular GSH concentrations in bovine NK cells were determined using flow cytometric analysis. Peripheral blood mononuclear cells were prepared by Ficoll-Paque density centrifugation and enriched for NK cells (1000U/ml of interleukin-2 for 72 h at 37 °C and 5% CO₂). After incubation mononuclear cells were stained with antibodies recognizing CD2 and CD3 to identify NK cells (CD2+, CD3-). Cells were sorted using a Becton Dickinson FACSVerse SE (92% NK cells). NK cells were further stained with monochlorobimane and intracellular GSH levels were determined as the fluorescence produced from the GSH-s-transferase conjugation of monochlorobimane with GSH. This method of fluorescence activated cell sorting (FACS) coupled with multiparameter immunofluorescence sub setting allowed for GSH levels of a particular cell type (NK cells) to be determined. This method allows for a rapid means to sort viable cells by their GSH levels then assay functionality of the cell.

Key Words: Glutathione, Flow Cytometry, NK Cells

280 Effects of high selenium wheat on carcass weight, visceral organ mass and intestinal growth in finishing beef steers. S. A. Soto-Navarro*¹, T. L. Lawler², J. B. Taylor², L. P. Reynolds¹, J. J. Reed¹, and J. S. Caton¹, ¹North Dakota State University, Fargo, ²USDA, ARS, U.S. Sheep Experiment Station.

Twelve crossbred steers (351.1 ± 24.1 kg initial BW) were used to determine effects of high selenium (Se) wheat on visceral tissue mass and intestinal cell growth. Steers were allotted randomly by weight to one of two treatments consisting of 75% concentrate diets that supplied: 1) adequate Se level (7 to 12 g kg BW⁻¹ d⁻¹), or 2) high Se level (60 to 70 g kg BW⁻¹ d⁻¹). Diets were similar in feedstuff composition (25% grass hay, 25% wheat, 39% corn, 6% desugared molasses, and 5% wheat middlings supplement, DM basis). In the Se treatment, high Se wheat (10 ppm) was exchanged for commodity wheat (0.35 ppm). Diets were formulated to be similar in nitrogen and energy (14.0% CP, 2.12 Mcal NEm/kg, and 1.26 Mcal NEg/kg DM) and were offered once daily (1500) individually to steers in a Calan Gate System. After 126 d, steers were slaughtered and individual visceral tissue weights determined. In addition, intestinal tissue protein, DNA, and RNA concentrations, and cell proliferation were determined. No effects were observed ($P > 0.05$) for mass of empty body, hot carcass, digesta, liver, spleen, kidney, duodenum, ileum, or small intestine. Concentrations of DNA, RNA, and protein of duodenum, ileum, and total small intestine were also unaffected by treatment. Ratios of RNA:DNA and Protein:DNA in duodenum, jejunum, ileum, and whole small intestine were not ($P > 0.10$) affected by high Se wheat. Conversely, jejunal weight was greater ($P < 0.002$) in steers fed high Se wheat compared with controls (916 vs 1427 ± 84 g). Jejunal DNA was increased ($P < 0.04$) in high Se steers (2.95 vs 3.56 0.19 mg/g) suggesting increased cell number. Concentrations of jejunal RNA and protein were not altered ($P > 0.59$) by treatment; however, since the jejunal weight increased in high Se steers, DNA, RNA, and

protein contents (g) were greater ($P < 0.05$). Jejunal crypt cell proliferation was unaffected ($P > 0.1$) by treatment. These data indicate that diets high in Se (provided from wheat) result in increased jejunal mass and DNA which is not explained by changes in crypt cell proliferation.

Key Words: Selenium, Intestinal Mass, Cellular Proliferation

281 Influence of dietary encapsulated ascorbate and α -tocopherol on performance, serum antioxidant concentrations and white blood cell changes of transit stressed wether lambs. N. K. Chirase^{1,2}, L. W. Greene^{1,2}, N. A. Cole³, and D. Putnam⁴, ¹Texas Agric. Exp. Sta., Amarillo, ²West Texas A&M Univ., Canyon, ³USDA/ARS, Bushland, ⁴Balchem Encapsulates, Midletown, NJ.

Animals often encounter many environmental stressors and pathogens associated with modern animal production which could compromise the antioxidant and immune defense systems. An experiment was conducted to determine the effects of dietary encapsulated ascorbate (VitC), α -tocopherol (VitE), and a combined encapsulated VitC and VitE (VitCE) on performance, serum antioxidants concentrations and white blood cell (WBC) changes of transit stressed wether lambs. Twenty four lambs (average BW 36 kg) were allotted randomly into 4 groups, and individually fed (ad libitum) a basal diet with a ground corn premix (100 g/d) containing the following antioxidant supplements: 1) Control (ground corn), 2) VitC (2 g/d), 3) VitE (490 IU/kg DM), and 4) VitCE (VitC 2 g/d and VitE 490 IU/kg DM). The basal diet contained 75% concentrate, 25% roughage, 15.6% CP, 54 IU of α -tocopherol/kg and unknown ascorbate content. Lambs were adapted to their diets and pens for 28 d pretransit. Daily feed intake (d 0 to 28) and BW were measured and blood samples taken every 7 d. Harvested serum or plasma was used for retinol (VitA), α - and γ -tocopherol and ascorbate assays. On d 29, lambs were transported (1158 km) by truck and a trailer for 12 h after 24 h of fasting. Sampling and analysis procedures were repeated every 7 d for 28 d, and WBC counts performed. The data were analyzed using Mixed Models procedures of SAS. Lambs fed VitC or VitE had lower ($P < 0.05$) pretransit feed intake, ADG, and gain to feed ratio than those fed VitCE. Serum α -tocopherol concentration (ug/ml) was greater ($P < 0.05$) in lambs fed VitE or VitCE than lambs fed control or VitC. Lambs fed VitC or VitCE had lower monocytes and higher ($P < 0.05$) hemoglobin concentrations than controls. Encapsulated antioxidants increased serum antioxidants and hemoglobin concentrations of transit stressed lambs.

Key Words: Lambs, Encapsulated Antioxidants, Transit Stress

282 Effect of energy level and a fibrolytic enzyme on performance and health of newly received shipping stressed calves. R.E. Peterson¹, C.R. Krehbiel¹, D.R. Gill¹, and C.E. Markham¹, ¹Oklahoma State University, Stillwater, OK/USA.

Maintaining health of newly received shipping stressed calves in the feedlot continues to be problematic for feedlot managers. Diets and (or) feed additives that can improve digestibility and (or) boost the immune system might be important for the overall health and performance of newly received shipping stressed calves. The objective of this experiment was to determine the effect of increasing dietary energy with or without a fibrolytic enzyme on health and performance of sale-barn origin calves during a 56-d receiving study. Four truckloads (approximately 100 calves/load) of calves (avg initial BW = 213 16 kg) were received at the Willard Sparks Beef Research Center during the months of January, February, and March 2002. Calves were blocked by weight and randomly assigned to pens with each pen having a randomly assigned dietary treatment. Dietary treatments were arranged in a 2 x 2 factorial: 1) low energy; 2) low energy + enzyme (215 mg/kg of DM); 3) high energy; and 4) high energy + enzyme (215 mg/kg of DM). The low-energy diet consisted of 60% alfalfa hay, 10% cottonseed hulls (CSH), 24% dry rolled corn (DRC), 5% molasses and 1% supplement (NEm = 1.49 Mcal/kg; NEg = 0.85 Mcal/kg). The high-energy diet consisted of 25% alfalfa hay, 10% CSH, 50% DRC, 5% molasses and 10% supplement (NEm = 1.81 Mcal/kg; NEg = 1.10 Mcal/kg). Low and high-energy diets were formulated for 180 kg medium-framed calves to gain 0.82 and 1.27 kg/d, respectively. Data were analyzed using the MIXED procedure of SAS. Feeding enzyme did not affect ($P > 0.20$) overall ADG, DMI or ADG:DMI; however ADG tended ($P = 0.06$) to be greater from d 15 through 28 for calves consuming the high-energy diets. In addition, ADG:DMI tended ($P = 0.06$) to be greater from d 15 through 28 and

d 0 through 56 for calves consuming the high-energy diets. Morbidity was not influenced ($P > 0.10$) by energy level or by the addition of a fibrolytic enzyme. In our experiment, health and performance of newly received shipping stressed calves was not affected by the addition of a fibrolytic enzyme. However, increasing dietary energy improved feed efficiency by 14.6%. Because increasing energy did not negatively affect the health of calves in this experiment, we conclude that economics should dictate the receiving strategy.

Key Words: Stressed Calves, Energy, Fibrolytic Enzyme

287 Field pea replacement value in calf weaning transition diets. D. Landblom¹, D. Olson², and K. Helmut¹, ¹NDSU-Dickinson Research Extension Center, ²Dickinson State University, Dickinson, ND.

In a two year study, 299 beef steer and heifer calves were weaned and moved to the Dickinson Research Extension Center/s growing lots to evaluate the effect of a 37d conditioning period in which field peas replaced a portion of commonly used fiber-based ingredients (soyhulls, wheat midds, barley malt sprouts) on postweaning diet composition, subsequent feedlot performance, carcass quality and system economics. Pelleted treatments fed were: 1) SBM/Corn, 2) Pea/Corn, 3) 0% Pea, 4) 10% Pea, 5) 20% Pea and 6) 30% Pea. Test diets replaced approximately 70% of the hay offered. ADG (37d) was greater for calves receiving SBM/Corn, 0,10 and 20% pea replacement diets ($P < .0002$). Calves receiving a diet with no added pea consumed more feed/d. ($P < .0001$) than calves offered SBM/corn, 10 and 20% pea test diets. Replacing 30% of fiber-based ingredients with peas depressed gain ($P < .0002$), feed intake ($P < .0001$), and numerically increased feed required/pound of gain. Feed efficiencies among the test diets were 7.23, 8.34, 7.34, 7.0, 7.23, 9.1, for treatments 1-6, respectively, but did not differ. Steer calves were fed to final harvest at Decatur Co. Feedyard, Oberlin, KS. Steers that received 0 and 20% pea weaning diets required numerically fewer days on feed. No difference was measured for hot carcass weight ($P > .59$), REA ($P > .53$), marbling score ($P > .14$), yield grade ($P > .18$), quality grade ($P > .13$) or percent choice ($P > .15$). Regarding carcass quality, steers receiving a 20% pea replacement diet graded numerically higher (71.3% Choice), however, heavier final carcass weight and lower weaning feed cost among steers started on the SBM/Corn weaning diet combined to increase net return, despite a lower number of carcasses grading choice (45.1%). Highest enterprise net returns of \$179.24, \$168.90, and \$166.56/Hd were realized for steers receiving SBM/corn, 0 and 20% pea test diets, respectively. Overall, enterprise net return favored selling after a short 37d weaning period (ave = \$264.10) vs. retaining ownership (ave = \$160.57).

Key Words: Field Peas, Calves, Weaning Diets

288 Effects of ethyl 2-butyrate and 3-butenic acid on in vitro ruminal fermentation. E.M. Ungerfeld*, S.R. Rust, and R. Burnett, Michigan State University, East Lansing, MI.

The objective of this study was to evaluate the effects of combinations of the methanogenesis inhibitor, ethyl 2-butyrate, and the fermentation promoter, 3-butenic acid, on batch mixed ruminal cultures. Under a 3 x 2 factorial arrangement, ethyl 2-butyrate at 0, 4, and 8 mM initial concentration was combined with 3-butenic acid at 0 and 4 mM initial concentration. Ruminal fluid was extracted from two dairy cows fed a roughage diet. Finely ground alfalfa hay was used as a substrate. Four Wheaton bottles were used per combination and incubated in a shaking water bath for 24 h. Ethyl 2-butyrate at 4 and 8 mM decreased ($P < 0.01$) methane production by 49 and 100%, respectively. Both 3-butenic acid effect and the interaction between both additives were statistically significant ($P < 0.05$), but biologically negligible. Ethyl 2-butyrate at 4 and 8 mM caused an accumulation of dihydrogen ($P < 0.01$; quadratic response), while 3-butenic acid had no effect. Ethyl 2-butyrate decreased ($P = 0.03$; quadratic response) carbon dioxide production, while 3-butenic acid increased it ($P = 0.04$). Ethyl 2-butyrate decreased ($P < 0.01$; quadratic response) the acetate to propionate ratio from 3.15 to 2.39, while 3-butenic acid increased ($P < 0.01$) it from 2.52 to 2.87. Ethyl 2-butyrate caused ($P < 0.01$) an increase in ethanol production. Both additives decreased ($P < 0.01$) the final pH. None of the additives had an effect on ammonia concentration. Ethyl 2-butyrate at 4 and 8 mM decreased ($P = 0.02$; quadratic response) substrate fermentation as estimated by a mass balance (assuming complete disappearance of the additive) by 2.5 and 13 percentage units,

respectively. 3-Butenoic acid increased ($P = 0.04$) substrate fermentation by 3.9 percentage units. At 4, but not 8mM ethyl 2-butynoate, 3-butenic acid could overcome the decrease in fermentation caused by ethyl 2-butynoate.

Key Words: Methane, Rumen, Inhibition

289 Effect of frequency of protein supplementation on intake, nitrogen balance, and VFA proportions in beef steers consuming low-quality, tallgrass-prairie forage. C. G. Farmer*, R. C. Cochran, E. C. Titgemeyer, and T. A. Wickersham, *Kansas State University, Manhattan.*

The impact of supplementation frequency on forage use, N balance, and ruminal VFA proportions was evaluated. Four ruminally fistulated beef steers (BW=513 kg) were used in a 2 x 2 crossover design with two periods and two supplementation frequency treatments, allowing for 4 replications. Supplementation frequencies were 2 and 7 d/wk. Steers were fed tallgrass-prairie hay (73.1% NDF, 5.3% CP) ad libitum. The supplement (42% CP) was fed at 0.36% BW/head daily to steers supplemented 7 d/wk, whereas steers supplemented 2 d/wk received the same amount of supplement per week but equally split among supplementation days. Steers supplemented 7 d/wk had higher ($P < 0.06$) forage and total digestible OM intake. Forage DM intake of steers supplemented 2 d/wk tended to decrease on their day of supplementation. Steers supplemented 7 d/wk had greater ($P < 0.02$) total N intake, fecal N, and N retention, whereas steers supplemented 2 d/wk had higher ($P < 0.01$) urinary N excretion. But, both treatment groups had positive N balance. Ruminal fluid samples were collected at 0, 2, 4, 6, 12, 24, 48, and 72 h post-supplementation beginning on a day when both groups were supplemented. Total VFA concentration was not different ($P = 0.35$) due to supplementation frequency. Frequency x hour interactions ($P < 0.01$) were observed for all molar proportions of VFA. The molar proportion of acetate and acetate:propionate ratio was lower and the molar proportion of propionate and butyrate were higher for steers supplemented 2 d/wk from 4 h to 24 h post-supplementation. Proportions of branched-chain VFA were lower for steers supplemented 2 d/wk from 0 to 6 h post-supplementation, but by 12 h post-supplementation was higher. In conclusion, forage intake and N balance were improved with increased supplementation frequency, although some desirable shifts in VFA proportions accompanied infrequent delivery of large supplement amounts.

Key Words: Frequency, Supplementation, Nitrogen

290 Effect of frequency of protein supplementation on ruminal nitrogen metabolism in beef steers consuming low-quality, tallgrass-prairie forage. C. G. Farmer*, R. C. Cochran, T. G. Nagaraja, and T. A. Wickersham, *Kansas State University, Manhattan.*

The impact of supplementation frequency on ruminal nitrogen metabolism over time was evaluated. Four ruminally fistulated beef steers (BW=513 kg) were used in a 2 x 2 crossover design with two periods and two supplementation frequency treatments, allowing for 4 replications. Supplementation frequencies were 2 and 7 d/wk. Steers were fed tallgrass-prairie hay (73.1% NDF, 5.3% CP) ad libitum. The supplement (42% CP) was fed at 0.36% BW/head daily to steers supplemented 7 d/wk, whereas steers supplemented 2 d/wk received the same amount of supplement per week but equally split among supplementation days. Ruminal fluid samples were collected at 0, 2, 4, 6, 12, 24, 48, and 72 h post-supplementation beginning on a day when both groups were supplemented. Frequency x hour interactions ($P < 0.02$) were observed for all ruminal nitrogen metabolism characteristics. Counts of bacteria that can use short peptides and AA as their sole energy source (ammonia-releasing bacteria) peaked at 2 h and returned to nadir by 12 h for steers supplemented 7 d/wk, whereas steers supplemented 2 d/wk peaked at 6 h with a much greater population and returned to nadir at 72 h. Ruminal ammonia concentrations followed a trend similar to the ammonia-releasing bacteria. Specific activity of ammonia production was lower immediately after supplementation for steers supplemented 2 d/wk, but by 12 h was the same as for 7 d/wk steers. Ruminal peptides and free AA peaked at 2 h for steers supplemented 2 d/wk and were generally higher during the first 6 h compared with steers supplemented 7 d/wk. In conclusion, it appears that observed differences in the ammonia concentration in steers supplemented infrequently may

have been due to differences in the population of ammonia-releasing bacteria present following extended supplement withdrawal.

