Table of Contents

ABSTRACTS
2007 ADSA/ASAS Midwest Meeting
March 19–21, 2007
*Author presenting paper

Animal Behavior, Housing, Well Being

1 Relationship of measures of disposition and feed intake and growth performance of steers. F. E. Creason*, W. H. Kolath, M. S. Kerley, and R. L. Weaber, *University of Missouri*, *Columbia*.

Data were collected on Angus cross steers (n=192) with known pedigree from four sources, to determine the effect of disposition on average daily feed intake (FI), residual feed intake (RFI) and average daily gain (ADG) during the feeding period. Disposition was measured by pen score (PS; 1=gentle, 5=aggressive) and exit velocity (EV; m/sec). EV was measured using infrared electronic triggers to start and stop an electronic recording device to time a steer as it traveled a fixed distance upon exiting a squeeze chute. EV data were recorded when the initial weights were recorded on two consecutive days then averaged for an initial weight (AVGWT) and initial EV (AVGEV). PS were recorded during the feeding trial. At the start of the trial steers weighed 342.60 ± 25.33 kg and 305.35 ± 32 kg, EV averaged 2.5 ± 0.68 m/sec and 2.68 ± 0.99, while PS averaged 1.95 ± 0.70 and 1.86 ± 0.81 respectively. Individual FI was measured using the Grow Safe System. FI, RFI and ADG were then computed at the end of the trial. A linear mixed model was analyzed using SAS PROC MIXED to investigate sources of variation in AVGEV associated with source, collection location (CL), PS (fixed effects) and AVGWT (covariate) and sire (random effect). Source, PS, AVGWT, and sire (via likelihood ratio test) are significant sources of variation in AVGEV (all $p<0.01$). Models for FI, ADG and RFI (dependant variables) were developed using source, CL, PS (fixed effects), AVGWT and AVGEV (covariates) and sire (random effect). For FI, only Group ($p<0.001$) and SID ($p<0.01$) were significant. For ADG, only AVGWT, AVGEV and Group were significant (all $p<0.01$). For RFI, only Group ($p<0.03$) and sire ($p<0.01$) were significant. Measures of disposition (EV and PS) were not important predictors of variation in phenotypic performance for FI or RFI, however AVGEV was an important source of variation in ADG. Sire effects described a significant portion of AVGEV and may indicate a heritable component of disposition. Selection for improved AVGEV may improve ADG.

Key Words: beef cattle, temperament, feed intake

3 Environmental factors affecting water intake in steers finished in feedlots. R. A. Arias*[1] and T. L. Mader[2], [1]*Universidad Catolica de Temuco*, *Temuco, Chile*, [2]*University of Nebraska*, *Lincoln*.

Simple and multiple regression analyses were executed using records from 5 trials conducted from 1999 to 2005 at Haskell Ag Lab, to assess the effects of environmental factors on daily water intake (DWI), and to obtain an equation to predict DWI on steers finished in feedlot. Cattle used in these studies were mixed breed, but predominantly Angus or Angus crossbreds. Daily (n=2,134) weather variables and DMI were obtained. Exploratory data analyses showed the presence of multicollinearity for temperature-humidity index (THI), and mean, minimum and maximum temperatures. Thereby, two analyses were conducted; 1) including daily minimum temperature (Tmin) and daily maximum temperature (Tmax), and 2) using THI instead of temperature variables. Results confirm that DWI increases significantly during the summer season, although variability in DWI was greater during this season. Seasonal simple regression equations produced low r^2 values ($r^2 < 0.5$). However, simple regression r^2 values were improved for models utilizing data from both seasons (Tmin $r^2= 0.57$; Tmax $r^2= 0.52$; and solar radiation $r^2= 0.50$). Multiple regression analysis improved predictions across seasons and resulted in better models than simple regression models. Within season multiple regression model R^2 values were 0.34 and 0.30 for summer and winter, respectively. However, when data were pooled among seasons an R^2 equal to 0.71 was obtained with Tmin, solar radiation, and DMI included in the model. When THI was used in the model there was not an improvement in R^2 across the seasons. The models were validated and compared with those reported by Winchester and Morris (1956; JAS 15(3):722-740) and Hicks et al., (NRC, 2000). Data from two experiments conducted during the winter and the summer of 2005-06 were used for this purpose. This analysis demonstrated that models providing the most accurate predictions of DWI were the THI and Hicks models. The data suggest that Tmin or THI are the primary weather parameters which influence DWI in steers.

Key Words: water intake, feedlot steers, environmental factors

4 The impact of crating gilts on bone metabolism. M. W. Orth*, G. M. Hill, D. S. Rosenstein, J. E. Link, and C. I. O'Connor, *Michigan State University*, *East Lansing*.

Housing sows in gestation crates has become a questioned practice in the swine industry. One reason is that confinement may compromise skeletal health. Thus, the purpose of our study was to determine the effect of confining gilts to crates on bone metabolism. Sixteen open gilts were divided evenly into 2 groups. Eight were housed in 0.6 × 2.1 m crates, which limited movement to a few steps backward and forward with no ability to turn around. The other 8 were divided evenly into 2 pens (2.4 × 3.0 m). The gilts were weighed at the beginning and the end of the experiment. Both groups were fed ad libitum a corn-soybean meal based diet that met or exceeded NRC requirements. Both urine and blood samples were collected at 0, 3, and 6 wk. At the end of 8 wk, the gilts were harvested and the forelimbs were obtained. Serum and urine were analyzed for osteocalcin and deoxypyridinoline concentrations (indicators of systemic bone metabolism), respectively. The bone mineral density (BMD) of the distal radius and ulna as well as the third metacarpus was estimated by quantitative computed tomography. Housing the gilts in crates did not adversely affect the BMD of the third metacarpus in either leg. The cortical BMDs of both distal radii and ulnae were similar between housing conditions, with the exception of a tendency for the left ulnae from crated gilts to be less mineral dense than the left ulnae from the penned gilts ($P = 0.1$). Trabecular BMDs were significantly lower in crated gilts as compared to penned gilts. The greatest difference occurred in the right radii (228 vs. 450 mg/cm^3; $P = 0.002$). Osteocalcin and deoxypyridinoline concentrations were not different between treatments at all timepoints. The results of this study suggest that limiting movement by crating gilts causes a decrease in BMD and that selective analysis of trabecular bone is necessary to demonstrate this effect. Cortical bone BMD and systemic markers of bone turnover did not reveal these differences.

Key Words: housing, skeleton, welfare

5 Characterization of sow longevity and the developmental factors that influence it. M. Hoge*[1] and R. Bates[2], [1]*Western Illinois University*, *Macomb*, [2]*Michigan State University*, *East Lansing*.

The length of adult sow life is now recognized as both an economical and welfare concern. However there are not consistent definitions to measure sow longevity. This study assessed four different descriptions of longevity and determined the relationship of developmental performance factors with them. Definitions included stayability (probability of producing 40 pigs or probability of reaching four parities), lifespan (number of parities a female accumulated before culling), and herdlife (time from first farrowing to culling). Data consisted of 14,401 records of Yorkshire females from both nucleus and multiplication herds across 21 farms from four seedstock systems. Within a subset of the data, information was available on the female's litter birth record and her growth and composition data. Therefore, data were subdivided into three data sets, consisting of; A. Data from a female's farrowing records, B. Data A and information from a female$'s litter birth record, and C. Data B and a female's growth and backfat data. A Cox proportional hazards model was used to determine the relationship of developmental factors and first farrowing record with longevity. Females that were older at first farrowing and that had increased time from performance test completion to first farrowing had a decreased risk of being culled regardless of longevity definition. The dynamics of a female's birth litter as well as her growth and backfat record did influence her culling outcome, but the associations of these factors with differing longevity definitions were not consistent. For stayability, herdlife and probability to reach four parities, the size of female's birth litter negatively impacted longevity. Females with a greater gilt ratio in their birth litter and a heavier litter birth weight had improved herdlife. Females that were fatter had improved stayability and lifespan. Female lifetime is influenced by both developmental and early adult events. However, how these influence longevity is dependent on the definition.