Key Words: Frequency, Supplementation, Ammonia

291 Nitrogen and phosphorus utilization by beef cattle fed three dietary crude protein levels with three levels of supplemental urea. K. W. McBride*¹, L. W. Greene¹, N. A. Cole², F. T. McCollum III¹, and M. L. Galyean^{3, 1} *TAES, Amarillo, TX, ²USDA-ARS, Bushland, TX, ³TTU, Lubbock, TX.*

Three dietary CP levels (11.5, 13.0, and 14.5% of DM) and three supplemental urea levels (100, 50, and 0% of supplemental CP from urea) were fed to determine performance, serum urea N (SUN), and N and P balance. Crossbred steers ($n = 27$; average BW = 315 kg) were blocked by weight and individually fed the nine treatments in a completely randomized block design. A steam flaked corn-based diet was fed, with supplemental CP supplied by either all urea, a 50:50 blend of urea and cottonseed meal (CSM), or all CSM. Steers were used in three nutrient balance collection periods (NBCP) at the beginning, middle, and end, of the feeding period. Venous jugular blood was obtained at the start and end of each NBCP. No CP level x CP source interactions ($P < 0.10$) were observed. Steer DMI, ADG, and feed efficiency did not differ ($P < 0.10$) among treatments. For each NBCP, urinary total N, urinary urea N (UUN), and SUN increased linearly ($P < 0.10$) as CP level increased. For NBCP 1 and 3, fecal N output increased linearly ($P < 0.10$) as supplemental CP from urea decreased. For NBCP 2 and 3, UUN decreased linearly ($P < 0.10$) as urea level decreased. For NBCP 1, fecal and urine P excretion increased linearly ($P < 0.10$), and P retained (% of intake) decreased linearly ($P < 0.10$), as CP level increased. Phosphorus intake increased linearly ($P < 0.10$) as urea level decreased for each NBCP. Fecal P output increased linearly ($P < 0.10$) in all NBCP, and urinary P excretion in NBCP 1 and 2 increased linearly ($P < 0.10$) as urea level decreased. Phosphorus retained (% of intake) decreased linearly ($P < 0.10$) as urea level decreased for NBCP 3. Results suggest that as dietary CP level increased, N retention decreased, and as supplemental CP supplied by urea decreased P balance decreased in feedlot steers. As days on feed increased, less N and P were retained, suggesting the potential to decrease N and P excretion by feeding less N and P as the feeding period progresses.

Key Words: Feedlot, Nitrogen, Phosphorus

292 Nitrogen retention and apparent digestibility of diets differing in concentration of soybean hulls fed to growing lambs. J. Rekhis¹ and T. R. Johnson*^{2, 1} *Manouba University Veterinary School of Tunisia, ²Purdue University West Lafayette, IN.*

The objective of this study was to determine digestibility, nitrogen retention, and efficiency of nutrient utilization of diets containing increasing levels of soy hulls fed growing lambs. Basil diet contained ground corn, soybean hulls, and hay crop silage. Soy hulls replaced corn at 25%, 50%, 75% or 100%. All lambs were fed ad libitum concentrate (1450 - 1800 g DM /day) and hay crop silage at 10% diet DM. Diet D, with 25% soy hulls, is the basil diet. Twelve wether lambs (27-34 kg BW) were assigned in a 3 period switch-back. Period contained 21d, 14 d adaptation, and 7d total collection of urine and feces. Efficiency and utilization of DM, OM, N, and ADF were measured as soybean hulls replaced corn. Composition of diets A, B, C, D and soy hulls were respectively, DM %, 84.1, 83.8, 84.9, 82.7, and 90.5; N %, 3.10, 1.97, 2.50, 2.39, and 2.78; ADF %, 39.9, 36.5, 27.6, 17.1 and 44.1. Intake and apparent digestibility of DM, and OM were not different between treatments. Nitrogen intake, digestibility, and retention were significantly different ($P < .01$). Intake of ADF, g/d was significantly increased as soy hulls replaced corn ($P < .01$). However, diet ADF digestibility was not significantly different ($P > .20$). Nitrogen retention, and apparent digestibility of N, DM, and ADF were not compromised by replacement of corn with soy hulls in diets fed growing lambs.

Diet	A	B	C	D	SE
DM-intake, g/d	1483.9	1520.6	1372.0	1431.5	64.2
N-intake, g/d	46.1	30.2	34.7	34.8	1.6**
N-retention, g/d	29.2	14.2	19.1	19.5	2.0**

** P<.01

Key Words: Sheep, Soybean Hulls, Nitrogen Retention

293 The effects of diet on the acid-resistance of *E. coli* in feedlot steers. C. J. Fu*¹, J. H. Porter¹, E. E. D. Felton², J. W. Lehmkuhler³, and M. S. Kerley¹, ¹University of Missouri-Columbia, ²West Virginia University, ³University of Wisconsin-Madison.

Fifty four feedlot steers were used to determine the effects of diet on acid-resistance of fecal *E. coli*. Steers were fed an 85% corn-based diet for 90 d and then shifted to treatment diets for 5 d prior to slaughter. The four treatment diets were: 1) 85% corn-based diet; 2) 85% soybean hull-based diet; 3) 100% hay diet; and 4) the 85% corn-based diet with a three-fold elevated level of calcium carbonate. Fecal samples were collected from each steer before dietary shift and 5 days after dietary shift. Acid-resistance was expressed as viability after acid-shock at pH 2.0 for 1 h for fecal *E. coli*. Petri-film (3M, Petrifilm, St. Paul, MN) was used to enumerate fecal *E. coli*. The *E. coli* O157:H7 was not found in fecal samples. The fecal *E. coli* viability decreased ($P < 0.05$) only in the hay group and increased ($P < 0.05$) in the elevated Ca group. The hay group and high Ca group also had decreased ($P < 0.05$) and increased ($P < 0.05$) VFA (acetate, propionate, and butyrate) concentration in the feces after dietary shift, respectively. The fecal pH was marginally increased in the hay group. This study indicated that acid-resistance of *E. coli* could be induced by VFA and possibly Ca levels even though the environmental pH was near neutral. Further research is needed to determine if dietary calcium concentration can influence development of acid-resistance.

Key Words: *E. coli*, Acid-resistance, Steer

294 Effect of degradable protein concentration on organic acid production by mixed rumen bacteria. C.A. Willis*, L.R. Legleiter, and M.S. Kerley, University of Missouri-Columbia.

Feeding strategies have been developed that allow feeding roughage free diets to beef cattle by modifying intake behavior. Our hypothesis is that control of acid production in the rumen can be manipulated to alleviate the need of roughage without intake modifications. Two experiments were conducted to determine the relationship between dietary degradable protein and VFA production. A pilot experiment was designed to test if calf growth performance was affected by absence of roughage and level of rumen degradable protein (RDP) in a feedlot diet. Sixty heifers (5/pen) were fed one of four diets. Diets were corn-based with 1) soybean meal (SBM) plus 15% hay (SBM-H), 2) bloodmeal (BM) plus 15% hay (BM-H), 3) BM with 0% hay (BM), and 4) SBM with 0% hay (SBM). Feed intake was monitored by orts and body weight was measured on day 1, 28, and 56. Average daily gain and feed:gain of heifers fed SBM-H, BM-H and BM were 3.0, 2.8, 2.2, 7.4, 7.0, and 6.6. The SBM treatment was stopped due to acidosis. It was concluded that roughage can be removed from a diet and result in improved feed efficiency, but with decreased daily gains. The volume of fecal output for the BM treatment was reduced compared to hay diets. A batch culture was conducted to compare 5 diets of differing RDP level to determine if excessive RDP promoted lactic acid production. Diets consisted of 1) 4% 2) 4% 3) 9% 4) 15% and 5) 28% RDP. Urea was added at 1% of the diet for treatments 2 thru 5 to ensure an adequate ammonia-N source for microbial growth. The basal diet was ground corn with SBM as the RDP source. As RDP level increased ($P < 0.01$) starch fermentation rate increased. Lactic acid concentration was different ($P < 0.03$) among diets, however, it did not increase as RDP increased. VFA concentration was greater ($P < 0.01$) at higher levels of RDP. It was concluded that total acid load was more important than lactic acid production. Further understanding of factors controlling rate of gain and feed intake is needed.

Key Words: Rumen Undegradable Protein, Volatile Fatty Acid

295 Effects of management on the voluntary dry matter intake and dry matter digestibility of tall fescue hay. J. E. Turner*, W. K. Coblenz, K. P. Coffey, R. T. Rhein, B. C. McGinley, N. W. Galdamez-Cabrera, C. F. Rosenkrans, Jr., D. W. Kellogg, and J. V. Skinner, Jr., University of Arkansas.

Relatively little is known about the effects of spontaneous heating and natural rainfall on the feeding value of tall fescue (*Festuca arundinacea* Schriebl.) hay. A digestion trial utilizing a 4 × 4 latin square design was initiated to determine the effects of management before baling on the voluntary DMI, OM and DM digestibility, in situ disappearance kinetics, and ruminal fermentation parameters of tall fescue hay consumed by steers (average initial BW = 226.8 kg). The four tall fescue hays utilized in this experiment were harvested on the same date and baled at either 9.9 (low, L), or 22.5% (high, H) moisture prior to rainfall, or at 24.6% moisture after a 2.26-cm rainfall event (HR, or at 9.3% moisture after an accumulation of 7.07-cm of rain (LR) over a seven day period. Voluntary DMI of hay and the total diet were greater ($P < 0.05$) for steers consuming the non-rain damaged hays than for those fed the HR hay. However, digestibilities of DM, OM, ADF, and NDF were greater ($P < 0.05$) for steers consuming the HR hay than for those fed the non-rain damaged hays. In situ disappearance kinetics of both DM and N indicated that the Effective ruminal degradabilities of the HR and LR hays were lower ($P < 0.05$) than either the H or L hays. Hays baled prior to rain-damage had greater ($P < 0.05$) proportions of DM, NDF, and N that were immediately soluble in the rumen than did the hays that received rain-damage prior to baling. Concentrations of rumen ammonia increased ($P < 0.05$) between feeding and 2 h, and then decreased during the subsequent 10 h. Therefore, rain damage can reduce the voluntary intake of hay. Although rain-damaged hays may have inherently lower effective ruminal degradation than non-rained-on hays, these differences can be masked by reduced intakes and subsequent potential reductions in rates of passage.

Key Words: Tall Fescue, Rain Damage, Intake

296 Thyroid hormone concentrations in the neonatal calf. J.E. Rowntree*, D.R. Hawkins, G.M. Hill, R.F. Nachreiner, J.E. Link, M.J. Rincker, and R.A. Kreft Jr., Michigan State University.

Thyroxine (T_4) is deiodinated by type 1 iodothyronine deiodinase, a Se requiring enzyme, to form triiodothyronine (T_3). One role of T_3 is temperature control via uncoupling protein 1 (UCP1) in brown adipose tissue (BAT) of neonatal calves. Typically BAT is mobilized in cattle during the first week of life. Cold temperatures coupled with Michigan's low Se status, increases the potential for diminished T_3 activation of BAT thermogenesis in neonatal cattle. Therefore, our objective was to monitor thyroid hormone variables in newborn Holstein heifer calves ($n = 8$) for 7 d during the winter. Initial blood samples were obtained when calves were < 12 hr of age and daily thereafter. Calves were administered 1 mg of selenium as sodium selenite and 68 IU vitamin E as d-alpha tocopheryl acetate (BO-SE, Schering-Plough, Kenilworth, N.J.) following the initial bleeding. On d 2, calves were placed in individual hutches located in an open front pole barn for the remainder of the trial. The mean concentration of T_4 on d 1 was 156 nmol/L, which declined to 71 nmol/L on d 7 ($P < 0.01$). The mean concentration of T_3 on d 1 was 6 nmol/L, which was reduced to 2 nmol/L on d 7 ($P < 0.01$). The $T_3:T_4$ ratio on d 2 was 0.045 and declined to 0.032 by d 7 ($P < 0.01$). The mean ratio of T_3 : reverse triiodothyronine (rT_3) was lowest ($P < 0.01$) on d 1 and peaked on d 3 (2.16 and 4.67, respectively) indicating improved conversion of T_4 to T_3 . These initial data indicate that age and/or Se injection may alter $T_3:T_4$ and $T_3:rT_3$ ratios in neonatal calves. However, data do not reveal which variable(s), Se or age, influence(s) thyroid hormone concentrations.

Key Words: Thyroid hormones, Selenium, Cattle

297 Performance of feedlot heifers fed corn silage or brown midrib forage sorghum silage as the roughage portion of a finishing diet. B. Hough^{*1,2}, L. W. Greene^{1,2}, F. T. McCollum, III³, B. W. Bean^{1,3}, N. A. Cole¹, and T. Montgomery², ¹Texas Agricultural Experiment Station, Amarillo, ²West Texas A&M University, Canyon, ³Texas Cooperative Extension, Amarillo, ⁴USDA-ARS, Bushland.

One hundred twenty six crossbred heifers (average BW=315 kg) were used to determine the performance of heifers fed brown midrib forage sorghum silage (BMRS) vs. corn silage (CS) as the roughage source in a finishing diet. Silage was stored in 4.5 m diameter silage bags. Heifers were blocked by weight and previous grazing program, and randomly assigned to one of three diets, 10% (DM basis) CS (C10), 10% (DM basis) BMRS (S10), and 7.5% (DM basis) BMRS (S7.5) in a randomized block design. Other diet ingredients consisted of steam flaked corn, choice white hog grease, and supplement. Diets were formulated to include CS and BMRS at equal levels of DM inclusion (C10 vs. S10), and equal NDF concentrations (C10 vs. S7.5). Heifers were housed in 18 pens (n = 7/pen), and fed in fence-line bunks. Carcass characteristics were determined after harvest. Heifers fed either the S10 or S7.5 diets gained 11.3% faster (P < 0.03) than those fed C10 (1.38 and 1.38 vs. 1.24 kg/d, respectively). Feed intake (8.5, 8.8, and 8.7 kg/d for C10, S10 and S7.5, respectively) was not different (P = 0.43) across treatments. Gain efficiency (gain/intake) was greater (P < 0.01) for heifers fed S10 and S7.5 compared to those fed C10 (0.158 and 0.158 vs. 0.148, respectively). Heifer performance was not different (P > 0.10) for heifers fed S10 vs. S7.5. No differences in carcass characteristics were detected (P > 0.10). Due to storage of the silages, the CS contained noticeable mold on the face of the silage when feeding which may have affected subsequent heifer performance. Results indicate that BMRS as a roughage source will not affect performance of heifers fed a high concentrate finishing diet when compared to those fed CS.

Key Words: Heifer, Corn Silage, Sorghum Silage

298 Digestibility of sunflower screenings by beef cows. K. P. Ladyman^{*1}, J. H. Porter¹, and M. S. Kerley¹, ¹University of Missouri-Columbia.

The objective of this study was to determine the nutritional value of sunflower screenings (SS) as a feed by-product for beef cattle. Three cannulated (rumen) beef cows (averaging 653 kg ± 14 kg) were used in a replicated 3 X 3 Latin square design to determine nutrient digestibility. The cows were fed three different rations consisting of: (1) 100% hay, (2) 80% hay and 20% SS, or (3) 60% hay and 40% SS. The hay was a medium quality alfalfa/grass mixture. The sunflower screenings were generated from a birdseed cleaning operation. Feed ingredients and feces were analyzed for dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), ether extract (EE), and acid detergent lignin (ADL). Acid detergent lignin was used as the marker to calculate nutrient digestibility. The nutrient composition of sunflower screenings was: DM 90%, CP 12.7%, NDF 75.4%, ADF 62.9%, and EE 10.7%. The cows were penned individually under roof with seven days of acclimation followed by three days of collection for each treatment and then rotated to a different ration. As compared to the hay, SS in the diet reduced DM digestibility by 17%. The apparent digestibility of CP was 21.5% lower and the digestibility of NDF and ADF was 7 and 18% higher, respectively, for SS. The SS contained 10.7% EE which was highly digested. The hay had a relative feed value of 78.4 and an estimated total digestible nutrient value of 47.3%. The energy value of SS was estimated to be approximately equivalent to the hay fed in this experiment.

Key Words: Sunflower Screenings, Digestibility, Feed By-product

300 Corn crop residue grazing effects on soil physical properties and soybean production in a corn-soybean crop rotation. J.T. Clark^{*1}, J.R. Russell¹, D.L. Karlen², W.D. Busby¹, D.L. Maxwell¹, and B. Peterson³, ¹Iowa State University, Ames, IA, ²USDA-NSTL, Ames, IA, ³USDA-NRCS, Creston, IA.