Key Words: pig, longevity, developmental factors

6 Association of lactation feed intake with sow longevity. L. Anil, S. S. Anil*, and J. Deen, *University of Minnesota*, *St. Paul*.

Nutrition during lactation is important to ensure reproductive efficiency and longevity of sows in breeding herds. The objective of this study was to assess the association of farrowing (parity, piglets born alive, mummies and stillborn) and lactation (lactation length, average lactation feed intake and reported incidences of diseases during lactation) factors with the likelihood for removal (cull, death or euthanasia) from the herd before next farrowing and to analyze the effect of low daily feed intake (≤4.5 kg) during first 2 wk of lactation on sow removals before subsequent farrowing. Data from 1354 sows from a breeding herd in Minnesota were analyzed using stepwise logistic regression. Parity was categorized as parities 1 and 2, 3 to 5 and ≥6 and mummies and stillborn were categorized as either present or absent. Lactation length, average lactation feed intake and piglets born alive were included in the model as continuous variables. The number of days with less than or equal to 1, 1.5, 2, 2.5, 3, 3.5, 4.0 or 4.5 kg of feed intake for the period from d 2 post–farrowing up to d 14 post–farrowing for each sow was calculated as the feeding levels. For this calculation, only those sows that had feed intake data for the entire 2 wk period were considered (n=1330). The effect of feeding levels on sow removals was assessed using separate univariate logistic regression analyses. Multivariate regression analysis indicated that the likelihood of removal from the herd decreased ($P < 0.05$) with an increase in average daily feed intake and in the number of piglets born alive (Odds ratio 0.79 and 0.91 respectively). Sows of parity 1 and 2 and 3 to 5 had lower ($P < 0.05$) likelihood of removal from the herd compared to sows of parity ≥6 (Odds ratio 0.63 and 0.57 respectively). Univariate logistic regression models indicated a higher ($P < 0.05$) likelihood of removal for sows consuming ≤4.5 kg feed on a single day during the first 2 wk of lactation (Odds ratio 1.25). The study suggests that measures to ensure adequate feed intake from the start of lactation may minimize sow removals in breeding herds. Inadequate consumption on a single day may adversely affect sow longevity.

Key Words: longevity, lactation feed intake, sow

7 Effect of parity advancement on the severity of claw lesions in breeding sows. S. S. Anil*, L. Anil, and J. Deen, *University of Minnesota*, *St. Paul*.

Claw lesions are very common in pigs and often cause lameness. A study was conducted in a breeding herd in Minnesota to analyze the change in the severity of claw lesions among sows over a parity cycle. The claws of 98 sows (parities 1–8) were examined for claw lesions between 110–114 d of gestation. Lesions were scored on a scale of zero (nil) to four (severe) and categorized as lesions on side wall (SW), heel, white line (WL), heel–sole junction (HSJ), sole, toe and overgrown heel (OGH). The final score on each area was obtained by multiplying number of lesions with corresponding severity of the lesions. The same sows were re-examined in their subsequent parity between 110–114 d of gestation. Categories of lesions in two parities were compared using Wilcoxon Signed Rank test and McNemar's symmetry test. Results indicated that the intensity of lesions (in both front and hind limbs) over a parity increased in the lateral claws and decreased in medial claws ($P < 0.05$ for both). The intensity of lesions increased ($P < 0.05$) in the hind limb lateral claws in the subsequent parity whereas front limb lateral claw scores did not differ. The intensity of lesions decreased ($P < 0.05$) in the front limb medial claws in the subsequent parity whereas hind limb medial claw scores did not differ. Within the hind limb lateral claws, the OGH and intensities of lesions on SW and WL increased and lesions at HSJ decreased ($P < 0.05$ for all) in the subsequent parity. Within the front limb medial claws, the intensity of WL lesions was lower ($P < 0.05$) in the subsequent parity. The intensity (all claws together) of OGH increased ($P < 0.05$) and intensity of lesions at HSJ decreased ($P < 0.05$) in the subsequent parity. The presence of OGH increased ($P < 0.05$) and the presence of lesions (of any severity) at HSJ decreased ($P < 0.05$) in the hind limbs in the subsequent parity. The presence of OGH in front limb was higher in subsequent parity. The presence of lesions (irrespective of the orientation of claws and limbs) at HSJ decreased and OGH increased ($P < 0.05$ for both) in the subsequent parity. Results are suggestive that lesions on hind limb lateral claws may increase in severity over time.

Key Words: claw lesions, sows

8 A real-time PCR assay for quantitative detection of *Babesia bigemina* in blood samples. S. M. Salto*[2] and G. J. J. Mosqueda[1], [1]*Centro Nacional de Investigación Disciplinaria en Parasitologia Veterinaria, INIFAP*, *Jiutepec, Morelos. México*, [2]*Universidad Veracruzana. Facultad de Medicina Veterinaria y Zootecnia*, *Veracruz, Veracruz. México*.

The diagnosis of bovine Babesiosis is currently based on direct microscopic detection of the protozoa in blood. However, the sensitivity of this method prevents detection of small numbers of parasites. A technique that may resolve this problem is real-time polymerase chain reaction (PCR). The objective of this work was to standardize the technique of real-time PCR for quantitation of red cell stages of *Babesia bigemina*. Intracellular parasites were obtained from in vitro culture by iso-osmotic shock and purified on percoll gradients. Purified parasites (1×10^6) were used to prepare a standard curve with fold dilutions of DNA from 1×10^6 through 1×10^3. The DNA of blood from a calf experimentally infected with *Babesia bigemina* was analyzed through 10 d post-infection. Oligonucleotide primers and a fluorescence labeled TaqMan® probe were designed to amplify a 394 bp DNA fragment corresponding to the small ribosomal subunit of *Babesia bigemina*. The results were calculated with software of the real-time PCR unit and were subsequently exported to a spreadsheet for analysis. We were able to obtain a standard curve with a linear range across ($R^2 = 0.997$) at least 4 logs of DNA concentration. An increase in the number of parasites in the blood was observed that began at 0.7×10^3 parasities/100 µL of erythrocytes at d 1 post-infection and increased to 36.7×10^6 parasites/100 µL at d 7. In contrast, analysis of Giemsa-stained blood smears from the same calf indicated an increase in the percentage of intracellular parasites from only 0.40 % on d 4 post-infection to a maximum of 1.78 % on d 7 post-infection. Theses results indicate the feasibility of early detection and evaluation of the behavior of the parasite during the course of the disease, as well as the progressive quantification using real-time PCR for detection. This technique represents a useful quantitative diagnostic tool to study the pathogenicity, immunoprophylaxis and treatment of Babesia infection in cattle.

Key Words: *babesia bigemina*, TaqMan®, real-time quantitative PCR

9 Effects of familiarity and weight variation on aggression among grow-finish pigs following regrouping. Y. Z. Li* and L. J. Johnston, *University of Minnesota*, *Morris*.

An experiment was conducted to study effects of familiarity and weight variation at regrouping on aggression and growth performance of pigs. Pigs (n=180) at 8 wk of age (BW=23.0±3.11 kg) from 3 group farrowing rooms where they mingled within each room from 10 d of age were used. Five groups of 9 pigs (5 males:4 females) were allotted to each of the four treatments: familiar pigs of uniform BW, familiar pigs of mixed BW, unfamiliar pigs of uniform BW and unfamiliar pigs of mixed BW. Familiar groups consisted of pigs from one farrowing room, and unfamiliar groups consisted of 3 pigs from each of the 3 farrowing rooms. Uniform groups were formed by using the middle 2 quartiles and the mixed weight groups by using the heaviest and lightest quartiles of pigs. Aggression and activity were observed directly for 4 h during the first 3 d, on d 7, and d 14 post regrouping. Skin lesions on head, shoulders and body were scored (scale 0-3 based on the number of scratches) on all pigs 48 h post regrouping. Total fighting durations were longer in unfamiliar groups during the first (48.5 vs 0.5 s/(pig.4h), SE=15.39; $P<0.001$) and second day (10.8 vs. 0.4 s/(pig.4h), SE=4.58; $P< 0.005$) post regrouping than in familiar groups. Unfamiliar pigs had higher total injury scores (6.5 vs 1.2, SE=0.40; $P<0.001$) and spent less time eating during the first day (5.2 vs 8.9%, SE=1.31 of total observation time; $P<0.01$) post regrouping than familiar pigs. There was an interaction ($P<0.02$) in injury score between familiarity and BW variation as pigs of mixed BW compared with uniform BW increased injury scores in unfamiliar groups but not in familiar groups. ADG in unfamiliar groups was lower during the initial 6 wk (809 vs 849 g/d, SE=11.2; $P<0.001$) but not for the entire 15 wk (806 vs 821 g/d, SE=9.7;$P=0.11$) compared with familiar groups. Familiarity did not affect ADFI or G:F. These results indicated that familiarity among pigs can reduce negative effects of regrouping. Sorting pigs by familiarity and weight at mixing could be beneficial in terms of alleviating aggression-associated injuries.

Key Words: pigs, regrouping, aggression

10 Impact of pig removal strategies at market on growth performance and production efficiency. J. M. DeDecker*[1], M. Ellis[1], B. P Corrigan[5], S. E. Curtis[1], B. A. Peterson[1], M. J. Ritter[1], J. L. Usry[2], D. M. Webel[3], and B. F. Wolter[4], [1]*University of Illinois*, *Urbana*, [2]*Ajinomoto Heartland, Inc.*, *Chicago, IL*, [3]*JBS United, Inc.*, *Sheridan, IN*, [4]*The Maschhoffs, Inc.*, *Carlyle, IL*, [5]*Vita Plus Corporation*, *Madison, WI*.

Determining the optimal pig removal strategy is essential to maximizing total facility output and profitability. Thirteen experiments were conducted on 4 commercial swine farms to determine the optimum pig removal strategy. Overall, removing the heaviest pigs from a pen increased ADG, ADFI, and G:F by on average 11%, 6% and 6%, respectively. Growth performance of the remaining pigs showed a linear increase as the proportion of pigs removed increased. Removal rates ≤20% produced similar total live weight from the pen compared to no removal, while removing 20 to 50% reduced total live weight but reduced the CV in pig BW at market. Studies evaluating the impact of timing of first pig removal have produced conflicting results, with one study showing removing pigs at 18 compared to wk 20 increased ADG (8.5%) of the remaining pigs and reduced CV in BW (20%) of all pigs marketed; however, another study showed removing pigs at wk 20 and wk 22 produced similar results. Increasing the frequency of removal of the heaviest pigs from once to twice increased ADG and G:F and reduced the number of light weight animals. The group size pigs were reared (26 vs 78 pigs/pen) prior to pig removal had no effect on post removal growth. However, pigs reared at low (0.58 m^2/pig) compared to high (0.82 m^2/pig) floor spaces had a greater change in ADG (+9.2%), ADFI (+4.6%), and G:F (+5.5%) from before to after pig removal. Studies investigating the reason for improved performance of the remaining pigs showed the greatest factor is the increase in floor space after the heaviest pigs are removed, with increase in feeder space and the process of pig removal having the least impact. In conclusion, results showed that removing a proportion of the heaviest pigs from a pen ~20 d before the final emptying of the pen resulted in increased ADG, ADFI, and G:F in the remaining pigs compared to pigs of the same weight in pens that had no pigs removed. This approach reduces both the variation in weight within the entire group and also the total feed consumed by the pen; the effect of these on production costs and carcass returns needs to be set against any decrease in the total live weight produced.

Key Words: pigs, removal

11 The effects of group size and floor space on pig growth performance and carcass characteristics in a commercial wean-to-finish facility. B. A. Peterson*[1], M. Ellis[1], R. Bowman[2], J. M. DeDecker[1], O. Mendoza[1], M. J. Ritter[1], A. Rojo[1], N. Williams[3], and B. F. Wolter[2], [1]*University of Illinois*, *Urbana*, [2]*The Maschhoffs, Inc.*, *Carlyle, IL*, [3]*PIC USA*, *Franklin, KY*.

The effects of group size and floor space on the growth performance and carcass characteristics of pigs housed in a commercial wean-to-finish building were evaluated in a study with 2600 pigs reared from weaning (17 ± 1 d) to wk 20 post-weaning (120.0 kg BW). The study was carried out as a randomized complete block design with a 2 × 5 factorial arrangement of treatments: group size (26 vs 78 pigs/pen) and floor space (0.58, 0.64, 0.70, 0.76, and 0.82 m^2/pig). At weaning, pigs were individually weighed and formed into outcome groups of ten pigs based on similar weight and gender and randomly assigned to one of the group size by floor space treatment combinations. Pens were mixed gender with equal numbers of barrows and gilts. Pigs were weighed at weaning and wk 4, 8, 10, 12, 14, 16, 18, and 20 post-weaning, and backfat and longissimus depth were ultrasonically measured at wk 20 post-weaning. Diets were formulated to meet or exceed NRC (1998) recommendations and pigs had ad libitum access to feed and water. Feed delivered to each feeder was recorded. Pigs in the smaller group size were heavier ($P < 0.05$) and had higher ADFI and G:F from weaning to wk 8 post-weaning, however, overall growth performance to wk 20 was similar for the two group sizes. Pigs housed at 0.58 m^2/pig were lighter at wk 20 post-weaning, had lower overall ADG and ADFI, and had the lowest backfat depth ($P < 0.05$). Pigs housed at 0.82 m^2/pig were the heaviest at wk 20 post-weaning, had the highest overall ADG and ADFI, and had the highest backfat depth ($P < 0.05$). No differences in morbidity and mortality were observed among the floor space or group size treatments. The results of this research suggest that for wean-to-finish production, housing pigs in larger group sizes gives similar growth performance, and that growth rate is maximized at 0.82 m^2/pig floor space.

Key Words: group size, floor space, pigs

12 Effect of removing pigs from a pen at different frequencies and times on growth performance and carcass characteristics of the remaining pigs. J. M. DeDecker*[1], M. Ellis[1], J. L. Usry[2], D. M. Webel[3], and B. F. Wolter[4], [1]*University of Illinois*, *Urbana*, [2]*Ajinomoto Heartland, Inc.*, *Chicago, IL*, [3]*JBS United, Inc.*, *Sheridan, IN*, [4]*The Maschhoffs, Inc.*, *Carlyle, IL*.