Over 3 yr, two 19.4-ha fields near Atlantic, IA were divided into four blocks with 6 paddocks to evaluate the effects of corn crop residue grazing by beef cows on soil characteristics and soybean yields. Three beef cows were allotted to each block to graze five of the paddocks at 28-d periods starting mid-October. Twelve grazing exclosures were

placed in two transects within each grazed paddock. Precipitation and soil temperature were measured daily and soil bulk density, moisture and clay contents, penetration resistance, surface roughness, and corn crop residue cover was measured at the termination of grazing in the spring. Soil bulk density, moisture content, and penetration resistance in grazed paddocks were measured inter-row to a depth of 20.3 cm inside and approximately 5 m outside grazing exclosures and expressed as the outside-to-inside ratio. In the subsequent growing seasons, soybeans were planted in replicate fields with disking or no tillage and yield determined at harvest. Compared to ungrazed paddocks, penetration resistance ratio was greater (P<0.05) in the second paddock grazed for all three years and greater (P<0.05) in the first and last paddock grazed in yr 2 and 3. Compared to the ungrazed paddocks, post-grazing crop residue cover was lower (P<0.05) in the first two paddocks grazed in yr 2 and for all paddocks grazed in yr 3. In yr 2, post-planting crop residue cover in blocks planted with no tillage were lower (P<0.05) in the second, fourth, and fifth paddocks grazed than the ungrazed paddocks. Soil surface roughness was greater (P<0.05) in the third and last paddocks grazed in yr 1 and in the second and last paddocks grazed in yr 2 than ungrazed paddocks. Bulk density ratio, post-planting crop residue cover in disked blocks, and soil clay contents were not different from ungrazed paddocks over the 3 yr. Soybean yields did not differ between grazed and ungrazed paddocks in the first two seasons measured.

Key Words: Corn Crop Residue, Grazing, Soil

301 Influence of prior nutritional treatment on residual feed intake as an indicator of efficiency. C. L. Ferrell^{*}, T. G. Jenkins, and H. C. Freetly, USDA-ARS, U.S. Meat Animal Research Center.

Objectives were to evaluate prior treatment effects on residual feed intake (RFI), an indicator of efficiency in beef steers. ADG, daily DMI, feed/gain (FPG), and residual ADG (RADG) were also evaluated as indicators of efficient steers. Simmental × MARC III steers (358±3.0 kg) were individually fed a diet (80% corn, 13.61% corn silage, 4.40% soybean meal, 0.78% urea, 0.67% limestone, 0.43% dicalcium phosphate, 0.09% salt, 0.008% trace mineral premix, and 0.015% monensin premix; dry basis) in pens of six. Twelve steers were assigned to each of eight preliminary treatments: 40, 50, 60, 70, 80, 90, 100, or 110 g × kg^{-0.75} × d⁻¹ for 112 d. Steers were weighed at 14 d intervals, and feed allotments were adjusted at those times. All steers were fed ad libitum until slaughter during the ensuing experiment which consisted of 74 d for steers fed at the 40-70 levels and 39 d for steers at the 80-110 levels during the prior period. Steers were slaughtered at a commercial facility and carcass data was collected. Initial weight (IWT), final weight (FWT) and ADG were calculated from regressions of weight on time for each steer. Similarly, DMI was calculated from cumulative feed consumed on time for each steer, and FPG was calculated. Residual feed intake was determined as the residual from the regression of DMI on IWT and ADG, and RADG was determined as the residual from the regression of ADG on IWT and DMI. Prior treatment influenced IWT (P<0.001), FWT (P<0.001), ADG (P<0.001), DMI (P=0.047), FPG (P<0.001), RFI (P=0.041), and RADG (P=0.053). Means (± SD) for these traits were 469 (55), 566 (39), 1.69 (0.33), 10.00 (1.31), 6.15 (1.52), 0.00 (1.04), and 0.00 (0.27), respectively. Five steers (of 93) identified as efficient based on low RFI had 14 kg greater IWT, 1.86 kg/d lower DMI, 0.32 kg/d lower ADG than the mean, whereas steers identified by RADG had 18 kg greater IWT, 0.04 greater DMI, and 0.41 kg/d greater ADG. These results suggest potential negative consequences of selecting solely on RFI and that RADG may be a viable alternative.

Key Words: Efficiency, RFI, RADG

302 The degradative properties of soybean proteins. W.H. Kolath^{*} and M.S. Kerley, University of Missouri - Columbia.

The objective of this study was to explore the degradative properties of soybean proteins in the rumen. A crude enzyme extract was prepared by isolating the bacteria in rumen fluid using differential centrifugation and disrupting those bacteria with a French press cell. Crude enzyme extract (3mL) was then incubated with 30mL of solubilized soybean protein for 48 hours. The soybean protein was found to be 90% soluble in McDougal's buffer. Samples were taken every 4 hours to determine which protein subunits were able to resist degradation and SDS-PAGE

was performed to determine the disappearance of each individual subunit. Alpha and alpha prime conglycinin (molecular weight 75,000 and 72,000) were completely degraded to smaller peptides (molecular weight less than 68,000) after 8 hours of digestion with alpha conglycinin being completely digested after 4 hours. The beta subunit of conglycinin was almost completely degraded at 24 hours, with the acidic subunit of glycinin disappearing by 28 hours. The basic subunit of glycinin was the most resistant to degradation with a slight amount remaining at 48 hours. An in situ was also performed to determine if the rate and extent of digestion seen with the crude enzyme extract was similar to what occurred in the rumen. Soybean meal (3g) was sealed in in situ bags and placed in the rumen for 0, 6, 12, 24, 48 and 72 hours. After 48 hours less than 3% of the initial soybean meal placed in the bags remained. The in situ loss of soybean protein closely matched what was observed by using the crude enzyme extract to digest the protein. Therefore, the genetic selection for soybean proteins with greater amounts of basic glycinin may increase the rumen undegradable protein value of soybean meal.

Key Words: Soybean, Degradation, In situ

303 Effects of metabolic acid-base disturbance caused by cation anion intake on performance of heifers before and during transition to a high concentrate finishing diet. J. J. Williams*¹ and L. W. Greene, ¹Texas A&M University Research and Extension Center.

The effects of metabolic acid-base disturbance caused by cation anion intake (DCAD) on performance of heifers during transition to a high concentrate diet were determined in 2 experiments. In Exp 1, 24 cross-bred heifers (245.5 kg), were blocked by weight and assigned to 3 high roughage DCAD diets, low (L) low+limestone (LL) and high (H). Heifers fed the LL diet received 0.80% dietary limestone during the transition period in the high concentrate diet. L and LL contained -99 mEq/kg and H contained +247 mEq/kg of DM calculated as $(\text{Na}^+ + \text{K}^+ + 0.38\text{Ca}^{2+} + 0.3\text{Mg}^{2+}) - (\text{Cl}^- + 0.6\text{S}^{2-} + .5\text{P}^{3-})$. The L and LL diets were prepared by the addition of NH_4Cl to the diet. By d 7 of feeding the anionic diets, urine pH was lower ($P < 0.05$) for heifers fed L and LL. From d 21 to 35 urine pH for heifers fed L and LL increased from 5.58 and 6.45 to 7.57 and 7.59, respectively. This response was presumably due to an increased ruminal fluid dilution rate caused by intake of added dietary salts. On d 10, 20 and 35 blood pH was lower ($P < 0.05$) for heifers fed L and LL compared to heifers fed H. During the transition period no difference in DMI was observed between H and L or LL. In Exp 2, heifers from Exp 1 were fed a high roughage diet, reallocated to treatments on d 10, and provided NH_4Cl in drinking water instead of the diet to prevent a dilution by increased water intake. L and LL heifers were given ad libitum access to water containing NH_4Cl (0.007 kg/liter) for 7 d (d 11 to 17). By d 12, urine pH was lower ($P < 0.05$) for L and LL than for H and remained lower until d 20. On d 17 blood pH and HCO_3^- were lower ($P < 0.05$) for L and LL than for H. By d 23 blood pH and HCO_3^- was not different ($p > 0.05$) for any treatment. DMI during the transition to a high concentrate diet (d 18 to 33) was 8.07, 8.49 and 9.15kg for L, LL and H, respectively ($P=0.46$). This data suggests that cattle consuming anionic diets prior to transition to a high concentrate diet are not any more susceptible to acidosis than those fed cationic diets.

Key Words: DCAD, Acidosis, Rumen

304 Effect of supplementation and advancing gestation on intake of low-quality forage. T. W. Loy*, D. C. Adams, T. J. Klopfenstein, and J. A. Musgrave, University of Nebraska, Lincoln.

Eighteen spring-calving heifers (406.7 kg, SD = 30) were used to determine the effects of advancing gestation and supplementation on intake of low-quality forage. Heifers were rectally palpated and paired based on expected calving dates. Each pen was assigned randomly to one of two supplement treatments; one high in undegradable intake protein (UIP; n = 4), and one based on dry corn gluten feed (DCGF; n = 5). Supplements were formulated to meet metabolizable protein requirements. Average supplement DMI was 0.7 and 2.6 kg / d for UIP and DCGF, respectively. Heifers were given ad libitum access to upland and meadow hays, combined to be reflective of the protein and energy content of grazed winter range. Intakes were measured weekly. The trial began Dec 18 and concluded May 7. Treatments were applied prior to calving (March and April). After calving, heifers were fed a common diet.

Weight and body condition score (BCS) were recorded on two consecutive days at the beginning and end of the trial, and at 28 d intervals throughout. Milk intake (MI) was determined at the end of the trial using 12-h weigh-suckle-weigh. Calf birth weights and ADG from birth to May 7 were recorded. Data were analyzed as repeated measures using the mixed procedure of SAS. Initial weight did not differ ($P = 0.58$) by treatment. Heifers in the UIP treatment lost 24.6 kg over the course of the study, compared to 1.3 kg for DCGF ($P = 0.02$). Treatment did not affect ($P = 0.41$) initial BCS (5.2) or BCS change (-0.2). Calf birth weight, MI, and ADG were not affected ($P > 0.12$) by treatment. Forage intake was not affected ($P = 0.43$) by supplement, and no time x supplement was detected ($P = 0.98$). Intake changed quadratically ($P < 0.01$) with respect to calving. Maximum forage DMI was 12.5 kg three weeks prior to calving. Intake at calving fell to 10.3 kg, and increased to 12.0 kg two weeks after calving. Providing energy in non-bulky form to heifers in late gestation may help alleviate effects of depressed intake of low quality forage.

Key Words: Intake, Gestation, Supplementation

305 Effects of RUP inclusion level on ruminal degradability of RUP. L. R. Legleiter* and M. S. Kerley, University of Missouri, Columbia, MO.

This experiment was designed to test the effect of protein inclusion rate on ruminal protein degradation and the subsequent RUP value. Twenty-four dual flow continuous culture fermentors were used in conjunction with 4 dietary treatments and one control diet. The five diets were basal (B) with no supplemental protein, basal + 2.5% blood meal (BM-L), basal + 5% blood meal (BM-H), basal + 4.45% soybean meal (SBM-L) and basal + 9.98% soybean meal (SBM-H). BM-L and SBM-L were formulated to be isonitrogenous; likewise, BM-H and SBM-H were isonitrogenous. The experiment consisted of two 10-d experimental periods including a 7-d acclimation period followed by 3-d of sampling for each period. Fermentor dilution rates were held constant at 4.5%/hr for all treatments. The treatments were fed at a rate of 60g/d throughout the experimental period. Ammonia concentration was not different ($P>0.05$) between BM-L and BM-H, but increased ($P<0.05$) from 3.84 mM for SBM-L to 7.44 mM for SBM-H. Microbial efficiency (g of N/kg OM truly digested) was not different ($P>0.05$) for BM-L vs BM-H or for SBM-L vs SBM-H with efficiencies of 19.47, 22.07, 21.9 and 23.64 respectively. Proteolytic activity was not different ($P>0.05$) between the two levels of protein sources with micrograms of Azocasein degraded/hr/mg of sample averaging 115.9, 129.5, 132.9 and 157.6 for BM-L, BM-H, SBM-L and SBM-H respectively. The VFA production and peptide concentration was not affected ($P>0.05$) by level of protein source. The % RUP of BM-L was not different ($P>.05$) from the % RUP of BM-H with values of 49.2% and 55%, respectively. Likewise, the % RUP was not different ($P>.05$) for SBM-L at 44.6% and SBM-H at 39.3%. These data suggested that increasing dietary inclusion rate of an RUP source from 2.5% to 5% did not significantly decrease the % RUP of the protein source.

Key Words: Bloodmeal, RUP, Continuous Culture

306 Effect of supplement type and degradable intake protein addition in diets for lactating beef cows. T. A. Baumann*, G. P. Lardy, W. W. Dvorak, and V. Anderson, North Dakota State University, Fargo, ND.

A 2 x 2 factorial design was used to determine the effect of supplement type (corn vs soyhulls) and protein addition (with or without) to a medium quality forage diet for lactating beef cows. Cow/calf pairs (n = 78; 610.5 ± 3.4 and 90.8 ± 1.5 kg initial BW; cows and calves, respectively) were used in the study. A basal diet consisting of 75% grass hay (11.5% CP, 65.9% NDF, and 40.1% ADF) and 25% wheat straw (7.4% CP, 75.9% NDF, and 50.2% ADF; DM basis) was fed from May 16 (43 ± 10 d post-partum) to September 6. Cows were stratified by calving date and BW and assigned randomly to treatment. Supplemental treatments and predicted DIP balances were 4.78 kg dry rolled corn (-415 g/d); 5.32 kg soyhulls (SH) (-260 g/d); 3.68 kg dry rolled corn plus 1.55 kg sunflower meal (-0.02 g/d); or 4.50 kg SH plus 1.05 kg sunflower meal (-0.02 g/d). Diets were formulated to provide 20 Mcal/d N_{em} . Cow BW, body condition score (BCS), milk yield, and calf BW were recorded at d 1, 28, 56, 84, and 112 for all response variables except milk yield which was not recorded at d 1. Data was analyzed as a split plot in time with pen as the experimental unit. No interaction between

grain source and addition of protein was present ($P = 0.33$) nor was there an interaction between treatment and period ($P = 0.91$) for any response variable. Therefore, the main effects of treatment and period are discussed. Grain source and addition of protein had no effect ($P > 0.16$) on cow BW, BCS, milk yield, or calf BW. Cow BW decreased ($P < 0.001$) from 610.5 to 584.2 ± 3.4 kg during the study. BCS decreased ($P < 0.001$) from 5.58 on d 1 to 5.01 ± 0.05 on d 112. Milk yield declined ($P < 0.001$) from 13.1 kg on d 28 to 7.7 ± 1.1 kg on d 112. Calf BW increased ($P < 0.001$) from 90.8 to 219.6 ± 1.5 kg during the 112 d trial. In summary, no differences due to supplement type or protein addition were noted for BW, BCS, milk yield, and calf BW. Therefore, corn or SH are suitable as a supplement for the quality of forage utilized in this trial. Addition of supplemental protein did not improve cow or calf performance.

Key Words: Digestible Fiber, Starch, Soyhulls

307 A dehydrated mixture containing food waste and wheat middlings serves as a protein and energy substitute in beef cow diets. P.M. Walker*¹ and A.D. Antas¹, ¹*Illinois State University, Normal, IL/USA.*

Three trials utilizing 222 crossbred beef cows were conducted over three years to evaluate the efficacy of replacing a portion of the diet with a dehydrated mixture containing wheat middlings and ground food waste (DF) from retail grocery stores. In trial 1 (T1), trial 2 (T2) and trial 3 (T3) 78, 73, and 71 beef cows in their second and third trimesters were blocked by parity (first parity vs. two or more parities), then allotted to treatment pens according to body condition, subject to variation in body weight. The duration of T1, T2, and T3 were 143, 184, and 155 days, respectively. Trials were terminated each year following a timed insemination to a synchronized estrus. Control (CTL) cows were fed a corn silage-shelled corn-soybean meal based diet according to NRC estimates. Treatment (TRT) cows received diets similar to CTL except DF replaced all of the soybean meal and corn. Chemical analysis found DF to contain $88.3 \pm 8.9\%$ DM, $19.6 \pm 13.3\%$ ADF, $19.0 \pm 17.0\%$ cellulose, $4.2 \pm 0.5\%$ ADL, $0.19 \pm 0.1\%$ AIA, $18.5 \pm 3.3\%$ CP, and $5.7 \pm 2.1\%$ EE. During T1, T2, and T3, EE values were higher and CP values were lower ($P < 0.05$) for TRT than CTL diets. No significant differences were observed for cellulose, ADF, ADL, Ash, DM and AIA for T1, T2, and T3 between TRT and CTL diets. No significant differences in daily corn silage consumption nor in ADFI were observed between TRT and CTL cows. The mean DF intake for TRT cows as a percent of diet (wet weight basis) was 11.1%. Mean body weight changes and body condition score changes were similar between TRT and CTL cows. Mean calf weight at the end of each trial and mean calf ADG were similar between TRT and CTL cows. Percent calf crop saved at birth, subsequent percent calf crop weaned and cow conception rates (chi-square = 1.61) were not different ($P > 0.05$) between TRT and CTL cows. Milk production (24 h estimated production) was higher ($P < 0.05$) for TRT than CTL cows but no significant differences were determined for milk fat or milk protein percents. The calculated feed replacement value for DF for this study was 11.04:kg. The data of this study suggests that DF can serve as an alternative feedstuff in diets of beef cows.