Fifty-six pens with 1,521 crossbred finishing pigs were used in a randomized complete block design with a 2×4 factorial arrangement of treatments: 1) gender (barrows vs gilts) and 2) removal strategy Trt 1. Control, no pigs removed (27 pigs/pen to end of study) vs Trt 2. Early removal (6 pigs removed at wk 20, remaining pigs removed at wk 24) vs Trt 3. Late removal (6 pigs removed at wk 22, remaining pigs removed at wk 24) vs Trt 4. Early and Late removal (6 pigs removed at wk 20, 6 pigs removed at wk 22, and remaining pigs removed at wk 24). Single-gender pens (27 pigs/pen; mean BW=108.2 ± 1.07kg) of barrows or gilts were randomly allocated to trt, and the heaviest animals were removed as dictated by trt. Floor spaces were 0.64m^2 when no pigs were removed (Trt 1), 0.82m^2 after 6 pigs were removed (Trt 2 and 3), and 1.15m^2/pig after 12 pigs were removed (Trt 4). Average daily gain (772, 782, 793, and 828 ± 14.9g/d for Trts 1, 2, 3 and 4, respectively; $P<0.001$) and feed intake (2,678, 2,800, 2,829, and 2,914 ± 43.3g/d, respectively; $P<0.001$) were highest for Trts 3 and 4 and lowest for Trt 1. Feed efficiency (0.27, 0.28, 0.28, and 0.29 ± 0.006%, respectively; $P<0.05$) was the lowest for Trt 1 and highest for Trts 3 and 4 while Trt 2 was similar to all. The total live weight of pigs produced was greater ($P<0.001$) for Trts 1 and 3 compared to Trts 2 and 4. However, the total feed consumed/pen during the study period and discount for light weight pigs at slaughter was lowest ($P<0.001$) for Trt 4 and highest for Trt 1. Carcass characteristics (backfat, loin depth, and percent lean) and pigs removed due to morbidity and mortality were similar across trts. Barrows had higher ADFI, ADG, and back fat depth and lower loin depth and percent lean compared to gilts.

In summary, these results suggest that removing the heaviest pigs from pens significantly improved growth rate regardless of timing and frequency of removal. Removing the heaviest pigs from a pen both early (wk 20) and late (wk 22) resulted in the largest improvement in growth. Timing of pig removal did not impact growth or CV of BW at the end of test.

Key Words: pig removal, frequencies

13 Performance comparisons between pigs raised in hoops and confinement in Southern Illinois. S. K. Zeilstra*, G. A. Apgar, D. R. Sanders, and A. AbuGhazaleh, *Southern Illinois University*, *Carbondale*.

The objective of this study was to compare hoop housing with conventional confinement in the southerly portion of the US. Comparisons were made by measuring pig performance and feed cost of production. Five hundred and seventy six crossbred pigs (initial BW of 45.63 kg) were utilized in six trials to assess the performance and economic difference between the two housing systems. Trials were conducted during spring, fall and summer in each environment. Pig weights and feed disappearance were determined when average pen weights approached 45, 69, and 92 kg BW. Trials were concluded when pigs weighed an average of 104 kg. Average daily gain, average daily feed intake and gain per feed ratios were compared using proc mixed, with the model including the effects of season, housing type and time. Average daily gains tended ($P < 0.11$) to be greater for pigs raised in the hoop as compared with pigs housed in confinement (767 vs 590 g). Average daily feed intake was slightly greater ($P < 0.13$) for pigs raised in the hoop environment (2.28 vs 2.00 kg) as compared with conventionally raised pigs, however gain per feed ratios did not differ among the housing groups (335 vs. 308 g/kg). Season significantly ($P < 0.01$) affected average daily feed intake, with the highest intake occurring during spring and the lowest during summer. Economic comparison between the two housing systems suggests that pigs raised in hoops are economically viable in the southern region of the US. Pigs in the hoop were bedded with hay and/or straw. Feed cost per kg of gain in the hoop was 37.26 cents per kg, while feed cost in the conventional finisher was 37.0 cents per kg of gain. Neither bedding nor labor costs were included in these calculations. Raising pigs in hoop structures in the southerly portion of the US is an economically appropriate housing method.

Key Words: pigs, hoop, performance

14 Physiological comparison of pigs fed ractopamine and transported with different handling intensities. M. H. Gillis, D. J. Ivers, K. D. Miller, D. H. Mowrey, S. N. Carr*, and T. A. Armstrong, *Elanco Animal Health, Eli Lilly and Company*, *Greenfield, IN*.

This study was designed to evaluate ractopamine (RAC) on performance when fed for 33 d at dietary concentrations of 0, 5 and 10 ppm to finishing pigs and on physiological measures following simulated marketing (i.e., loading, transportation, unloading, lairage, and final drive processes) occurring after 34 to 36 d of treatment. A randomized complete block design with three concentrations of RAC (0, 5, or 10 ppm), two marketing conditions (low or moderate handling intensity), and two genders (barrows or gilts) was evaluated. The simulated marketing process occurred over 3 days (d 34, 35, and 36; 4 pigs•pen^{-1}•d^{-1}). Comparisons were made between low intensity (LOW) vs. moderate intensity (MOD) handling treatments and RAC concentrations. Two hundred eighty eight pigs (96.47 ± 0.27 kg) were assigned to 24 pens for evaluation. Feeding RAC at 5 and 10 ppm increased ($P < 0.05$) ADG and improved ($P < 0.05$) efficiency (G:F) compared to controls after a 33 d feeding period. No differences were observed in serum bicarbonate or pH values between handling conditions or RAC concentrations. Lactate dehydrogenase activity was 54% higher ($P < 0.01$) for pigs in the MOD compared to LOW intensity. An interaction ($P < 0.01$) between gender and handling intensity was detected for serum lactate. Lactate levels for LOW gilts were lower ($P < 0.01$) in comparison to LOW barrows. Pigs fed RAC at 10 ppm tended ($P < 0.10$) to have higher serum lactate levels following the final drive compared to controls, while pigs from the 5 ppm group were intermediate. Serum creatine kinase (CK) concentration was higher than the normal reference range values with MOD having higher CK than LOW ($P < 0.05$), and a trend ($P < 0.10$) was detected for higher CK in RAC-treated pigs compared to controls. The differences between the two marketing conditions used in this study emphasize the importance of proper animal handling techniques and proper transportation stocking densities when marketing finishing pigs fed RAC.

Key Words: handling, pigs, ractopamine

15 Effect of pen location within a tunnel ventilated wean-to-finish building on pig growth performance. J. M. DeDecker*[1], M. Ellis[1], C. M. Murphy[1], B. A. Peterson[1], and B. F. Wolter[2], [1]*University of Illinois*, *Urbana*, [2]*The Maschhoffs, Inc*, *Carlyle, IL*.

This study was carried out to measure the variation in growth performance of pigs housed in different locations within a standard, tunnel-ventilated, wean-to-finish building. Seventy-two pens with 2,376 crossbred finishing pigs were used in a randomized complete block design with a 2×4 factorial arrangement of treatments: 1) Season: (summer vs winter) and 2) Pen location: six locations. The building was 91m long by 31m wide and consisted of two identical rooms with 60 pens/room and an interior dividing wall between rooms. The study was conducted in one of the rooms. The six locations compared consisted of 10 continuous pens located on either the exterior or the interior walls at the front (air inlet end), middle, and rear (fan exhaust end) of the building. Six pens were randomly selected within each location to evaluate pig performance. The data for the summer were collected from May to October and for the winter from November to March. Both the summer and the winter replicates were carried out with pigs from weaning to wk 20 post-weaning. At weaning, piglets were blocked into outcome groups of thirty-six pigs on the basis of similar sex and weight and randomly allotted from within outcome group to single-gender pens of 33 pigs. Temperature and humidity were continuously recorded using HOBO data loggers placed in each location. No season by pen location interactions were found.

Temperature (26.4 and 21.5 ± 1.04C° for summer and winter, respectively; P<0.001) and humidity (58.1 and 38.0 ± 2.32% for summer and winter, respectively; P<0.001) were higher for summer compared to winter, but were similar (P>0.05) across pen locations within season. Average daily gain from weaning to wk 20 post-weaning was higher for pigs located in the front (air inlet end) compared to pigs in the middle and the rear of the building (734, 719, and 714 ± 7.4g/d for front, middle, and rear, respectively; P<0.05). Pigs in pens located beside the interior and the exterior walls had similar growth rates. These results suggest that, despite the similarities in temperature and humidity within this tunnel-ventilated barn, pen location impacted the growth rate of pigs.

Key Words: pigs, pen location, season

Beef Extension

16 Climatic influences within cattle feeding facilities. T. L. Mader*, *Northeast Research and Extension Center, University of Nebraska*, *Concord*.

Annually, heat waves and/or periods of severe winter weather cause significant economic losses in the cattle industry in one or more regions of the United States. Altering the microclimate by providing protection from the environment is one of the most useful tools to help animals cope with climatic conditions. In the Northern Plains and Midwest, muddy feedlots in the winter and spring periods and heat stress in the summer are the most challenging environment-related problems for feedlot managers. Increasing pen space available per animal and/or the use of bedding are management alternatives that can be used to control mud or lessen its impact for cattle fed in conventional outside feedlots. Performance losses due to mud will vary and are most likely due to wet hide and hair coat contributing to excess body heat loss. In general, energy costs to travel through mud are relatively small due to the limited distances feedlot cattle move. Also, 2 to 3 cm of mud in a pen presents few problems unless drying conditions are poor. However, when mud is at a sufficient depth to limit access to the feedbunk or adversely affect eating pattern due to social order changes, then the altered feeding pattern and activity will contribute to performance losses. To minimize effects of summer heat stress, inexpensive management alternatives, such as sprinkling feedlot surfaces need to be considered. Mounds which are located in outside feedlots have also been found to provide benefits to cattle by altering the feedlot microclimate and surface conditions during both summer and winter seasons. Solid-floor, bedded confinement barns are a relatively new design structure that also provide a buffered environment for feedlot cattle. These structures act primarily as solar shields in the summer and buffer the animal against cold stress in the winter. The type of feeding facilities chosen will depend on climatic conditions as well as site location and topography, annual precipitation, waste management issues and regulations, type of cattle to be fed, and value-added opportunities.

Key Words: beef cattle, environment, facilities

17 Comparing feedlot housing/pen designs. R. H. Pritchard* and E. R. Loe, *South Dakota State University*, *Brookings*.

Considerations in finishing cattle housing/pen designs include cost of construction; operations and maintenance; cattle performance, health and comfort; and characteristics of emissions. Optimization is very site specific based upon climate (especially rainfall), topography, soil types, and proximity to surface and ground water bodies. There is a feedlot facility in southeast South Dakota with three distinct pen designs for making these comparisons. There are 4 pens (80 head capacity each) in each housing design. The Open design has concrete bunk aprons (4.3 m) and earthen pen floors with mounds 2 m high. Space is 25.5 m^2/head with 2.8 m^2/head mound space. The Shed design has a monoslope shed over the feed alley and 6 m of pen. The concreted area is 10 m (extending 3.6 m beyond the roof). The balance of the pen is earthen (20 m^2/head) with mounds 1 m high. The Confined system is solid concrete floor, 100% under the roof of a monoslope building. Pens are 11 m deep with total space of 4.3 m^2/head. Deep pack bedding is used in the back of Confined pens providing 1.1 m^2/head of bedded area. Lots (minimum 200 head) are allotted sequentially at initial processing to one pen in each housing system. During a 3 year span there have been 10 lots suitable to stratify across all three systems involving 2,305 head of cattle to use for design comparisons. These 3-pen lots are closed out in a single event. Most placements were in Jan-Feb and closed in June (mean = 147 d on feed). Cattle performance for Open, Shed, and Confined designs, respectively, were: ADG 1.59, 1.65, 1.65 kg ± 0.02; DMI 11.17, 11.19, 11.11 kg ± 0.07; and G/F 143, 148, 149 g/kg ± 1. Gain and G/F were 4% lower ($P < 0.05$) in Open pens. Additional replications throughout the year will be necessary to refine the performance response. In one study of heat stress, cattle in Open pens were the first to display symptoms of heat load. As the heat index rose to higher levels, cattle in all systems were similarly stressed. Valid comparisons of facility operations and maintenance cost will require data collection over a time span approaching the depreciation schedule for each facility.

Key Words: cattle, feedlot, housing

18 Designing a hoop building for feeding beef cattle. W. D. Busby*, S. C. Shouse, and D. L. Maxwell, *Iowa State University*, *Ames*.

In order to maintain cattle feeding efficiency while reducing or eliminating the environmental impacts of open lot runoff, this project explores the feasibility of using a hoop building for bedded confinement feeding of beef cattle. Performance of the cattle and facility will be compared to a semi-confinement feeding facility (open lot with shed). The hoop building is 15 meters wide and 36 meters long with 3 meter sidewalls. The building capacity is 120 head with 4.5 square meters of building space and 0.30 meters of bunk space per head. The feed bunk and alley are located on the outside of the building sidewall posts. The building length is oriented north-south to allow maximum summer airflow and minimum summer solar gain. The feed bunk is located

on the east sidewall to minimize winter snow and wind effects. A 1.2 meter roof awning with rain gutter protects the feed bunk. A ridge vent 25 cm wide will assist with summer heat release. The west wall of the building is lined with lumber to reduce summer afternoon solar gain. The building is divided into three 40-head pens for comparison with the semi-confinement facility. Gates allow tractor access through the pens along the feed bunk. Three gates in the west sidewall allow movement of cattle from each pen to an outside sorting alley. These gates were outfitted with solid covers and overhead flap doors to provide wind and solar gain protection. No end wall enclosures are used. Bedding bales stacked outside the north and south pens provide winter wind break protection. The entire building floor is sloped 0.5% to one end. The first 6 meters of floor adjacent to the feed bunk is treated with 15 cm of reinforced concrete. The first 3 meters of concrete slopes 4% away from the bunk. The remaining 3 meters of concrete is level. A concrete 14 cm x 30 cm step is installed along the bunk. The remaining 9 meters of floor is treated with geotextile fabric covered with 15 cm of limestone screenings (10 cm and finer aggregate). The total finished cost of the building is approximately $44,400 ($370/head capacity). A 3 year building comparison study will be completed in summer 2008.

Key Words: beef, housing

19 The performance, economic, and environmental value of bedding feedlot cattle during Northern Plains winters. V. L. Anderson* and R. J. Wiederholt, *North Dakota State University*, *Carrington*.

Bedding feedlot cattle during the winter in the northern plains is not consistently practiced. Two trials were conducted to evaluate the benefits of winter bedding in North Dakota. In trial one, finishing steers (n=103) were not bedded or bedded with wheat straw at modest (175 kg/hd), or generous (306 kg/hd or 2x modest) amounts. From December through March, daily gains were greater (P<0.01) for modest (1.67 kg) and generous bedding (1.60 kg) vs. no bedding (1.28 kg). Dry matter intake was not affected by bedding treatment. Marbling scores favored (P<0.01) modest (392) and generous beddding (415) vs. no bedding (361) as did percent choice at 45% and 63% vs. 23%, respectively. Carcass value was calculated at $61.76 and $81.61 greater for modest and generous bedding, respectively, compared to no bedding when the choice-select spread was $10.00 per cwt. Nitrogen content of composted manure was 0.83, 1.40, and 1.61 %, respectively, for no bedding, modest, and generous bedding. Winters during this two-year study were typically cold and snowy. In the second trial, bedding materials from residues of wheat, corn, and soybeans were compared to non-bedded pens during one of the mildest winters on record. During December and January, DMI was greatest (P<0.06) for non-bedded calves. Gains were greater overall (P<0.01) for wheat straw (1.77 kg) and soybean residue (1.74 kg) vs. non-bedded (1.65 kg) with corn stover (1.69 kg) intermediate. Marbling scores were not different (P>0.17). Composted manure contained 1.31, 2.21, 2.55 and 2.62 percent nitrogen, respectively, for no bedding, wheat straw, corn stover, and soybean residue. Bedding improved gains in both trials and appears to be more effective in cold and dry winters. Bedding may improve carcass quality and value. Providing bedding of any type had a positive influence on the amount of nitrogen in composted manure. More research is warranted to understand nitrogen volatilization during seasons of the year and the sequestering effect of bedding materials.