Key Words: Feedstuff, Cows

308 Effect of low-level fall protein supplementation on the performance of beef cows grazing tallgrass-prairie range. D. A. Llewellyn*, R. C. Cochran, T. T. Marston, D. M. Grieger, C. G. Farmer, and T. A. Wickersham, *Kansas State University, Manhattan.*

An experiment was conducted to evaluate the effect of providing a limited quantity of a high-protein supplement during the fall grazing period on cow and calf performance. Time of initiation of supplementation was also examined. One hundred-thirty six multiparous, pregnant, spring-calving cows grazing native range were assigned to supplementation treatments in a randomized complete block design. Twelve pastures were used providing four replications per treatment. Control (CTRL) cows received no fall supplementation. Supplemented cows received .68 kg/d of a high-protein supplement (40% CP, as-fed basis) approximately 2 mos pre- and post-weaning (PRPO; 8/15 to 12/14; weaning = mid-October) or only post-weaning (POST; 10/15 to 12/14). Supplement was fed 3 d/wk (prorated to deliver designated daily amount). All cows received 1.8 kg/d of the same supplement during the winter (12/14 to calving; calving = early March). Through weaning, PRPO cows gained

more ($P=0.03$) body weight (BW); body condition score (BCS) followed a similar trend ($P=0.16$). Both PRPO and POST had greater ($P=0.02$) increases in BCS and BW compared with CTRL over the entire fall period; although PRPO and POST were not significantly different in the period from weaning until the beginning of winter supplementation. Cows supplemented during fall had slightly greater ($P=0.05$) cumulative BW change through calving, although BCS change was not different ($P=0.30$) among treatments. Calf birth weights were not significantly different among treatments. Calves from PRPO cows gained BW more rapidly ($P=0.02$) from birth through the start of the grazing season than those from POST cows, and the average of calves from PRPO and POST was greater ($P=0.03$) than for CTRL calves. In conclusion, feeding beef cows a limited amount of a high-protein supplement during the fall and the length of the supplementation period affected cow BW and BCS changes and, in some cases, subsequent calf performance.

Key Words: Protein, Beef Cattle, Supplementation

309 Effect of rumen degradable protein source on forage intake, digestion, and ruminal kinetics in beef steers fed low-quality hay. W. W. Dvorak*, M. L. Bauer, G. P. Lardy, and J. S. Caton, *North Dakota State University, Fargo.*

Four ruminal and duodenally cannulated beef steers (417 ± 87 kg initial BW) were used in a 4 x 4 Latin square to evaluate effects rumen degradable protein (RDP) source on intake, ruminal fermentation, site of digestion, and microbial protein synthesis. Steers had ad libitum access to low-quality cool-season grass hay (6.4% CP, 68.3% NDF, DM basis) that was offered twice daily. Treatments were control (C; corn-based supplement), urea (U; NPN), steep liquor (L; amino acids and peptides), and sunflower meal (S; intact protein) based supplements. Supplements were fed daily at 0.237, 0.273, 0.269, and 0.295% of BW on DM basis for C, U, L, and S, respectively. Urea, steep liquor, and sunflower supplements were formulated to have a RDP balance of 0 according to the 1996 NRC model and all treatments supplied equal NE. There were no differences ($P > 0.10$) in DM or OM intake between RDP and C treatments. Treatments supplemented with RDP had increased ($P = 0.08$) duodenal microbial OM flow. Control treatment tended ($P = 0.12$) to have decreased intestinal OM disappearance (OMD) compared with RDP treatments. RDP supplementation increased (59 vs $53 \pm 2\%$; $P = 0.02$) total tract CP disappearance (CPD) compared with C. Also, RDP supplementation tended ($P = 0.15$) to increase apparent digestion rate of CP and NDF as a percentage of rumen fill. Supplementation with L and S increased ($P < 0.02$) intake of all nutrients compared to U. Supplementing L and S increased (4.9 vs 4.6 ± 0.1 kg/d; $P = 0.10$) OMD in stomach and bacterial CP flow ($P = 0.01$) compared to U. In situ forage DM disappearance (DMD) and NDF disappearance (NDFD) was increased ($P < 0.04$) by RDP supplementation compared to C. Supplementation with L and S increased ($P < 0.02$) in situ forage NDFD, neutral detergent insoluble crude protein disappearance and tended to increase ($P = 0.12$) DMD. Data suggests that supplemental RDP enhances ruminal kinetics and utilization of protein deficient hay consumed by beef steers.

Key Words: Rumen Degradable Protein, Protein Supplementation, Ruminal Kinetics

310 Use of *Ascophyllum nodosum* for alleviation of heat stress in cattle. L.N. Thompson*¹, J.E. Williams¹, K.J. Barnhart¹, L.E. McVicker¹, D.E. Spiers¹, and D.P. Colling², ¹*University of Missouri, Columbia, MO,* ²*Acadian Seaplants, Inc.*

A study was conducted to evaluate the influence of *Ascophyllum nodosum* (Tasco meal) on core body temperature and in situ DM disappearance in cattle exposed to elevated ambient temperature. Twenty-four steers (avg. wt. = 300.6 kg) were randomly assigned to treatments: 1% Tasco meal (TM) vs no Tasco Meal (NT), thermoneutral (TN) vs heat load (HL) conditions. The steers were placed in one of four environmental chambers, maintained initially at TN (19C), with 3 steers in each room assigned to TM vs NT. Prior to the study, steers were ruminally cannulated (n=8) and telemetric transmitters (n=24) installed in the peritoneal cavity. For 7 d, steers were acclimated to chambers at TN and remained at TN through period 1. Prior to 0700 h, steers were fed treatment pre-mixes of ground corn / alfalfa meal + 1% TM or NT. At 0700 h, steers were fed a cottonseed hulls / cracked corn diet (12.6% CP; 30.8% ADF) ad libitum. During periods 2, 3, and 4 (all 10 d), 2 chambers were maintained at TN. For period 2, HL chambers were

maintained at 36C daytime high with nighttime low of 19C. For period 3, HL was maintained at 36C and nighttime low at 31C. For period 4, the TN and HL treatments were reversed. An in situ study was conducted to measure DM disappearance during each period. Core body temperature, DM intake and ADG were recorded for each period. Steers exposed to elevated ambient temperature had decreased ($P < 0.05$) DM intake and ADG. The TM had no effect ($P > 0.05$) on DM intake or ADG. The steers exposed to elevated temperature had higher ($P < 0.05$) core body temperature than the TN treatment; for period 2, TM appeared to lower core body temperature ($P < 0.20$) for HL treatment compared to NT. A treatment by temperature interaction ($P < 0.05$) revealed that TM increased in situ DM disappearance as compared to NT under HL. In conclusion, Tasco Meal had short-term effects on lowering core body temperature as well as enhancing in situ DM disappearance in cattle exposed to heat stress.

Key Words: Tasco Meal, Heat, DM Disappearance

311 Effect of interseeding lespedeza versus additional nitrogen fertilization in a wheat-crabgrass double-crop system on forage production and cattle performance. L.W. Lomas*, J.L. Moyer, F.K. Brazle, G.L. Kilgore, and G.A. Milliken, *Kansas State University, Parsons.*

Grazing and subsequent finishing performance of steers that grazed a wheat-crabgrass double-crop system were evaluated in 1999, 2000, and 2001 to compare interseeding lespedeza with an additional application of N fertilizer. Ten 1.62-ha pastures were used in a completely randomized design with 5 replications per treatment. Hard red winter wheat was no-till seeded (119 kg/ha) in all pastures in the fall of 1998, 1999, and 2000, and 'Red River' crabgrass seed was broadcast (2.2 kg/ha) over all pastures in early spring of 1999, 2000, and 2001. Crabgrass had been grown on these pastures since 1997. 'Korean' lespedeza was no-till seeded (20 kg/ha) in five of the pastures in early spring of 1999, 2000, and 2001. All pastures received similar applications of fertilizer except those pastures not seeded with lespedeza received an additional 56 kg of N/ha in mid-July of 1999, 2000, and 2001. Wheat grazing was initiated in mid to late March of each year. Following wheat graze-out, cattle remained on the pastures and grazed crabgrass from mid to late May until early September. Pastures were initially stocked with 3 steers/ha and stocking rate was reduced to 2.5 steers/ha at the end of the wheat grazing phase. Legume cover, forage dry matter production, grazing steer performance, and subsequent feedlot performance were measured. Available forage dry matter and grazing gains during the crabgrass phase were similar between pastures fertilized with additional N and those interseeded with lespedeza in all 3 years. In 1999, finishing gain and ribeye area were higher ($P < .05$) for steers that grazed pastures interseeded with lespedeza. In 2001, wheat grazing gain, overall grazing performance, finishing gain, and overall performance (grazing + finishing) were higher ($P < .05$) for steers that grazed pastures fertilized with additional N.

Key Words: Crabgrass, Lespedeza, Grazing

312 Protein requirements of bison bulls fed for meat. V. L. Anderson*¹ and L. Helbig², ¹*North Dakota State University-Carrington Reserach Center*, ²*University of Saskatchewan-Saskatoon.*

Dietary protein requirements of bison bulls fed for meat have not been determined. This study compared four crude protein (CP) levels (9.4, 11.6, 13.9, and 16.0%) fed to bison bull calves (n=80, avg. initial wt 287 5.37 kg) for 250 days prior to market. Canola meal (41% CP) was used as the protein source in the 75% concentrate rolled corn based diet that included chopped native grass hay as the forage. Bison were randomly assigned to one of eight pens (10 head per pen) and weighed individually at 90 day intervals. Totally mixed rations were fed to appetite once daily in fenceline bunks. Fecal samples were composited for each treatment using three fresh samples from each pen collected on weigh dates. Blood urea nitrogen (BUN) levels were determined using 5 additional bison calves fed the same CP diet treatments with sequentially higher CP levels offered at weekly intervals. Blood was sampled by veinipuncture at the end of each feeding period and serum analyzed for BUN. Data were analyzed using SAS GLM. Feed intake (7.82 kg) was not affected by protein level. Gain improved ($P < .05$) with increased CP in the diet. Bulls fed the 13.9% CP diet had the greatest daily gain during the first three months on feed (.91 kg) and overall (.90 kg). Lowest daily gains

were observed from the 9.4 and 11.6% CP diets (.75 kg) with daily gains from the 16.0% CP diet intermediate (.79 kg). Feed efficiency was not affected ($P > .10$) by protein level (.10 units dry matter per unit gain). Fecal nitrogen was not different due to treatment ($P > .10$). BUN increased linearly (13.9, 16.0, 18.9, and 26.1 mg/dl) with increasing CP level ($P < .05$). Carcass traits used in the bison industry were not affected ($P > .10$) by CP level. While wild ungulates are known to recycle nitrogen more efficiently than domestic livestock, this data suggests bison will gain faster on higher levels of CP than commonly used by bison feeders.

Key Words: Bison, Protein, Requirements

313 Effects of advancing season on nutrient quality of alfalfa and black medic in southwestern North Dakota. D. M. Oe*¹, G. P. Lardy¹, W. W. Poland², and P. Carr², ¹*North Dakota State University, Fargo*, ²*Dickinson Research Extension Center, Dickinson.*

The objective of this research project was to characterize changes in nutrient quality of alfalfa (*Medicago sativa* L.) and black medic (*Medicago lupulina* L.) over a 9 week grazing season. Three replicate pastures of each forage species were established at the Dickinson Research Extension Center in southwest North Dakota. Each alfalfa pasture was split into three paddocks for the study. One paddock in each replicate pasture was clipped on June 10, 17, and 24, and then again on July 16, 22, and 29, such that each paddock was sampled once in June and once in July. Four random sites within each paddock were selected for each clipping date. Forage samples were clipped at ground level and samples were composited across site within paddock. A concurrent grazing trial was also conducted; samples collected in July were regrowth following grazing in June. The original protocol called for clipping each alfalfa and medic paddock on each sampling date. However, lack of forage growth in the black medic pastures prevented sampling until July 16. Samples were analyzed for DM, CP, NDF, ADF, and in vitro organic matter disappearance (IVOMD). Based on laboratory data, relative feed value (RFV) and net energy for lactation (NE_L) were also calculated. Because only six medic samples were collected, those data were not included in the statistical analysis. Data from the alfalfa paddocks were analyzed as a split-plot in time using the GLM procedures of SAS. Effects of sampling date (June vs July) were tested using replication by date as the split-plot error term. Significance was declared at $P < 0.05$. From June to July, NDF increased (39.7 vs 44.4%; $P = 0.008$), ADF increased (30.4 vs 34.1%; $P = 0.05$), while IVOMD decreased (70.4 vs 59.0%; $P = 0.009$). Net energy for lactation and CP tended to decrease (1.50 vs 1.41 Mcal/kg, $P = 0.052$; 18.4 vs 15.8%, $P = 0.08$). However, there was no difference in RFV (avg. = 154 ± 14.0; $P = 0.21$). In conclusion, the nutritive quality of alfalfa decreased as season advanced. Unfortunately, problems with stand establishment for black medic prevented adequate sampling necessary to compare the two legume species in this pasture situation.

Key Words: Alfalfa, Season, Nutrients

315 Effect of various alternative forages on late summer forage production and grazing livestock performance. W. Poland* and P.M. Carr, *North Dakota State University, Dickinson.*

The potential of using millet (M; *Setaria italica*), sweetclover (C; *Melilotus alba*) and alfalfa (A; *Medicago sativa*) as grazable forage in late summer was evaluated in southwestern ND. Forage treatments (TRT) were seeded into paddocks (1-ha) in each of two year and included M, C, A, barley (B; *Hordeum vulgare*), pea (P; *Pisum arvense*) and combinations of MC and MA. Paddocks were grazed starting in early August using yearling heifers (BW=432±4.6 kg). At initiation of grazing, seeded ($P < .01$; x=4170kg/ha; SE=720) and total forage ($P < .01$; x=5845kg/ha; SE=622) DM and percentage seeded of total forage ($P < .01$; x=68.0%; SE=5.9) differed by treatment. P produced more seeded DM than A and C (3670 vs 2056 and 2308kg/ha). MC and MA produced more seeded (6219 and 5757 vs 2056 and 2308kg/ha) and total (7598 and 7149 vs 4459 and 4523kg/ha) DM than A and C. Percentage seeded forage was greater in P (66%) compared to A (47%) and C (48%); in M (74%) compared to A, C, MA (81%) and MC (79%); and in MA and MC compared to A and C. Forage concentrations of CP ($P < .05$; x=11.9%; SE=1.3), NDF ($P < .01$; x=57.5%; SE=2.0) and ADF ($P < .01$; x=38.9%; SE=1.1) differed by TRT. CP was greater in B

(12.3%) compared to M (9.4%); in A (13.3%), C (16.1%), MA (11.5%) and MC (10.9%) compared to M; and in A and C compared to MA and MC. NDF was reduced in A (51.5%), C (47.0%), MA (60.9%) and MC (63.0%) compared to M (63.7%); and in A and C compared to MA and MC. ADF was reduced in B (35.8%) compared to M (41.3%); in A (37.3%), C (35.5%), MA (39.1%) and MC (39.5%) compared to M; and in A and C compared to MA and MC. Grazing days ($P < .05$; $x = 35.0$; $SE = 2.9$), final BW ($P < .1$; $x = 465$ kg; $SE = 5.1$), ADG ($P < .1$; $x = .91$ kg/d; $SE = .14$) and gain ($P < .1$; $x = 95.0$ kg/ha; $SE = 15.1$) differed by TRT. Grazing days were greater in M (41 d) compared to B (33 d); in M compared to A (28 d), C (31 d), MA (37 d) and MC (35 d); and in MA and MC compared to A and C. A and C had heavier final weights (464 and 466 vs 453 kg) and larger ADG (1.04 and 1.00 vs .64 kg/d) and total gain (90.9 and 94.6 vs 59.3 kg/ha) compared to P. Annual grasses produced more forage of a lower quality compared to legumes. However with the exception of P, animal performance was not affected by forage treatment. Although forages differ with respect to production and quality, these characteristics alone are not accurate predictors of grazing animal performance.

Key Words: Forage, Grazing

316 Performance of crossbred steers grazing photoperiod sensitive and non photoperiod sensitive Sorghum Sudangrass hybrids. J. T. Vasconcelos*, L. W. Greene, F. T. McCollum, III, B. W. Bean, and R. Van Meter, *Texas A&M University Agricultural Research and Extension Center, Amarillo.*

Twelve 2.23 ha pastures were seeded with 28 kg/ha of two non photoperiod sensitive (PP) sorghum sudan (SS) hybrids, SS 200 BMR or SS 201 BMR, or two PP SS hybrids, Mega Green (MG) or PS 210 BMR (n=3 pastures/hybrid). SS 200 BMR, SS 201 BMR and PS 210 BMR contained the brown midrib gene. Pastures were irrigated with 49.4 cm/ha and fertilized with 336 kg/ha of 20-10-0 before planting. Crossbred steers (n=132; avg BW=251 kg) were allotted to the pastures using a put-and-take pasture management. On d 0 and the last day of the grazing period, forage availability was determined by hand clipping six predetermined areas in each pasture. For the forage samples collected on d 0, leaf and stem percentages were determined. Grazing was terminated when forage growth and availability did not support steer growth. Amount of available forage at the initiation of grazing was greater ($P = 0.0464$) for SS 201 BMR (3,002 kg/ha) than MG (2,163 kg/ha) or SS 200 BMR (2,206 kg/ha), with PS 210 BMR being intermediate (2,500 kg/ha). No differences ($P = 0.3869$) occurred in the initial percentage of leaf or stem. Grazing head days/ha were greater ($P = 0.0234$) for MG than for PS 210 BMR, SS 201, BMR and SS 200 BMR (447 vs 382, 373, and 373 d/ha). Amount of available forage at the conclusion of grazing was similar ($P = 0.2414$) for the hybrids (1,763, 1,253, 1,186, and 868 kg/ha for MG, PS 210 BMR, SS 201 BMR and SS 200 BMR, respectively). Steers grazing SS 200 BMR had a greater ($P = 0.0086$) ADG than those grazing MG, PS 210 BMR or SS 201 BMR (1.38 vs. 1.02, 1.05, and 1.16 kg/d, respectively). Gain per ha was greater ($P = 0.1010$) for steers grazing SS 200 BMR (515 kg/ha) than PS 210 BMR (404 kg/ha) with MG (456 kg/ha) and SS 201 BMR (436 kg/ha) being intermediate. These data show that grazing SS 200 BMR resulted in greater ADG and gain/ha than PS 210 BMR.