Key Words: bedding, beef feedlot, manure

20 CAFO manure management with alternative technologies. J. Lorimor*, *Curry-Wille & Associates*, *Ames, IA*.

Beef cattle CAFOs in Iowa have two options to control runoff from their feedlots: traditional systems or alternative systems. Traditional systems consist of small settling basins, followed by containment basins and irrigation systems. Alternative systems consist of large settling basins, followed by vegetative infiltration basins and/or vegetative filter strips. The alternative systems offer some advantages, compared to traditional systems, but also have some negative characteristics. This paper will describe the different types of alternative systems, and discuss the advantages and disadvantages of each. Results from the initial monitoring of pilot sites around the state will be presented.

21 Factors influencing price of North Dakota feeder calves. J. L. Leupp*[1], G. P. Lardy[1], K. L. Haadem[1], K. R. Maddock-Carlin[1], W. W. Dvorak[2], K. J. Froelich[3], J. R. Kramlich[4], G. L. Payne[5], L. K. Hansen-Lardy[1], and K. G. Odde[1], [1]*North Dakota State University*, *Fargo*, [2]*West River Consulting*, *Dickinson, ND*, [3]*Stark County Extension Office*, *Dickinsion, ND*, [4]*Logan County Extension Office*, *Napoleon, ND*, [5]*Kidder County Extension Office*, *Steele, ND*.

Our objective was to determine factors influencing sale price of calves and destination of feeder calves from North Dakota (ND) auction markets. Data were collected at three auction markets in ND in late October and November, 2005 (31,312 calves; avg wt = 244 ± 118 kg; three sales per market) and again in January, 2006 (JAN; 29,907 calves; avg wt = 285 ± 137 kg; three sales per market). The following data were collected for each lot of calves sold: sex, weight, breed description, health program, vaccinations, deworming products, implant status, natural qualified, and beef quality assurance certification. Destination of calves was determined from brand inspection records. In the fall, calves sold in larger lot sizes (≥ 21 head) received greater (P < 0.0001) prices when compared with those sold in smaller lot sizes. Price for steer calves was $0.18/kg greater ($P$ < 0.0001) than heifer calves. Price for black-hided cattle was $0.02/kg greater than ($P$ = 0.04) Charolais-cross cattle. Charolais-cross cattle averaged $2.84/kg, which was greater (P = 0.05) than the average price received for red-hided cattle ($2.80/kg). Price for red-hided cattle was $0.02/kg greater than mixed colored cattle. Vaccinations (7-way clostridial, 4-way viral, and Pasteurella) increased (P < 0.0001) price received for calves sold in the fall compared with no vaccinations. In JAN, price for calves sold in lot sizes of ≤ 5 was lower (P < 0.0001; $2.63/kg) compared with the other lot sizes (≥ 6). Price for steer calves was $0.06/kg greater than heifer calves. Price for black-hided and Charolais-cross cattle was greater (P ≤ 0.01) than mixed and red-hided cattle. Vaccinations (7-way clostridial, 4-way viral, and Pasteurella)

tended to increase ($P = 0.06$) sale price compared with no vaccinations. Non-implanted calves averaged $0.03/kg greater than implanted calves. Calves sold in the fall were shipped to 11 states with most remaining in ND (46%) while 41% remained in ND following JAN sales. These data suggest that feeder calf price is dependent on multiple factors. Selling calves in larger lot sizes and with vaccinations brought higher prices in ND auction markets.

Key Words: auction markets, feeder calves, prices

22 Effect of sorting feedlot cattle at re-implant using ultrasound and computer technology to predict carcass value. A. J. Garmyn* and D. W. Moser, *Kansas State University*, *Manhattan*.

The objective of this study was to determine the profitability of sorting feedlot cattle at re-implant time using ultrasound and computer technology to group cattle into uniform market groups. The Designer Genes (DG) sorting system combines initial body weight, ultrasound backfat thickness, longissimus dorsi area (LM), and percentage intramuscular fat, as well as average daily gain (ADG) and ribeye shape to predict days on feed needed to reach optimum carcass composition. The DG sorting system was applied to 311 steers at re-implant time. Steers were alternately assigned either to one of four system-assigned test groups, or the control group. An implant regime was also recommended on individual basis for the test group steers. Implant protocol and harvest date were determined by feedyard management for the control steers. Initial value was assigned to all steers based on live weight at scanning. Each of the four test groups were marketed as a single group based on the projected days on feed from the DG sorting system. Profit was defined as the carcass value, less the value of the steer at sorting plus feed, implant, and scanning costs. The data were analyzed using the Generalized Linear Model Procedure (SAS Institute, Inc. 1992). Initial weight and value, ADG, and LM were similar between sorted and control groups. Sorted steers were fed 11.4 days longer (P=0.001) and had 13.2 kg heavier (P=0.009) hot carcass weights (HCW), 1.8 mm greater (P=0.015) backfat thickness, 0.3 higher (P=0.005) numerical yield grades (YG), and 0.3 higher (P=0.001) numerical quality grades. Although, there were significant differences in HCW and YG, there were no significant differences in weight discounts or yield grade premiums based on the pricing model. Total costs were $23.39 per head higher (P=0.001) for sorted steers. The average quality premium was $0.06 per kg higher (P=0.001) for sorted steers, thus making the sorted steers $22.93 per head more profitable (P=0.014) than the non-sorted steers after deducting all applicable costs. Increased profitability was primarily due to premiums for higher quality cattle.

Key Words: beef cattle, carcass uniformity, ultrasound

23 Comparison of yearling steers sorted into heavy, medium, and light weight groups at feedlot entry. W. A. Griffin*, J. D. Folmer, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

Two separate experiments were used to determine differences in feedlot performance of sort groups. Each experiment was repeated across 2 yr. Steers were sorted into heavy (Sort H), medium (Sort M), and light (Sort L) groups and compared to an unsorted control (CON). Additional analyses were used to compare the sorted groups to control sort groups of heavy (CON H), medium (CON M), and light (CON L). In each experiment Sort H was fed the least number of days (average = 87 d), Sort M, Sort L, and CON were fed 3, 5, and 2 wk longer than Sort H, respectively. The CON steers were fed the same number of d, so the CON H, CON M, and CON L cattle were retrospectively, evaluated. In exp. 1, steers were sorted into 25% heavy, 50% medium, and 25% light. In exp. 2, steers were sorted into 32% heavy, 44% medium, and 24% light. In exp. 1 each sort group had higher final BW compared to CON (P = 0.01). However, CON H (P < 0.01) and CON L (P < 0.01) had the heaviest and lightest final BW, respectively. Daily gain was greatest for CON H (P < 0.01) and similar for other treatments (P > 0.05). Control heavy had the heaviest HCW and CON L had the lightest (P = 0.01); additionally, CON H produced the most overweight carcasses (P < 0.01). Marbling score (P < 0.01) was highest for Sort L and lowest for Sort H. Sort L had greater fat thickness (FT; P < 0.01) and Sort H had the lowest FT (P < 0.01). In exp. 2, CON H had heaviest final BW (P < 0.01) and CON L had lowest final BW (P < 0.01). Among treatment groups, Sort H and CON H had highest DMI (P < 0.01); however, Sort H had the poorest G:F (P = 0.02). In exp. 2, HCW (P < 0.01) was greatest for CON H and lowest for CON L. Marbling score (P < 0.05), and FT (P < 0.01) increased with increasing DOF. In both the sorted and control treatments heavier steers had the poorest G:F. Control heavy steers need to be managed to reduce overweight carcasses; however, when sorted, medium steers have a higher risk of producing overweight carcasses based on the sorting procedures used in this study.