Key Words: Grazing, Sorghum Sudangrass, Photoperiod Sensitive

318 Comparison of beef NRC model and equations using dilution rate to predict microbial efficiency and yield in the rumen. A.L. Mueller* and M.S. Kerley, *University of Missouri-Columbia.*

The NRC model predicts microbial efficiency (MOEFF) based on the maintenance rate of the bacteria, the digestion rate of a feedstuff, and the theoretical maximum yield of the bacteria. Data from our laboratory have shown that dilution rate (DR) is determinant of microbial yield, growth and efficiency. The objective of this study was to compare equations based on DR and the NRC model to predict MOEFF. A single-flow continuous culture system operating at fractional DR of 0.03 and 0.06 per hour was used to determine MOEFF and bacterial N yield. Treatments consisted of diets containing two different levels of neutral detergent fiber (40 and 22 %). Diets were 1) 22 % ground corn (GC), 70 % soybean hulls (SH), and 8 % soybean meal (SBM; HF) and 2) 65 % GC, 25 % SH, and 10 % SBM (LF). Data from this study

was used to assess the effectiveness of the two methods to predict MOEFF. The equations for calculating the passage rate were removed from the NRC model to allow for the programmed DR to be used in predicting MOEFF. The DR equations calculated MOEFF and bacterial N yield closer to the experimentally determined values than the NRC model for both diets at the low DR but not at the high DR. The experimentally determined MOEFF at the high dilution rate was lower than MOEFF reported in the literature for diets with similar DR. Data from published studies reporting organic matter intake, particulate flow rate and MOEFF were also used to compare MOEFF prediction equations. The DR-based equations tended to predict MOEFF, bacterial N yield and amino acid (AA) flow closer to the reported values than the NRC model. When the DR equations did not predict MOEFF similar to reported data there appeared to be a biological inconsistency between the measured DR and the MOEFF. Based on these findings DR-based equations to predict MOEFF, bacterial N yield and AA flow appear to be more accurate than the NRC model. Further investigations into the accuracy of using these equations to predict MOEFF and bacterial N yield is needed.

Key Words: Microbial Efficiency, Rumen Modeling

319 Effect of an estrogenic implant on performance of newly received steer calves or calves castrated on arrival. H. A. DePra*, D. L. Step, R. E. Peterson, D. R. Gill, and C. R. Krehbiel, *Oklahoma State University.*

The objective of this experiment was to determine the effect of an estrogenic implant (10 mg of estradiol benzoate) on daily gain and feed efficiency of newly-received steers vs bull calves castrated upon arrival during a 42-d receiving study. A total of 104 steers (avg initial BW = 238 24 kg) and 103 bulls (avg initial BW = 239 23 kg) were received in two loads (one wk apart) at the Willard Sparks Beef Research Center during September 2002. At processing (d 0), bull calves were castrated using a Newberry knife and a single crimp emasculator. Calves were sorted by sex and blocked by initial BW, then randomly assigned to implant or no implant. All calves were fed a diet consisting of whole shelled corn, 49.7%; cottonseed hulls, 12%; ground alfalfa, 25%; molasses, 3%; and pelleted supplement 10.3% (DM basis). The diet was formulated for 250 kg calves to gain 1.10 kg/d. Data were analyzed using the MIXED procedure of SAS. There was no sex X implant interaction ($P = 0.63$) for overall ADG. Daily gain was greater ($P < 0.001$) for steers (0.94 kg) compared with bulls (0.76 kg), and was greater ($P < 0.001$) for implanted (0.91 kg) vs non-implanted (0.79 kg) calves. Dry matter intake was not influenced ($P = 0.68$) by sex over the 42-d feeding period (5.72 vs 5.63 kg/d for steers vs bulls, respectively). Across the 42-d feeding period, steers had 26% greater ($P = 0.02$) ADG:DMI than bulls. We conclude that an estrogenic implant administered to steer or castrated calves upon arrival at the feedlot will increase daily gain compared with non-implanted calves, and that the magnitude of the response to implant is similar in both steers and castrated calves. Despite the increased performance of castrated calves receiving an implant, both implanted and non-implanted steer calves had greater ADG and ADG:DMI than calves castrated at arrival over a 42-d receiving period.

Key Words: Castration, Implants, Receiving Cattle

320 Effect of copper level and zinc level and source on finishing cattle performance and carcass traits. L.J. McBeth*, C.R. Krehbiel, D.R. Gill, C.E. Markham, R.E. Peterson, R.L. Ball, C.K. Swenson, and S.S. Swaneck, *Oklahoma State University.*

One hundred sixty heifers (BW = 317 22 kg; Trial 1) and 160 steers (BW = 341 18 kg; Trial 2) were fed for an average of 140 d to determine to effect of Cu level and Zn level and source on feedlot performance and carcass merit. Treatments were: 1) 80 ppm ZnSO₄ and 12 ppm amino acid complexed Cu (AACu); 2) 80 ppm ZnSO₄, 12 ppm AACu and 12 ppm CuSO₄; 3) 40 ppm ZnSO₄, 40 ppm amino acid complexed Zn (AAZn) and 12 ppm AACu; 4) 40 ppm ZnSO₄, 40 ppm AAZn, 12 ppm AACu and 12 ppm CuSO₄; 5) 320 ppm ZnSO₄ and 12 ppm AACu; 6) 320 ppm ZnSO₄, 12 ppm AACu and 12 ppm CuSO₄; 7) 160 ppm ZnSO₄, 160 ppm AAZn and 12 ppm AACu; 8) 160 ppm ZnSO₄, 160 ppm AAZn, 12 ppm AACu and 12 ppm CuSO₄. Heifers and steers were blocked by initial weight and assigned to 32 pens each (5 head/pen; 16 pens/block). Data were analyzed using PROC MIXED of SAS with treatment, pen and block as class variables and 28-d periods as repeated measures. The model included Cu level, Zn level, and Zn source and

subsequent interactions. In Trial 1, no significant differences ($P > 0.10$) were observed for overall gain, DMI, or feed efficiency. From d 0 to 27, DMI tended ($P = 0.11$) to be greater for heifers consuming 320 vs 80 ppm Zn. No differences ($P > 0.01$) were observed for hot carcass weight, rib-eye area, kidney, pelvic and heart fat, marbling, quality grade, or yield grade. Twelfth-rib fat depth tended ($P < 0.10$) to be greater for heifers fed 24 vs 12 ppm Cu and 320 vs 80 ppm Zn. In Trial 2, no significant differences ($P < 0.10$) were observed for overall gain, DMI, or feed efficiency. At 12 ppm Cu, daily gain was significantly greater ($P < 0.01$) for steers consuming AAZn vs ZnSO₄ from d 0 to 27. Dressing percent tended ($P = 0.09$) to be greater for steers fed 320 vs 80 ppm Zn and was significantly greater ($P > 0.05$) for steers consuming 12 vs 24 ppm Cu. Twelfth-rib fat depth tended ($P = 0.09$) to be greater at 320 vs 80 ppm Zn, and was significantly greater ($P < 0.05$) for steers consuming AAZn at 320 ppm Zn vs those consuming AAZn at 80 ppm Zn. In our experiments, there appeared to be no advantage to feeding 24 vs 12 ppm Cu and inconsistent with other research, source of Zn had little influence on animal performance or carcass merit.

Key Words: Copper, Zinc, Steers

321 Effect of cottonseed byproduct feeds on feedlot performance and carcass traits of finishing heifers. C.E. Markham*, C.R. Krehbiel, D.R. Gill, R.E. Peterson, and H.A. DePra, *Oklahoma State University*.

One hundred fifty crossbred yearling heifers (initial BW = 318 ± 12 kg) were fed to compare the effect of source and level of cottonseed byproducts on feedlot performance and carcass characteristics. A control treatment was established consisting of 78.5% dry-rolled corn, 7.5% cottonseed hulls (CSH), 3.0% fat and 8.7% cottonseed meal (CSM). Delinted whole cottonseed (DWC) or pelleted delinted whole cottonseed (PDWC) was included in the diet to replace CSH and supplemental fat (15% of diet DM), or to replace CSH, fat, and cottonseed meal (25% of diet DM). In the initial 28-d period heifers fed the control diet tended ($P = 0.06$) to have greater ADG compared with heifers fed 25% PDWC, 15% DWC or 25% DWC diets. From d 56 to 84, heifers fed 15% PDWC had the greatest ($P < 0.001$) ADG, while heifers fed the control, 15 or 25% DWC diets had the lowest ADG; 25% PDWC was intermediate. From d 112 to 140, heifers fed 15 or 25% PDWC or the 25% DWC diet had greater ADG ($P = 0.03$) than heifers fed 15% DWC with control cattle being intermediate. Over the entire feeding period (d 0 to 150), heifers fed the 15% PDWC diet had greater ($P = 0.002$) ADG and heavier ($P = 0.001$) final live weights (560 vs 540 kg) compared with heifers fed the DWC or control diets. Heifers fed 25% PDWC also tended ($P = 0.10$) to have greater ADG and final live weights than DWC and control treatments. No treatment differences ($P > 0.10$) were observed for overall DMI or feed efficiency. Heifers fed 15 and 25% PDWC had greater ($P = 0.001$) HCW (avg = 349 vs 337 kg, respectively) compared with heifers fed DWC and control diets. No other differences ($P > 0.10$) were observed for carcass traits. We conclude that including PDWC in finishing rations resulted in greater live weight gain and heavier hot carcass weights compared with DWC or a combination of corn, CSH, CSM and fat.

Key Words: Feedlot Cattle, Cottonseed, Byproduct Feeds

322 Effect of continuous infusion of degradable or undegradable intake protein on forage intake, digestibility and nitrogen balance in steers consuming low quality forage. R. Basurto-Gutierrez*, H. T. Purvis II, G. W. Horn, C. R. Krehbiel, J. S. Weyers, and T. N. Bodine, *Oklahoma State University, Stillwater, OK, USA*.

To determine the effect of undegradable intake protein (UIP) or degradable intake protein (DIP) on forage intake, digestibility and N balance in steers consuming low quality forage, eight cannulated Angus steers (598 kg) were assigned to a replicated 4x4 Latin square and fed ad libitum low quality prairie hay (PH; CP = 5.0). Supplemental N sources were casein and urea, which were considered as UIP or DIP sources depending on infusion site. The four supplemental treatments were: 1) control (CON; ad libitum PH); 2) undegradable intake protein (UIP; PH + 24-h abomasal infusion of casein, 55 g N/d); 3) degradable intake protein from casein (DIP; PH + 24-h ruminal infusion of casein, 55 g N/d); and 4) degradable intake protein from urea (UDIP; PH + 24-h ruminal infusion of urea, 55 g N/d). Each experimental period consisted of 10 d for adaptation and 6 d for sample collection. Total PH intake, output of

feces and urine was collected daily. Nitrogen supplements were placed in water (3.6 L) and pumped at a rate of approximately 2.5 mL min⁻¹ by a peristaltic pump. Nitrogen supplementation increased ($P < 0.01$) forage intake compared with CON, but no difference was detected among supplemental nitrogen treatments (7.1 vs 9.1, 10.3 and 10.4 kg/d for CON, UIP, DIP and UDIP, respectively). Organic matter digestibility (52.0%) was not influenced ($P > 0.25$) by treatment. Fecal (42.2, 56.3, 66.6, 64.2 g/d for CON, UIP, DIP and UDIP, respectively), absorbed (14.7, 69.7, 69.7, 75.8 g/d for CON, UIP, DIP and UDIP, respectively) and urine N (19.4, 44.3, 36.3, 51.8 g/d for CON, UIP, DIP and UDIP, respectively) reflected ($P < 0.01$) total N intake. Excretion routes of N differed among treatments; urinary N was higher ($P < 0.02$) with UDIP than with DIP. In contrast, fecal N was lower ($P < 0.01$) with UIP than with DIP. Nitrogen supplementation increased ($P < 0.01$) N balance to a similar plane independent of source or infusion site (-4.7 vs 25.4, 33.3, 24.0 g/d for CON, UIP, DIP and UDIP, respectively). These data show that N supplementation for cattle consuming low quality forage can increase forage intake independent of N source or location of infusion, and alter N excretion, while maintaining similar N balance.

Key Words: Low Quality Forage, Nitrogen Balance, Beef Cattle

323 Antibiotics in ruminant feeding practices. D. Hausmann* and D. Hausmann, *Alpharma Animal Health*.

Since the early 1950's, antibiotics have been administered through feed as a tool to promote growth and manage diseases affecting cattle: the end result being a safer food supply. The practice of utilizing antibiotics in this manner is currently being evaluated, as it has in the past, with respect to overall contribution to agriculture and relationship to public health issues.

The extent of antibiotic use in animals, relevance to human medicine, as well as feed-grade antibiotic applications in typical management schemes will be presented. The industry's struggle with proper and timely identification of those cattle requiring antibiotic intervention, and its cost to the industry will be discussed. Consumer perceptions surrounding antibiotic use, and popular myths regarding the consequences of antibiotics in feed will also be examined.

Key Words: Feed, Antibiotics, Cattle

324 Targets for feed antimicrobials. M. Apley*, *Iowa State University*.

Feed additive therapeutic or disease control approvals for cattle include amprolium (coccidiosis), bacitracin (liver abscesses), chlortetracycline (liver abscesses, E. coli enteritis, pneumonia, anaplasmosis), decoquinate (coccidiosis), monensin (coccidiosis), neomycin (colibacillosis), oxytetracycline ((liver abscesses, E. coli enteritis, bacterial enteritis, pneumonia), and tylosin (liver abscesses). There is a different set of approvals for swine, poultry, and some minor species.

Feed application of these additives results in different pharmacokinetic profiles than if they were to be administered in a bolus dose, either orally or parenterally. The science of relating these pharmacokinetic parameters to the amount needed to inhibit or kill the target pathogen is referred to as pharmacodynamics. Recently, pharmacodynamic relationships have also been evaluated for predicting the potential for a given dosing regimen to contribute to antimicrobial resistance.

These feed additives, regardless of target species, share some regulatory aspects. Extralabel use of feed antimicrobials is banned in the United States. It is important to note that milk replacer is not considered a feed in regards to this regulatory ban.

Guidance document 152, recently released by the FDA Center for Veterinary Medicine, is designed to evaluate the potential impact of food animal antimicrobial use on human health. In this document, multiple aspects of antimicrobial use are subjectively classified as being of low, medium, or high risk to human health. The release assessment portion of this draft guidance for industry includes a section on resistance selection pressure. In this section the extent of use is considered in the areas of individual vs. small groups vs. flocks or herds. An antimicrobial applied to an entire flock or herd will most likely receive higher scrutiny for potential resistance development.

Key Words: Antimicrobials, Feed, Indications

325 Appropriate usage of antibiotics for disease control. A. Confer*, *Oklahoma State University.*

Bovine respiratory disease, especially bacterial pneumonias in beef and dairy cattle, will be used as the model disease for this discussion. The main bacteria that cause pneumonia in cattle, *Mannheimia haemolytica*, *Pasteurella multocida*, *Haemophilus somnus*, *Arcanobacterium pyogenes* and *Mycoplasma bovis*, and the different lesions produced will be reviewed. There will be a discussion of typical antibiotic treatment strategies and how they may contribute to an apparent increase in prevalence of chronic pneumonia and possible reasons why this has occurred. Shifts in antibiotic resistance for the various respiratory bacterial pathogens will be described. The need for better and/or more critical diagnostic techniques for cattle that need to be treated with antibiotics will be discussed along with the value of current and the need for better respiratory vaccines.

Key Words: Bovine Respiratory Disease, Antibiotic Resistance, Vaccines

326 Modeling alternative strategies to stabilize host response in subclinical disease. T.H. Elsasser*, *USDA, ARS Growth Biology Laboratory.*

Subclinical infection and disease load presents a significant challenge to producers and veterinarians. Often overlooked or undiagnosed, the presence of the vectors that define the subclinical situation are a real concern due to the potential for disease transmission via several "shedding" routes as well as priming animals for more severe reaction to a secondary infection. Traditional uses of the lower levels of antibiotics for disease control purposes has come under tremendous scrutiny and criticism. Issues regarding the development and transmission of antibiotic resistance in microbes of food animals are at the forefront of risk assessment paradigms. In this regard, alternatives to antibiotic regimens can be developed, but more importantly they need to be used where available. Certain commonsense approaches can be partnered to capitalize on these alternatives. At the heart of alternative approaches to disease management are the "3 needs": the alternative actually needs to be effective, it needs to readily implementable into an existing management program, and it needs to be economical. In this light therefore one should rethink what constitutes "disease", which is actually the biochemical manifestations of the host response to the presence of an immunological threat. An important consideration in the development of "alternatives" might be to focus on what can be done to stabilize host homeostatic mechanisms and allow the animal to utilize its own defenses to combat the vector. Approaches are being developed that range from nutrient alterations to genetic manipulation of endogenous antimicrobial peptides. Finally, where we can anticipate the timing of certain production stresses, including birth/parturition, weaning, transport, feeding changes, etc., we may be able to provide dietary supplements in the short term to limit stress-related free radical production and imbalances in the intracellular REDOX potential that set animals up for metabolic imbalances. When animals are less than stable they are more susceptible to opportunistic infections.