Key Words: feedlot, sorting, yearling

24 Economic model for determining byproduct returns in finishing diets. C. D. Buckner*, T. J. Klopfenstein, G. E. Erickson, D. R. Mark, and V. R. Bremer, *University of Nebraska*, *Lincoln*.

An economic model was developed for determining economic returns when feeding byproducts alone or in combinations in finishing corn-based diets. Byproducts included in the model are wet and dry distillers grains with solubles (WDGS and DDGS), Sweet Bran, ADM gluten feed, and Dakota Bran Cake (DBRAN). Performance responses from research trials were used to predict DMI, G:F, and ADG. Model inputs include: cattle BW and prices, DMI and G:F if fed just corn, byproduct inclusion, mileage for trucking byproduct, and yardage costs. Outputs from the model include: ADG, costs of byproduct hauling, rations and feeding, and profit/loss compared to a corn diet. In several scenarios that we compared, model assumptions were 336 kg initial and 590 kg final BW, 10.9 kg DMI and 0.154 G:F for a corn-based diet, $0.35/hd/daily yardage cost, and projected corn futures price. Feeding WDGS at 95% corn price increased returns up to $50 per steer depending upon inclusion level and trucking distance. With higher corn prices and a fixed 95% byproduct cost to corn, relationships across byproduct inclusion levels remained similar while absolute economic values increased. When byproduct was priced less than 95% the price of corn, the returns to feeding byproduct increased accordingly, depending on inclusion level and trucking distance. Little change occurred due to increased trucking cost. This new economic model allows flexibility for byproduct types, inclusion levels and trucking, while combining user inputs with biological performance predictions.

Table 1. Equations for predicting DMI and G:F for byproduct dietary inclusion levels.

Byproduct	DMI, kg	R^2 fit
WDGS	$y = -0.00228x^2 + 0.10099x + 23.942$	0.9959
DDGS	$y = -0.00088x^2 + 0.03944x + 20.68$	0.6474
DBRAN	$y = 0.038x + 25.62$	0.6327
	G:F, g/kg	R^2
WDGS	$y = -0.0141x^2 + 1.0539x + 153.3$	0.8712
DDGS	$y = -0.015x^2 + 0.75x + 164.4$	0.6054
DBRAN	$y = 0.1667x + 147.5$	0.6983

[a] y = predicted variable, x = byproduct inclusion level

Key Words: economics, byproducts, cattle

25 The effect of breed type and year on real-time ultrasound carcass traits, performance and pelvic measurement of heifers enrolled in the Eastern Kentucky Heifer Development Program. B. E. Galbreath*, T. J. Wistuba, P. E. Prater, K. E. Peterson, and J. G. Willard, *Morehead State University*, *Morehead, KY*.

Heifers were weighed, pelvic measured, and ultrasonically scanned to study breed and year differences for performance, pelvic area, 12th rib fat depth, longissimus muscle area, intramuscular fat, and rump fat in February of 2005 and 2006. Angus (AN), Angus cross (AC), Gelbvieh cross (GC), Limousin (L), Charolais (CH), and Charolais cross (CC) heifers (411 hd in 2005 and 335 hd in 2006) were delivered to Hazard, KY, for the Eastern Kentucky Heifer development program. Heifers were grazed for 138 d with minimal supplementation and then pelvic measurements were taken by an experienced veterinarian and carcass measurements were obtained by a Ultrasound Guidance Council certified ultrasound technician. Measures of 12th rib fat depth, longissimus muscle area, intramuscular fat, and rump fat were taken with an ALOKA 500V ultrasound unit equipped with a 17.2 cm, 3.5 MHz linear transducer. Ultrasound images were then submitted to the International Livestock Image Analysis lab (Gustine, TX) for determination of 12th rib fat depth, longissimus muscle area, intramuscular fat, and rump fat. There were no statistical differences for the breed by year interaction, therefore data were combined and analyzed for breed type differences. Initial, mid test and end BW did not differ between breed ($P > 0.05$). However, there were differences in total gain and ADG in that the GC heifers had increased total gain and ADG than the other breed types ($P < 0.05$). There were no consistent results for pelvic area although CC heifers did have larger ($P < 0.05$) pelvic areas than AN or AC heifers. The L heifers had the largest ($P < 0.05$) LM area (63.5 cm^2) and AN had the smallest (50.6 ^{2}) where as the AC, CH, CC, and GC were intermediate, in addition, AN and AC heifers had the greatest ($P < 0.05$) 12th rib fat depth, intramuscular fat, and rump fat of the heifers. These results support the knowledge that earlier developing breeds of cattle have increased intramuscular fat and subcutaneous fat depots whereas the continental breeds are leaner and have greater longissimus muscle area.

Key Words: ultrasound, heifer, beef

26 Cattle corral design-learning by doing. S. L. Boyles*, *The Ohio State University*, *Columbus*.

It is easier to show a three dimensional structure than to describe it. Many of us used toy bricks and logs to construct buildings and other structures when we were young. We could easily change and experiment with these toys. Just because many of our extension audiences are adults, such tools or toys can still be useful in education. The objective of this project was to support the tactic of handling and sorting cattle in a safe and humane manner. The fence panels are 8 cm long and 6 cm high for easy use by adult hands. The kits were designed to be 18 kg in total weight and cover the area approximately equivalent of a small pick-up truck bed. A PowerPoint presentation and handbook were created to supplement the learning module for adult producers. There have been 2,304 people participate in these corral design and animal handling programs. Seventy-three percent of the programs had more than 30 people and the largest group had over 300 participants. The corral self-audit consisted of forty-seven questions relating to topics on corral location and existence of the basic parts of a corral (holding pens, alleys, crowding pen, working alley, squeeze chute, and loading area. The kits have been used Ohio, Nevada, North Dakota, Wisconsin, Kentucky, Indiana, Maryland, New York, Pennsylvania, West Virginia, Vermont and the province of Ontario. Evaluations averaged a 9.2 + 0.58 on a 10-point scale (1=terrible idea, 10=great idea). Thirty-seven percent of participants returned the self-audit at the end of the program. Respondents indicated some deficiencies in the existence of basic facilities such as alleys and crowding pens (33% and 37%, respectively). Forty-two percent of respondents indicated they would prefer to have more holding pens. Engineering-based education curricula can be assisted with the use of tactile methods of interactive class instruction.

Key Words: cattle, corral, BQA

27 Feedlot performance, management factors, and carcass traits by *Certified Angus Beef*® acceptance rate classes. G. Fike* and M. King, *Certified Angus Beef LLC*, *Manhattan, KS*.