Key Words: Antibiotics, Redox Potential, Infection

327 Comparison of two heifers development systems on a commercial ranch. T. W. Loy*¹, D. C. Adams¹, T. J. Klopstein¹, J. A. Musgrave¹, and B. Teichert², ¹*University of Nebraska, Lincoln*, ²*Rex Ranch, Ashby, Nebraska.*

Spring-calving heifers were used in a two-year study to evaluate two systems of developing bred heifers. The control system (CON; n = 558) included native winter range, undegradable intake protein supplement (average 0.5 kg / d), and increasing amounts of hay (average 3.3 kg / d). The alternative system (TRT; n = 559) included winter range and increasing amounts of a dry corn gluten feed-based supplement (average 1.5 kg / d). Supplements were formulated to meet protein requirements, and systems were designed to supply similar NE. Heifers were managed as a group throughout calving and the subsequent grazing season. Weights and body condition scores (BCS) were assigned during the fall as yearlings (Sept to Oct), near the beginning of the calving season (March 1), and in the fall as two-year-olds. Calf birth and weaning weights were recorded. Pregnancy as two-year-olds was determined by rectal palpation. Weight and BCS data were analyzed using the GLM procedure of SAS, and pregnancy data by chi-square analysis. Initial weight was 393.3 kg, BCS was 5.5, and neither differed ($P > 0.42$) by

treatment. A year x treatment interaction was detected for weight and BCS change prior to calving. In year 1, no difference was observed ($P = 0.69$) in weight change, although TRT heifers lost less ($P = 0.02$) BCS than CON. In year 2, TRT heifers gained more ($P < 0.01$) weight and lost less ($P < 0.01$) BCS than CON. Calf birth and weaning weight were not affected ($P > 0.21$) by treatment, although calves nursing TRT cows tended ($P = 0.10$) to have higher ADG than those nursing CON cows. Post-calving weight loss was 22.2 kg, which was not affected ($P = 0.88$) by treatment. A year x treatment interaction in BCS change was observed, with a similar ($P = 0.38$) increase in BCS occurring in year 1, while TRT cows lost more ($P = 0.04$) condition than CON in year 2. Pregnancy rate was 96.1% and was not affected ($P = 0.87$) by treatment. Bred heifers can be managed on winter range and supplement without compromising performance.

Key Words: Heifer Development, Supplementation

328 Effects of fat supplementation on heat-stressed lactating beef cows grazing endophyte-infested fescue. E Myers*, E Vanzant, L Anderson, R Burris, B Hightshoe, J Johns, and K Schillo, *University of Kentucky.*

To assess the effect of a high-fat liquid supplement on heat-stressed lactating beef cows grazing endophyte-infested tall fescue (E+), 130 predominantly Angus cows (initial BW = 563 kg; initial body condition score (BCS) = 5.7; 1 to 9 scale) at 2 locations (n=80 at location ARC, n=50 at location PTN) were allotted to 8 (ARC) and 4 (PTN) E+ pastures, balanced within location for calf birth date, calf sex, cow age, cow BCS, and cow BW. Within location, half of the groups were randomly assigned to receive either a commercial liquid supplement containing approximately 22% fat (MIX-30™, AgriDyne, Inc; MIX) or a corn/soybean meal supplement (CON) fed to provide similar amounts of ME and CP from 30 days before, through the last day of a 60-d breeding season. Cows were offered MIX twice weekly on a free choice basis up to 2.72 kg/head-d; CON groups were fed supplement daily with intakes adjusted twice weekly to match MIX intakes. No treatment x location interactions were detected ($P > 0.10$). Cows receiving MIX gained more weight ($P = 0.08$; 14.1 vs. 5.2 ± 3.5 kg), and body condition ($P < 0.01$; BCS change = 0.24 vs -0.17 ± 0.08 BCS units), had higher pregnancy rates ($P = 0.05$; 74 vs 57 ± 6%; determined by ultrasound 35 d after end of breeding season), lower final body temperatures ($P < 0.01$; 38.8 vs 39.3 ± 0.06 °C), greater body temperature decrease ($P < 0.01$; -0.26 vs 0.07 ± 0.06 °C), and lower serum thyroxine concentrations ($P < 0.01$; 35 vs. 40 ± 1.0 ng/mL; ARC only) than cows receiving CON. Final calf weights and calf average daily gains were unaffected ($P > 0.10$) by treatment. Supplementing heat-stressed cows from 30 d before, through the end of the breeding season with a liquid, fat-containing supplement increased pregnancy rates by 17%, decreased body temperatures by 0.5 °C, and lowered serum thyroxine concentrations compared with corn/soybean meal supplementation.

Key Words: Dietary Fat Supplement, Pregnancy, Beef Cow

329 Effect of increasing level of soybean hulls on intake and utilization of endophyte-infested tall fescue hay by beef steers. L. van Rensburg*, E.S. Vanzant, J.A. Benson, C.L. Adkins, and K.A. Beighle, *University of Kentucky, Lexington.*

Twenty ruminally cannulated, crossbred beef steers (476 kg) were randomly assigned within weight blocks to receive soybean hulls (SH; 18.0% CP; 58.7% NDF) at 0, 0.32, 0.64, 0.96, or 1.28% (DM basis) of BW as a supplement to endophyte-infested tall fescue hay (14.1% CP; 68.0% NDF). Adaptation (d 1 to d 14) was followed by total fecal collection (d 15 to d 21), Co:EDTA dosing (d 22 at 0600) and subsequent ruminal fluid sampling (d 22; 0600, 1100, 1400, 1700, 2000; d 23 at 0600) for Co, pH, NH₃-N, and VFA analyses. Voluntary forage DMI decreased linearly ($P < 0.01$; 1.61, 1.55, 1.41, 1.19, and 1.05 %BW) and total (1.61, 1.87, 2.05, 2.15, and 2.33 %BW) and digestible (0.96, 1.16, 1.32, 1.43, and 1.52 %BW) DMI and liquid dilution rate (9.4, 10.0, 10.6, 11.7, and 12.2 %/h) increased linearly ($P < 0.02$) with increasing SH. Total tract DM digestibility increased as SH increased from 0 to 0.96% BW and plateaued with the next increment of SH (quadratic; $P = 0.01$; 59.6, 61.9, 64.6, 66.8, and 65.6%). All ruminal fermentation characteristics except molar proportion of acetate had sampling time x treatment interactions ($P < 0.10$). Generally, ruminal pH decreased linearly ($P = 0.07$) and total VFA concentrations increased linearly ($P < 0.02$) with increasing SH. Peak ruminal NH₃-N concentrations (at 1100) increased as SH

increased from 0 to 0.96% BW and decreased with the next increment of SH (quadratic; $P < 0.01$). Molar proportions of acetate decreased (linear; $P < 0.01$) with increasing SH and, in general, molar proportions of propionate increased ($P = 0.06$) with increasing SH. For C4 and C5 VFA, observed differences were characterized by increasing proportions with increasing SH. Changes in digestible DMI and modest shifts in fermentation characteristics suggest that increasing SH supplementation from 0 to 1.28% of BW would result in linear increases in growth of stocker cattle consuming endophyte-infested fescue.

Key Words: Forage Utilization, Fiber Supplements, Beef Steers

330 Restricting time of access to large round bales of hay on cow performance, hay waste, manure production, and manure nutrients. T. C. Cunningham*, D. B. Faulkner, A. J. Miller, and J. M. Dahlquist, *University of Illinois at Urbana-Champaign*.

Restricting time of access to round bales of hay on cow performance, hay waste, manure production and manure nutrients was evaluated in two experiments. In Exp. 1, seventy-two Simmental cows (616.7 ± 28.3 kg) with calves were used in four replications to evaluate three treatments: Ad libitum hay (no time restriction) or access restricted to 8 or 4 hours/day. All treatments received high quality hay (relative feed value=134) stored inside. Cows and calves were randomly allotted to 12 pens 24 h after parturition. Final cow weight ($P=.06$) and BCS ($P=.04$) increased as hay access times lengthened. Calf weight and milk production were not affected by access time. Hay disappearance for 4h cows was 37% less than for cows having ad libitum access to hay (linear, $P=.01$). Manure production (kg DM/hd/d) was increased ($P=.02$) with increasing time of access to hay. Manure output of N, P, and K (kg/hd/d) increased ($P=.01$) with increased time allowed to hay. Nitrogen disappearance (kg/hd/d) increased linearly ($P=.01$) with increasing time of access to hay, however, % N recovered was not different across treatments. In Exp. 2, 72 Simmental cows (593 ± 18.6 kg) in the third trimester of gestation were evaluated in four treatments: ground hay (100%) fed to meet NRC recommendations (7.5 kg/hd/d); and access to hay restricted to 3, 5, or 7 hours/day. All treatments were fed average quality hay (relative feed value=80) stored outside. Cows were blocked by weight and assigned to 12 pens resulting in 3 replications. Cow weight ($P=.08$) and cow weight change ($P=.04$) improved with increasing time allowances. Manure production (kg DM/hd/d) tended to increase ($P=.08$) with longer access to hay. Increases in N disappearance (kg/hd/d) ($P=.01$) and %N recovered ($P=.02$) were observed with increasing time allowance to hay. Manure output of N, P, and K (kg/hd/d) increased ($P<.05$) for longer time periods. Restricting time of access to large round hay bales reduced hay disappearance while maintaining acceptable cow performance.

Key Words: Cows, Hay, Limit-feeding

331 Restricted feeding of ground hay on cow performance, manure production, and manure nutrients. T. C. Cunningham*, D. B. Faulkner, A. J. Miller, and J. M. Dahlquist, *University of Illinois at Urbana-Champaign*.

One hundred eight Simmental cows (614 ± 30.0 kg) with calves were used to evaluate the effects of restricted-feeding ground hay on cow performance, manure production, and manure nutrients. Cows and calves were randomly allotted to 12 pens 24 h after parturition, resulting in 4 replications, with 9 head per pen. Average quality hay (relative feed value = 105) stored inside was used in three feeding levels: 100% NRC requirement for maintenance (14 kg DM/hd/d); restricted-fed hay at 90% of NRC (12.7 kg DM/hd/d); restricted-fed hay at 80% NRC (11.2 kg DM/hd/d). All hay was ground to pass a 7.6 cm screen. Trial duration was 75 days. Diets were fed once daily and supplemented with 200 mg of Rumensin along with .9 kg cracked corn and .11 kg mineral as a carrier. No differences in cow performance or calf gain were observed. Manure production (kg DM/hd/d) numerically increased with increased feeding level, but was not significant ($P=.36$). As designed, a linear treatment effect ($P=.001$) was observed for hay disappearance (kg DM/hd/d) with increased feeding levels. Cows on the 80 and 90% restricted-fed treatments actually received restricted levels of 84.1 and 91.3%, respectively. Percent DM recovery as a percent of DM disappearance was calculated for each pen from hay disappearance and manure production. A trend for increased %DM recovery as a percent of DM disappearance was observed with increased feeding level, however, no statistical differences were observed. Nitrogen disappearance

(kg/hd/d) linearly increased ($P=.01$) with increased feeding level, however, %N recovered as a percent of N disappearance did not differ across treatments. Manure output of P (kg/hd/d) tended to increase ($P=.09$) as feeding level increased. Results from this study indicate restricted-feeding ground forages at levels slightly below NRC recommended maintenance levels may be a viable feeding strategy for producers to achieve a desired level of performance for their cows. Additional benefits may include reduced manure production and manure nutrient output.

Key Words: Hay, Restricted-feeding, Cows

332 Effects of program-fed corn/hay diets on performance, lactation and manure production. A.J. Miller*¹, D.B. Faulkner¹, and K.E. Tjardes², ¹*University of Illinois at Urbana-Champaign*, ²*South Dakota State University, Brookings*.

Ninety-six developing heifers (195 ± 35 kg) were allotted to 3 treatments (4 pens/treatment): 90% Hay:10% Concentrate (HAY); 50% Hay:50% Concentrate (50:50); or 10% Hay:90% Concentrate (CORN); to determine the effects of program-fed intermediate levels of forage and concentrate on heifer performance and manure production. Concentrate consisted of 76% cracked corn and 24% SBM. HAY was fed ad libitum and other diets were restricted to be isocaloric. Heifer ADG increased linearly with increasing levels of concentrate ($P<0.001$; 0.52, 0.73, 0.83 kg). By design DMI decreased linearly with increasing concentrate level ($P<0.001$; 5.32, 4.63, 4.00 kg/hd/d), resulting in a linear increase in gain:feed for program-fed diets ($P<0.001$; 0.099, 0.159, 0.208). Manure production was weighed and sampled by cleaning pens at the beginning and end of a 28 day period. Manure production decreased curvilinearly with increasing concentrate levels (linear $P<0.001$, quadratic $P<0.01$; 0.98, 0.39, 0.20 kg/hd/d). Manure composition results indicate linear increases in percent nitrogen (N) and phosphorus (P) ($P=.015$) and decrease in percent potassium (K) ($P=.015$) resulting in curvilinear decreases in total N, P, and K recovered in the manure (linear $P=.0001$, quadratic $P=.06$). Experiment 2 utilized 46 lactating Simmental cows (560 ± 66 kg) blocked by calving date and assigned to 3 pens per treatment following calving for 88 ± 15d. Diets were identical to Exp. 1 with HAY being fed at 12.4 kg/hd/d. Cow ADG increased linearly with increasing concentrate levels ($P<0.001$; -0.32, 0.11, 0.45 kg), as did cow body condition score change ($P<0.001$; -0.07, 0.54, 1.15). Milk production tended toward a curvilinear response (linear $P=0.07$, quadratic $P=0.08$; 7.03, 8.69, 8.30 kg/d). Percent total solids and percent fat in milk were highest for 50:50 (quadratic $P<0.02$). Calf ADG was not different ($P>0.2$). Program-fed corn-based diets improved heifer and lactating cow performance while reducing manure production and total N, P, and K excretion.

Key Words: Cows, Program-fed, Corn

333 Mineral content of forages grown on poultry litter-amended soils. B. C. McGinley*¹, K. P. Coffey¹, J. B. Humphry¹, T. J. Sauer², H. L. Goodwin¹, W. K. Coblenz¹, and L. J. McBeth¹, ¹*University of Arkansas, Fayetteville, AR*, ²*USDA National Soil Tilth Lab, Ames, IA*.

Large amounts of poultry litter are applied each year to pastures in northwest Arkansas and northeastern Oklahoma resulting in an increase of certain minerals in the soil. The objective of this study was to monitor the mineral concentrations in forages grown on poultry litter-amended soils and compare concentrations of these minerals with those required by beef cows during gestation and early lactation. Four farms in NW Arkansas and NE Oklahoma with a history of broiler-litter application were used to monitor forage mineral concentrations and the grass tetany ratio (equivalent ratio of K to Ca + Mg) from April 2000 to March 2002. Two-year mean forage Ca, P, K, S, Fe, and Zn concentrations from each farm were greater ($P<0.05$) than NRC requirements for gestation and lactation. Forage concentrations of Ca, P, K, and Zn rarely fell below requirements for lactating beef cows on any date during the study. Mean forage Mg concentrations from one farm were ($P<0.05$) above requirements for lactating beef cows while those from three farms were not different ($P<0.05$) from the requirements. However, forage Mg concentrations during January and February of 2001 and 2002 on each farm fell below the Mg requirement for beef cows in early lactation. Mean tetany ratios from all farms were below ($P < 0.05$) the tetany threshold of 2.2, but forage from one farm surpassed the tetany ratio of 2.2 during the spring of 2000 and another surpassed the tetany ratio during the spring of 2000 and 2001. Average forage Cu concentrations were

above ($P < 0.05$) requirements on one farm (12 mg/kg), below ($P < 0.05$) requirements on another farm (8.5 mg/kg) and did not differ ($P < 0.05$) from the requirements on two farms. Forage Cu concentrations were at or below beef cow requirements during much of the fall of 2000 and early winter of 2001 on each farm. Pastures fertilized with broiler litter may meet most but not all mineral requirements of beef cattle and warrant supplementation of specific minerals, particularly Mg.

Key Words: Manure Management, Forage, Minerals

334 Effect of harvest date and fertilization rate on nitrogen degradation of bermudagrass. B. C. McGinley*, K. P. Coffey, W. K. Coblenz, N. W. Galdamez-Cabrera, and J. E. Turner, *University of Arkansas, Fayetteville, AR.*

Fertilizing bermudagrass (*Cynodon dactylon*) with N can produce large quantities of forage and increase plant N concentrations. Bermudagrass growing on a layer manure-amended site was fertilized with ammonium nitrate at four rates (0, 56, 112, and 168 kg N/ha) approximately one month before first and third harvests on May 30 and August 18, 2000 to determine in-situ degradation kinetics of N and neutral detergent insoluble N (NDIN). Five crossbred ruminally-cannulated steers (BW=422 21.0 kg) were used to evaluate in-situ degradation kinetics in a randomized complete block design with a 2 x 4 factorial arrangement. The immediately soluble N fraction (Fraction A) was greater ($P < 0.05$) for bermudagrass harvested May 30, but the potentially degradable N fraction (Fraction B) was greater ($P < 0.05$) for bermudagrass harvested August 18. Fraction A was greater ($P < 0.05$) and fraction B was lower for forage fertilized with 112 and 168 kg N/ha compared with fertilization at lower N rates. A harvest date x N fertilization rate interaction ($P < 0.05$) was detected for the undegradable N fraction (fraction C) and for effective ruminal N degradation. Effective ruminal N degradability was greater ($P < 0.05$) within each harvest date for bermudagrass fertilized with 112 and 168 kg N/ha compared with lower N fertilization rates and was also greater from each of the forages harvested on May 30 compared with August 18. Fraction A of NDIN was not affected ($P < 0.05$) by harvest dates or N fertilization rates. Fraction B was greater ($P < 0.05$) on May 30 than August 18. A harvest date x fertilization rate interaction ($P < 0.05$) was detected for fraction C. Rate of NDIN degradation was not affected ($P < 0.05$) by harvest date or fertilization rate. Effective degradability of NDIN was improved ($P < 0.05$) by N fertilization. Nitrogen fertilization may improve the degradability of both total N and NDIN from bermudagrass. Later harvests may have lower degradability of total N, but NDIN may not be affected.

Key Words: *Cynodon Dactylon*, Nitrogen, In Situ Degradation

335 Utilization of genetically enhanced corn residue for grazing. C. B. Wilson*¹, C. N. Macken¹, G. E. Erickson¹, T. J. Klopfenstein¹, and E. Stanisiewski², ¹*University of Nebraska, Lincoln, NE*, ²*Monsanto Company, St. Louis, MO.*

Two studies were conducted to evaluate transgenic and non-transgenic corn for residue grazing. The objectives were to compare growth performance of steers grazing 1) corn residue from a Corn Root Worm protected (Bt) corn (event MON 863) and the near isogenic, non-transgenic (nonBt) corn, and 2) corn residue from a Roundup Ready® (RR) corn (event nk603) and the near isogenic, non-transgenic (nonRR) hybrid. In the first study (Exp 1), two irrigated corn fields were used after grain harvest of RR and nonRR control. The second study (Exp 2) was conducted the following year using dry land corn with Bt, RR, and their non-transgenic controls. In Exp 1, 64 crossbred steer calves (241 kg) were stratified by weight, and assigned randomly to one of eight equally sized pastures (4 RR and 4 nonRR). Each pasture was stocked with 8 steers to achieve stocking rates of .354 ha/steer/60 d. In Exp 2, 128 crossbred steer calves (262 kg) were used in a completely randomized design with four, 13.8 ha fields (Bt, nonBt, RR and nonRR corn residue). Steers were assigned as in Exp 1 to one of sixteen equally sized pastures (4 pastures per hybrid) for 60 d. Each pasture was stocked with 8 steers to achieve stocking rates of .43 ha/steer/60 d. Both experiments were supplemented with protein supplement (.45 kg/steer/d) to ensure protein intake did not limit performance. Steer performance data were analyzed using the GLM procedure of SAS. Exp 1 grazing was terminated at 35 d due to snow cover. There was no significant difference ($P > .05$) in steer performance. In Exp 2, steer performance was not different between Bt corn or RR corn and their respective controls following the 60 d grazing period. Steer ADG for the Bt and nonBt were

.40 and .36 kg/d. Roundup Ready and nonRR were similar with ADG of .39 and .36 kg/d. The animal performance data demonstrates feeding value of corn residue does not differ between genetically enhanced corn hybrids and their near isogenic, non-transgenic controls.

Key Words: Corn Residue Grazing, Transgenic Corn, Beef Cattle

336 Supplement type and frequency on intake and performance, and energy value of dry distillers grains in a high-forage diet. T. W. Loy*, T. J. Klopfenstein, G. E. Erickson, and C. N. Macken, *University of Nebraska, Lincoln.*

Crossbred heifers (n = 120; 265 kg, SD = 37) were individually fed to determine the effect of supplement type and frequency on intake and performance, and to measure the energy value of dry distillers grains plus solubles (DDGS) in a high-forage diet. Treatments were arranged in a 3 x 2 x 2 factorial, with three supplements, two levels and two frequencies of supplementation. Supplements included dry rolled corn (DRC), DRC with corn gluten meal (DRC+CGM), and DDGS. Supplements were fed at 0.21% (LOW) or 0.81% (HIGH) of BW, and were provided daily (DAILY) or three times weekly (ALT) in equal portions, with 7-d supplement intake similar between DAILY and ALT. Heifers were fed to consume grass hay (8.7% CP) ad libitum. Weights were recorded every 28 d, with supplement levels adjusted accordingly. Individual DMI, diet composition, BW, and ADG were used to calculate energy values for DDGS and DRC. Supplement type, level, frequency, and interactions were tested using the GLM procedure of SAS, with initial weight included as a covariate. Supplement by level interactions for gain ($P = 0.01$) and efficiency ($P < 0.01$) were detected. At the LOW level, DDGS heifers gained more and were more efficient ($P < 0.03$) than DRC or DRC+CGM. No performance differences were observed ($P > 0.22$) between DDGS and DRC+CGM in HIGH treatments, although both improved ($P < 0.01$) gain and efficiency relative to DRC. Calculated NE content of DDGS was 27% higher than DRC. Gain and efficiency were improved ($P < 0.01$) in heifers fed HIGH vs LOW. Total intake was higher ($P < 0.01$) for HIGH than LOW (2.35 vs 2.06% BW, respectively). However, LOW heifers consumed more hay ($P < 0.01$) than HIGH (1.78 vs 1.49% BW, respectively). Heifers supplemented DAILY consumed more ($P < 0.01$) hay and total DM than ALT heifers. Daily supplemented heifers gained more ($P < 0.01$) than ALT, but efficiency was not affected ($P = 0.85$) by supplementation frequency. In a high forage diet, DDGS has a higher energy value than corn.

Key Words: Dry Distillers Grains, Supplementation, Forage Intake

337 Estimation of rumen undegradable protein in forages using neutral detergent insoluble nitrogen at a single in situ incubation time point. H. Haugen*, M. Lamothe, T.J. Klopfenstein, and M. Ullerich, *University of Nebraska-Lincoln.*

Two experiments were conducted to evaluate the use of neutral detergent insoluble nitrogen (NDIN) at a single in situ incubation time point to estimate the rumen undegradable protein (UIP) in forages as well as to compare rates of NDIN degradation. In Experiment 1, forage samples from upland range and subirrigated meadow were incubated in situ for their mean retention time estimated from in vitro dry matter digestibility plus a 10 hour lag. Samples were also incubated for 0 h, 10 h, 75% of the estimated total mean retention time (TMRT), and 96 h. Rates of ruminal degradation were calculated using the slope of the regression of the natural logarithm of the potentially degradable NDIN remaining (96 h indigestible fraction subtracted) against time. Rates of degradation for forage samples from range and meadow sites collected in May and June were slower from 0 to 10 h than from 10 h to 75% TMRT ($P < 0.05$) but were not different for collections from July to September ($P > 0.1$). The estimated UIP using 75% of the TMRT was highly correlated ($R^2 = 0.95$) with UIP values obtained from the fractional rates of degradation and passage plus accounting for a 10 h passage lag. In Experiment 2, clip samples of four forages (alfalfa, birdsfoot trefoil, kura clover, and smooth brome) and diet samples containing mixtures of alfalfa/brome, birdsfoot trefoil/brome, kura clover/brome, or brome were incubated in situ as described in Experiment 1. Estimated UIP values using 75% of the TMRT were highly correlated ($R^2 = 0.99$) with those obtained using fractional rates of degradation and passage plus accounting for a 10 h lag. Rates of degradation were not different from 0 to 10 h and 10 h to 75% TMRT ($P = 0.3253$ and $P = 0.8690$ for diet and clip samples, respectively). The UIP of the forages used in these

two experiments was accurately estimated using a single in situ incubation time point equivalent to 75% of the TMRT, and rates of digestion can also be obtained at this time point plus 0 h and 96 h.

Key Words: Rumen Undegradable Protein, Neutral Detergent Insoluble Nitrogen, Forages

338 Effects of roughage source and particle size on feedlot performance and subsequent carcass characteristics of finishing heifers. C.E. Markham*, C.R. Krehbiel, D.R. Gill, R.E. Peterson, and H.A. DePra, *Oklahoma State University.*

One hundred crossbred yearling heifers (initial BW = 364 ± 10 kg) were fed to evaluate differences in feedlot performance and carcass characteristics due to roughage source and particle size. Diets consisted of 80% dry rolled corn (DM basis), 3% fat, a pelleted supplement, and one of four roughage treatments. Dietary treatments consisted of either 12% alfalfa hay (32% NDF; DM basis) or 4.5% cottonseed hulls (86% NDF; DM basis) as the roughage source, and diets were formulated to provide an equal concentration of NDF from roughage. Geometric mean diameter (d_{gw}) of the roughage treatments was determined by dry sieving, and particles retained on a 1.18-mm screen or greater were considered physically effective. Alfalfa hay was fed either coarsely chopped (AC; d_{gw} = 4.73 mm) by a Rotomix bale processor, or finely ground (AF) through a hammer mill equipped with a 1.3 cm screen (d_{gw} = 1.13 mm). Cottonseed hulls were fed as either unprocessed (CSH; d_{gw} = 4.78 mm) or pelleted (PCSH; d_{gw} = 8.76 mm). The percent of roughage retained in the physically effective fraction was 99.8, 96.0, 77.2 and 34.0% for PCSH, CSH, AC and AF, respectively. Physically effective NDF from roughage was estimated to be 10.9% for AF, 24.6% for AC, 82.6% for CSH and 85.9% for PCSH. Total dietary NDF concentrations were 19.8, 17.2, 18.0 and 19.6% (DM basis) for AC, AF, CSH and PCSH, respectively. No treatment differences were observed for ADG (P = 0.78) or DMI (P = 0.44). In the initial 28-d period, heifers fed AF had greater (P < 0.05) ADG:DMI compared with the other treatments. However no differences were observed for feed efficiency in the subsequent periods and overall efficiency did not differ (P = 0.84) among treatments. Additionally no treatment differences (P > 0.10) were observed for any carcass characteristics. We conclude that altering roughage source (alfalfa vs CSH) or physical form does not affect performance or carcass characteristics of heifers fed high-grain diets balanced for NDF from roughage.

Key Words: Feedlot cattle, Roughage source, Particle size

339 Effect of limit-feeding on performance, carcass merit, and digestion by finishing steers. M. L. Linville*, K. C. Olson, C. A. Stahl, D. L. McNamara, T. B. Schmidt, G. R. Rentfrow, E. L. McFadin, D. K. Davis, and E. P. Berg, *University of Missouri, Columbia.*

Angus steers (n = 84; BW = 348 ± 21 kg) were used to evaluate the effects of limit-feeding on performance, carcass merit, and digestion. Treatments consisted of 3 diets that were formulated to promote a 1.6 kg ADG at intake levels corresponding to approximately 100% (AL), 90% (90), or 80% (80) of ad libitum intake. Each diet delivered similar NE and MP at prescribed intake levels. Daily feed amounts offered to each treatment group were determined according to the previous 3-d average intake for steers on the AL treatment. Intake of offered feed by all treatment groups was usually complete each day. Actual DM intakes during the trial, as a percent of average BW, were 2.55% for AL, 2.38% for 90 (93% of AL), and 2.02% for 80 (79% of AL). Steers on the 80 treatment had greater (P < 0.01) ADG and G:F than AL or 90 steers (ADG = 1.61, 1.53, and 1.82 kg and G:F = .14, .15, and .19 kg gain/kg DMI, for AL, 90 and 80, respectively). Hot carcass weights of 80 steers were greater (P = 0.01; 365 kg) than steers on the AL (350 kg) or 90 (343 kg) treatments. Marbling scores of AL and 80 steers were greater than those of 90 steers (P < 0.05); however, average quality grade for all three treatments was low Choice. Yield grade tended to be improved in 90 and 80 steers (P = 0.11; 3.20 and 3.26, respectively) compared to AL steers (3.56). Ribeye area was not affected by treatment (P = 0.28). A second trial (12 steers; BW = 440 ± 21 kg) was conducted to evaluate digestion characteristics of the diets used in the feedlot experiment. Fecal output by 80 steers was reduced (P < 0.01; 3.98 g DM/kg BW) relative to AL and 90 steers (6.16 and 6.01 g DM/kg BW, respectively). Digestion of OM by 80 steers was greater

(P < 0.01; 80.2 %) than by AL and 90 steers (72.8 and 70.7%, respectively). Growth performance was greater than that predicted by NRC models when finishing steers were fed a diet formulated to promote 1.6 kg ADG but limited to approximately 80% of ad libitum DMI.

Key Words: Intake, Digestion, Steers

342 Wet corn gluten feed and alfalfa hay levels in dry-rolled corn finishing diets. T. B. Farran*¹, G. E. Erickson¹, T. J. Klopfenstein¹, C. N. Macken¹, and R. U. Lindquist², ¹University of Nebraska-Lincoln, ²Archer Daniels Midland Company.

Steers (n = 192; 351 ± 11.3 kg) were stratified by weight and assigned randomly to 1 of 24 pens (2 × 3 factorial; 4 pens/ treatment) and fed for 132-d to determine if alfalfa hay (AH) can be reduced in feedlot diets containing wet corn gluten feed (WCGF). Finishing diets contained either 0 or 35% WCGF and 0, 3.75, or 7.5% AH. Experimental diets were formulated to be iso-nitrogenous based upon the 35% WCGF and 7.5% AH treatment. DMI increased linearly when AH increased in both 0 (P < 0.07) and 35% (P < 0.01) WCGF diets. Daily gain and hot carcass weight (HCW) increased (P < 0.05) with increasing AH in diets containing 0% WCGF. Interactions for AH and WCGF were observed for ADG:DMI, fat depth, and longissimus area. Gain efficiencies of cattle fed WCGF were 7% higher (P < 0.02) than efficiencies of cattle fed no WCGF at 0% AH, suggesting a reduction in acidosis when WCGF was included. Within 35% WCGF diets, efficiency decreased as AH inclusion increased (P < 0.05). These data suggest that AH has less value when diets contained WCGF, and can be decreased from conventional levels. Efficiency was equal across AH levels when 0% WCGF was fed; however, ADG was depressed when AH was removed in diets containing 0% WCGF.

WCGF level, % DM:	0	0	0	35	35	35	
AH level, % DM:	0	3.75	7.5	0	3.75	7.5	SEM
DMI, kg ^{a,b}	10.1	10.6	10.7	10.1	11.1	11.4	0.2
ADG, kg ^c	1.67	1.82	1.82	1.79	1.85	1.85	0.04
ADG:DMI ^b	0.165	0.171	0.170	0.177	0.166	0.163	0.003
HCW, kg ^c	360	372	372	371	375	375	4
Marbling score ^d	499	502	504	494	491	500	12
Fat depth, cm ^e	1.14	1.31	1.25	1.34	1.29	1.46	0.06

^aLinear effect of AH within 0% WCGF (P < 0.07). ^bLinear effect of AH within 35% WCGF (P < 0.05). ^cLinear effect of AH within 0% WCGF (P < 0.05). ^d400 = Slight 0, 500 = Small 0. ^eAH × WCGF interaction (P < 0.10).

Key Words: Wet Corn Gluten Feed, Feedlot Cattle, Roughage

343 Effects of level and composition of wet corn gluten feed in steam-flaked corn based finishing diets. C.N. Macken*¹, G.E. Erickson¹, T.J. Klopfenstein¹, R.A. Stock², and R.J. Cooper², ¹University of Nebraska, Lincoln, ²Cargill Inc., Blair, NE.

Two finishing experiments were conducted to determine the effects of level and composition of wet corn gluten feed (WCGF) in steam-flaked corn (SFC) based diets on feedlot steer performance. In experiment 1, 192 crossbred steer calves (298 kg) were stratified by initial weight and assigned randomly to 1 of 24 pens (8 steers/pen). Pens were assigned to 1 of 6 treatments (4 pens/treatment). Treatments were six levels of Sweet Bran[®] WCGF, with 0, 10, 20, 25, 30, and 35% WCGF replacing SFC (DM basis). All diets contained 10% corn silage, 5% supplement, and 3.5% tallow. Steers were implanted with Synovex C on d 0, reimplanted with Revalor-S on d 53, and fed for 151 d. Feed efficiency and ADG were similar among treatments. Dry matter intake was lower (P < 0.10) for 0% WCGF compared with levels of 20, 25, and 35% WCGF. Dry matter intake was not significantly different for treatments containing WCGF. In experiment 2, 160 crossbred steer calves (290 kg) were stratified by initial weight and assigned randomly to 1 of 20 pens (8 steers/pen). Pens were assigned to 1 of 5 treatments (4 pens/treatment). Treatments were assigned based on four ratios of steep to bran/germ meal mix in WCGF plus a negative control (CON). Wet corn gluten feed was fed at 25% of the dietary DM and was made by mixing the different components into the diet. The 4 levels of steep that comprised the ratios were 37.5, 41.7, 45.8, and 50% steep of the WCGF. All diets contained 10% corn silage, 5% supplement, and 3.5% tallow. Steers were implanted with Synovex C on d 0, reimplanted with Revalor-S on d 46, and fed for 132 d. Daily gain was similar among

treatments. Feed efficiency was similar between CON and 50% steep. However, feed efficiency was decreased ($P < 0.05$) for levels of 37.5, 41.7, and 45.8% steep compared with CON. These data show that WCGF fed up to 35% has energy equal to SFC and the importance of the level of steep in WCGF in maintaining feed efficiency in SFC based finishing diets.

Key Words: Finishing Cattle, Byproducts, Steam-flaked Corn

344 Corn processing method and crude protein level in finishing diets containing wet corn gluten feed. C.N. Macken^{*1}, G.E. Erickson¹, T.J. Klopfenstein¹, and R.A. Stock², ¹University of Nebraska, Lincoln, ²Cargill Inc., Blair, NE.

Three hundred twenty crossbred steer calves (307 kg) were used in a completely randomized design finishing experiment to determine the effect of corn processing and additional urea on performance of steers fed diets containing *Sweet Bran*[®] wet corn gluten feed (WCGF). Steers were stratified by initial weight and allotted to 1 of 40 pens (8 steers/pen). Pens were assigned randomly to 1 of 10 dietary treatments (4 pens/treatment). The treatment design was a 5x2 factorial with factors being corn processing method (dry-rolled, DRC; fine-ground, FGC; rolled high-moisture, RHMC; ground high-moisture, GHMC; or steam-flaked corn, SFC) and CP level (13 or 14%). Observed protein levels fed were 14 and 15%. The final diet contained 60% of the respective corn, 25% WCGF, 10% corn silage, and 5% supplement. Steers were adapted to final diets in 21 d. Steers were implanted with Synovex S on d 1, reimplanted with Revalor-S on d 51, and fed for 152 d. No significant protein x grain processing interactions occurred for any feedlot performance or carcass variables. Protein level had no effect on any of the variables measured, suggesting protein requirements were met. Grain processing method did affect cattle performance. Dry-rolled corn and FGC had similar intakes but had higher ($P < 0.01$) intakes than RHMC, GHMC, or SFC. Intakes were similar among RHMC, GHMC, and SFC. Therefore, more intense processing decreased DMI. Daily gain was similar across all treatments (average = 1.94 kg/d). Feed efficiency was improved ($P < 0.01$) by 3.8, 7.0, 8.7, or 11.8% for FGC (0.189), RHMC (0.195), GHMC (0.198), or SFC (0.204), respectively, compared with DRC (0.182). Feed efficiency was significantly different among the processing treatments, except for RHMC and GHMC. While the grains were not fed without WCGF, the large response to intensive processing suggests WCGF alleviated problems with acidosis and sorting which allowed expression of differences in energy value associated with processing.

Key Words: Finishing Cattle, Byproducts, Grain Processing

345 Effects of starch endosperm type and corn processing method on feedlot performance and nutrient digestibility of high-grain diets. C.N. Macken^{*1}, G.E. Erickson¹, C.T. Milton¹, T.J. Klopfenstein¹, H.C. Block¹, and J.F. Beck², ¹University of Nebraska, Lincoln, NE, ²Syngenta Seeds, Golden Valley, MN.

Finishing and metabolism experiments were conducted concurrently to evaluate two starch types and two corn processing methods. For both experiments, two dent type corn hybrids were grown under similar conditions with one hybrid containing primarily vitreous endosperm (FLINT) and the other hybrid containing primarily flourey endosperm (FLOUR). Corn was harvested at two different times, as high-moisture (HMC; > 28% moisture) or dry corn (DRC) and processed through a roller. Treatment design was a 2x2 factorial with factors being corn hybrid (FLINT or FLOUR) and processing method (HMC or DRC). Diets contained 81% of the respective corn, 8% alfalfa hay, 3% molasses, and 8% supplement. In the finishing experiment, 160 crossbred steer calves (291 kg) were used in a completely randomized design with 4 pens per treatment. Steers were implanted with Synovex C on d 0, reimplanted with Revalor-S on d 72, and fed a total of 191 d. The FLOUR endosperm improved ($P < 0.05$) ADG and feed efficiency compared to FLINT endosperm when fed as DRC. However, ADG and feed efficiency were similar between endosperm types when fed as HMC. Feeding FLINT as HMC improved feed efficiency by 9.5% compared to DRC and feeding FLOUR as HMC improved feed efficiency by only 3.5%. In the metabolism experiment, four ruminally fistulated steers (542 kg) were used in a 4x4 Latin Square experiment with periods consisting of 14 d adaptation and 7 d of continuous rumen pH measurement. Chromic oxide was used as a digestibility marker. The FLOUR endosperm had

higher ($P = 0.06$) starch digestibility than the FLINT endosperm, while processing method had no effect. Rumen pH change and variance were increased ($P < 0.10$) for HMC compared to DRC with no significant difference between endosperm types. These data suggest an important interaction between starch type and processing method, with less intensive processing required for corn containing less vitreous endosperm.

Key Words: Finishing Cattle, Corn Processing, Endosperm Type

346 Effect of wet distillers grains plus solubles and corn oil level on finishing heifer performance. K. J. Vander Pol^{*}, G. E. Erickson, T. J. Klopfenstein, and C. N. Macken, University of Nebraska-Lincoln, Lincoln, NE.

A 113 d feeding trial was conducted utilizing 60 crossbred yearling heifers, (349 ± 9 kg) to determine if the higher energy value of wet distillers grains plus solubles (WDGS) compared to corn is due to the higher concentration of oil in WDGS. The data were analyzed as a 2 x 3 factorial arrangement of treatments, with factors being source (corn oil, or WDGS) and level (0, medium, or high). Treatments were zero fat (0F), zero WDGS (0DG), 2.5% fat (2.5F), 20% WDGS (20DG), 5.0% fat (5F), or 40% WDGS (40DG). Alfalfa hay was included in all diets at 7.5% of DM, and high-moisture corn and dry-rolled corn were fed at a 1:1 ratio (DM-basis). Corn oil or WDGS replaced corn. Diets were formulated so that 2.5F and 20DG, as well as the 5F and 40DG diets contained the same amount of EE, however, the 2.5F and 5F diets were .8% units higher in EE than the 20DG and 40DG diets, respectively, based on analysis. Heifers were individually fed, weighed every 28 d, and implanted on d 28 with Synovex-Plus. Data were analyzed using the mixed procedures of SAS, using previous ADG as a covariate. There were no significant differences observed ($P > 0.10$) for the main effects or interaction for initial weight, final weight, hot carcass weight, or yield grade. Significant interactions were observed ($P < 0.10$) for ADG, and feed efficiency. Looking at the simple effects, there was a linear decrease in ADG and feed efficiency as corn oil in the diet increased. Overall, increasing the level of fat in the diet by the addition of corn oil, reduced ADG and feed efficiency, while increasing the level of fat in the diet by the addition of WDGS did not affect ADG, and feed efficiency. Further, calculated from feed efficiency, the energy value of WDGS in the 20DG, and 40DG diets were 4% and 16% higher than the high-moisture corn/dry-rolled corn control. From these data, we were unable to determine if the higher concentration of corn oil in WDGS is responsible for the higher energy value of WDGS compared to corn.

Key Words: Wet Distillers Grain plus Solubles, Corn Oil, Feedlot Cattle

347 Seasonal effects of growth promotants on blood metabolites in feedlot heifers. W. M. Kreikemeier^{*} and T. L. Mader, University of Nebraska.

Growth promoting agents may alter metabolic rate in beef cattle, thus product efficacy may vary with season. Thyroid hormones (triiodothyronine, T₃ and thyroxine, T₄; ng/ml), urea nitrogen (UN; mg/dl) and IGF-1 (ng/ml) concentrations were measured in summer and winter. Yearling heifers (n = 9 head/pen) were allotted to twelve pens in both December and June. Initial BW was 379 and 385 kg in December and June, respectively. Pens were assigned to one of six growth promotant treatments; control (C, no growth promotant), estrogen implant (E), androgenic implant (trenbolone acetate; TBA), E + TBA (ET), megestrol acetate (MGA), and ET + MGA (ETM). Blood samples were collected from the same four heifers/pen/study on d 0, 28, 56, and 84 via jugular puncture. Concentrations of IGF-1, T₃ and T₄ were increased ($P < 0.05$) in winter (105.0, 1.5 and 70.1 ng/ml) vs summer (92.2, 1.1, and 63.0/ml) but UN concentration was not altered (13.6 vs 14.0 mg/dl; $P > 0.05$). Estrogen + TBA and ETM reduced UN concentration by 2.0 ng/ml and increased IGF-1 concentration by 17.6 ng/ml when compared to other treatments ($P < 0.01$). When averaged across season, treatments did not alter T₃ or T₄ concentration. A season by treatment interaction ($P < 0.01$) indicated ET increased T₃ in winter but had no effect on T₃ in summer. However, E, TBA, MGA, and ETM did not effect T₃, T₄, UN or IGF-1 concentration in either season ($P > 0.05$). Based on pooled data of implant treatments only, IGF-1 concentration peaked on d 28 and declined to baseline on d 56 in winter but leveled off from d 28 to d 84 in summer (season * bleed; $P < 0.05$). Urea nitrogen concentration peaked on d 56 in winter and on d 28 in summer (season*bleed; $P < 0.05$). Metabolic rate was increased in winter vs. summer based on T₃ and T₄ concentration. During the summer,

exogenous steroids maintained elevated IGF-1 levels from d 28 to 84 suggesting higher metabolic rate in winter resulted in faster exogenous steroid payout.

Key Words: Growth Promotants, Feedlot Heifers, Season

348 Evaluation of initial implants on performance and carcass quality in feedlot heifers. T. B. Farran*¹, G. E. Erickson¹, T. J. Klopfenstein¹, G. Sides², B. Dicke³, and J. S. Drouillard⁴, ¹University of Nebraska-Lincoln, ²Intervet, Inc., ³Cattlemen's Consulting, ⁴Kansas State University.

A commercial feedyard experiment was conducted to compare a new low-dose implant to a more traditional high-dose product as the initial implant for feedlot heifers. Heifers (n = 1,124; initial BW = 278 kg) were implanted with either Revalor-IH[®] (Rev-IH; 8 mg estradiol, 80 mg TBA) or Synovex-H[®] (Syn-H; 20 mg estradiol benzoate, 200 mg testosterone propionate) at initial processing. Each group of incoming cattle constituted a treatment replication, providing a total of six replications per treatment (12 pens total). Heifers were kept separate by arrival date and assigned to treatment by every other animal during initial processing. After processing, pens were immediately group weighed to establish initial weight of the pen prior to experiment initiation. Replicates of heifers were reimplanted with Revalor-200[®] (20 mg estradiol, 200 mg TBA) as the common terminal implant 81 d (range 69 to 85 d) prior to slaughter. Cattle were fed for an average of 177 d (range 147 to 202 d). DMI was similar between treatments. Implanting heifers initially with Rev-IH improved feed efficiency (0.190 vs. 0.186; P = 0.03) and tended to increase ADG (P = 0.10) with a 4-kg difference (P = 0.15) in hot carcass weight compared to heifers implanted with Syn-H. Furthermore, Rev-IH implanted heifers had higher marbling scores (P < 0.07), with 8.7% more carcasses (P = 0.02) achieving the upper two-thirds Choice category compared to heifers initially implanted with Syn-H. Fat depth and longissimus area were not different (P > 0.25), but calculated yield grades were higher for heifers administered Rev-IH (2.60 vs. 2.71; P = 0.09). Syn-H heifers contained 29.0% empty body fat compared to 29.4% for Rev-IH implanted heifers (P = 0.12). Results indicate that in commercial feedlot size pens, Rev-IH can improve feed conversion,

marbling scores, and carcass quality with no negative impact on growth performance.

Key Words: Implants, Feedlot Heifers, Carcass Quality

349 Relationships of chute-side measurements to carcass measurements. J.C. MacDonald*, T.J. Klopfenstein, G.E. Erickson, C.N. Macken, and J.D. Folmer¹, ¹University of Nebraska - Lincoln.

Three data sets were compiled to determine relationship of body weight (BW), hip height (HH), and ultrasound fat thickness (FTU) to hot carcass weight (HCW) and carcass fat thickness (FTC). Data set one (DS1) included every steer calf from a herd (n = 41). Data set two (DS2) included steers (n = 200; BW = 366; SD = 19 kg) on a 112d feeding trial in which no treatment differences were expected or observed. Steers on this trial had been sorted to meet a specific weight range. Data set 3 (DS3) related initial weight and reimplant weight to HCW in calf-fed steers. DS3 includes steers (n = 352; BW = 285; SD = 22 kg) from three calf-fed trials. Steers were included in the data set if was similar to control treatments within trial. Relationships were established using correlation coefficients which were considered to be significant at P = 0.05. DS1 indicated that birth weight is not related to HCW or FTC. The relationship of BW to HCW improved from winter period to summer period and feeding period (r = 0.71, 0.82, 0.81, respectively). HH was a less precise indicator of HCW during winter period (r = 0.32) and finishing period (r = 0.50) and was not an indicator of HCW during grazing period. HH was not an indicator of FTC. FTU was related to HCW during grazing period only (r = 0.55), and was related to FTC during grazing and finishing periods (r = 0.51 and 0.53, respectively). DS2 suggests that relationship of BW to HCW improves with time on feed and is not an indicator of FTC. The relationship of HH to HCW does not greatly change during finishing period (r = 0.43 to 0.50) and is not related to FTC. The relationship of FTU to FTC ranged from r = 0.47 to 0.50 during finishing period. DS3 suggests that relationship of BW to HCW improves from initial weight to reimplant weight (r = 0.18 and 0.76, respectively). BW is the best indicator of HCW and FTU is the best indicator of FTC. Relationships for both measurements improve as marketing date approaches.

Key Words: Ultrasound, Hip Height, Carcass Characteristics

Teaching

350 The University of Missouri internship in reproductive management of beef cattle. J. E. Stegner*¹, T. A. Strauch¹, J. E. Williams¹, P. A. Kunkel², K. D. Switzer², R. F. Hill³, D. E. Broek³, D. J. Patterson¹, and M. F. Smith¹, ¹University of Missouri, Columbia, ²KABA/Select Sires, Louisville, KY, ³Cache Valley/Select Sires, Logan, UT.

Internships provide students with the opportunity to develop critical thinking and problem solving skills. An internship program was developed in cooperation with Select Sires, Inc., and the University of Missouri-Columbia (F.B. Miller Endowment Fund) to provide students with practical training in reproductive management of beef cattle. [Update of J. Anim. Sci. 77: (Suppl.1): 276]. Objectives of the internship are: 1) to provide students with practical training in the development and execution of estrus synchronization (ES) and artificial insemination (AI) programs, and 2) to provide extensive hands-on experience in ES, estrus detection (ED), semen handling (SH), and AI. Most students do not have prior experience with the preceding techniques before the internship. Students are required to attend weekly classroom or on-farm training sessions, and a 3 d Select Sires AI training school. Other responsibilities include: formulating a statement of specific learning objectives, a written protocol of overall plans, and participation in ES, ED, SH, and AI on designated farms and ranches. Students accompany AI industry personnel to assist in on-site ES, ED, SH and AI, and are exposed to diverse beef production systems. Over the past 5 years, 66 students have participated in ES, ED, SH and AI on beef farms and ranches in CO, IA, IN, KY, MO, MT, ND, NE, OR, SD, and WY. Students have worked with approximately 90,000 heifers and cows on farms and ranches in these various states. Student-faculty interaction and student-producer interaction is facilitated through the internship. Participation fosters a greater working appreciation of beef cattle reproductive management,

creates ties for students with allied industry, and expands career opportunities following graduation.

Key Words: Internship, Estrus Synchronization, Artificial Insemination

352 Retention of non-traditional agriculture students in animal sciences. M. Diekman*, B. Delks, and R. Allrich, Purdue University.

In the fall of 2001 and 2002, entering freshmen in the Department of Animal Sciences (ANSC) initially indicated the following options within the department: agribusiness, 8%; science, 75%, production/management, 13%; and products, 4%. Within the science option, 52% of the students (75% female, 25% male) are majoring in pre-veterinary medicine with the majority interested in companion animals. In March, 2002, 53.6% of 125 ANSC majors indicated they had an interest in companion animals or zoo/exotic animals. Of the ANSC students that matriculated in 1996-99, approximately 40% received their B.S. degree in ANSC. Of the ANSC students that matriculated in 2000 and 2001, 48.4 and 67.9% of ANSC students have remained ANSC majors, respectively. Of the students that transferred from ANSC in 2001-02, 23 of 48 (48%) and 15 of 28 (54%) remained in the School of Agriculture, respectively. With support from the Lilly Endowment, Inc., a freshmen orientation class was developed and required for ANSC majors in 2000. Topics for the course include: creating an on-line resume, preparation of plan of study, interaction with senior undergraduates and faculty, and participating in an overnight trip visiting animal enterprises. In addition, retention efforts of freshmen have been enhanced by the availability of Animalia, a program that offers a living/learning community to agriculture students. Students in Animalia reside in the same residence hall and are