Data describing 134 complete lots representing 11,645 head of Angus-type beef cattle with detailed performance and carcass data were analyzed from the 2005 Certified Angus Beef LLC (CAB) Feedlot Licensing Program database. Cattle were fed at commercial feedlots and closeout and carcass data were collected. Lot CAB® acceptance rates (AR) were calculated and categorized into four classes; Low (L) 0-9.9% AR, Medium (M) 10-19.9% AR, High (H) 20-29.9% AR, and Very High (VH) >30% AR. Feedlot, management, and carcass values were characterized by lot CAB® AR classes. Implant potency scores were determined by hormonal content of the implants. Breed of sire was recorded at feedlot entry. Mean values for initial BW, BW at harvest, days on feed, ADG, F:G, HCW, and dressing percent were similar ($P>0.10$) for all AR classes. The mean cost of gain for VH was lower ($P<0.10$) than L but similar to M and H. Fat thickness at the $12^{th}/13^{th}$ rib was greater ($P<0.05$) for H (1.52 cm) than for M (1.31 cm) and L (1.30 cm) but similar to VH (1.41 cm). Ribeye area for VH (82.45 cm^2) was smaller ($P<0.10$) than L (84.84 cm^2) but similar to M and H (84.52 cm^2 and 83.23 cm^2, respectively). Marbling scores increased linearly from L to VH and were different for all classes

(P<0.05). VH had lower (P<0.05) mean and total implant potency scores compared with L, M, and H. The percentage of USDA Yield Grade (YG) 4 or 5 carcasses, which are not accepted as CAB®, was higher (19.1%, P<0.05) in H than in L, M, or VH (10.9, 9.9, and 11.0%, respectively). Of the YG 4 or 5 carcasses in the VH and H classes, 61.6 and 42.9% had enough marbling to qualify for the CAB® program, while only 18.5 and 22.5% of the L and M YG 4 or 5 carcasses had adequate marbling to meet CAB® requirements. Lots of cattle sired solely by Angus bulls had higher (P<0.05) CAB® AR at 27.5% than lots sired by predominantly Angus (18.7%), Brangus (10.6%), or unknown breed (11.3%) bulls. Results from this study indicate that cattle with genetics to deposit marbling can achieve higher CAB® AR without affecting most other performance and carcass values.

Key Words: carcass, feedlot, performance

Billy N. Day Symposium

28 Fallacies in research on pig reproduction. P. Dziuk*, *University of Illinois*, *Urbana*.

Tradition leads to fallacious assumptions in our studies on pig reproductive physiology. I will try to question these assumptions. (1) ″Normal estrous cycle″ is an oxymoron. Normally a female comes into heat, is mated and conceives. Cycles are an aberration. (2) Number of corpora lutea (CL) is an inaccurate measure of number of potential embryo/fetuses as the number changes over the period of an estrous cycle or pregnancy. The number of CL has been found to be less than the number of embryos/fetuses and has been found to change significantly from counts separated by several days. (3) Unilateral hysterectomy may reduce the uterine space available in that female but the one uterine horn will be longer than both horns in about 30% of gilts. Each fetus requires a certain absolute space not a proportion of available space. (4) Embryos migrate from one horn to the other and mix from both uterine horns from day 3 to 12. They do not implant in series from tip to body. (5) Percentage of embryonic survival is immaterial to the pig. It makes little difference to her or the species if 10 fetuses of 10 oocytes survive or if 10 of 20 survive. Nature is extravagant. (6) The onset of estrus and peaks of LH and estrogen are nebulous points from which to determine time of ovulation because the critical amount or concentration of LH has been reached much earlier than the superfluous peak. (7) A physiologically significant effect of a treatment on number of CL and fetuses requires more than 30 randomly selected animals. With groups of 10 to 30 a statistical difference has been found in 20% of cases from computer generated ″treatments″ from a group of 400 untreated controls. The literature is skewed badly towards ″treatments″ that never stood the test of repeats. Seminal plasma has no essential role in preparing the uterus or on ovarian function. Thousands of successful embryo transfers and normal cycles, pregnancy and parturition in gilts with ovaries transplanted to distant anatomical locations show this. Oocyte maturation follows an unalterable time schedule not influenced by seminal plasma.

Key Words: pigs, reproduction, fallacies

29 Opportunities to use the boar effect to enhance management of replacement gilts. J. L. Patterson*, *Swine Research & Technology Centre, University of Alberta*, *Edmonton, Alberta, Canada*.

The boar effect, primarily attributed to the synergistic actions of a combination of olfactory, tactile, visual and auditory cues, has long been shown to be a potent stimulus of pubertal onset in gilts. Olfactory cues act via the transfer of androstene pheromones accumulated in the saliva of mature boars to the vomeronasal organ of the gilt. Pheromones act as either priming, longer term, stimuli causing physiological changes in endocrine status, or as signaling, shorter term stimuli resulting in immediate behavioral responses. There is little evidence that gilts become insensitive or habituate to primer pheromones during puberty stimulation and multiple, daily, exposures to a rotation of mature boars maximize the response to this component of the ″boar effect″. In contrast, gilts exhibiting a full standing heat in response to signaling pheromones (the receptive state) will eventually habituate to these signals and a period of refractoriness to the ″boar effect″ is observed. Consequently, recording of standing heat should only occur when gilts are first allowed contact with boar signaling pheromones. However, boar pheromones are not volatile substances and to promote physical transfer of pheromones from the boar to the gilt, direct ″snout-to-snout″ contact between the boar and the gilt is an absolute requirement. Indeed, only direct physical tactile contact between the boar and gilt will ensure the maximal response to the full ″boar effect″. Because the ″boar effect″ is the single most important factor in stimulating gilts to attain sexual maturity, a properly designed gilt development unit (GDU) is the key to successful puberty stimulation, breeding and labor management. Unfortunately, a failure to effectively apply the accepted principals of using the primer pheromone from boars to optimize the stimulation of pubertal estrus is common. A GDU should be designed to optimize, not to compromise, gilt management, by facilitating the exposure of gilts to the boar, thus taking full advantage of the incremental effects of stimulation by primer pheromones delivered by the boar.

Key Words: boar effect, pheromones, puberty gilts

30 Current technology for estrous synchronization and timed insemination of gilts. R. Knox*, *University of Illinois*, *Urbana*.

Estrous synchronization reduces gilt pool size, animal crowding, and labor for detection of behavioral estrus, while improving production scheduling and flow. Timed AI eliminates breeding based on estrus, and facilitates mating at time of peak fertility for semen and ova. Past research has involved the ability to stimulate synchronized follicle development and estrus, from the use of purified hormones such as PMSG with or without hCG. In addition, synthesis and approval of progestagens and prostaglandins for controlling hormonal feedback in the pig, facilitates estrous synchronization. Purification and synthesis of the ovulation inducing hormones GnRH, its analogues, and LH

and hCG allows precision in ovulation timing. The technology for induction of estrus in gilts relies on pheromonal stimuli from the boar but provides limited synchrony in a 20 day period while stimulation using PMSG/hCG induces 70% of gilts into estrus within 4-6 days. The fertility of gilts at any induced estrus shows slightly reduced pregnancy rates and litters sizes. There has been little progress in luteal control of the estrous cycle using prostaglandins due to their limited use in mature CL on d 12-15 for synchronization. Luteal lifespan extenders such as estrogen and prostaglandin inhibitors are effective but their approval and practical administration methodology are uncertain. Progestagen control is effective if given for 14 days in the feed and can synchronize >80% of gilts in estrus within 5-8 days after last feeding. Synchrony of estrus does not guarantee synchronized ovulation which can occur over a 3-4 day period, regardless of the synchrony protocol. The hormones hCG and LH advance ovulation at the ovarian level, while GnRH increases LH to advance ovulation. The combination of estrus synchronization, with or without follicle induction, and ovulation induction for use with timed AI in prepubertal gilts has been successful in production of litters. Yet more research is needed to improve and assess these technologies for their practical use in the commercial production industry and their equivalence and profitability to current reproduction methodologies.

Key Words: synchronization, gilts, AI

31 Influence of age and weight at breeding on gilt productivity and sow longevity. R. Kummer*, *Pig Improvement Company*, *Brazil*.

Recommendations for the timing of gilt insemination have been based on breed, age, weight, estrous cycle and backfat depth. Gilt insemination at the right time is necessary as it has a high impact on non-productive days and because the longevity and reproductive performance are correlated to this moment. This study was divided into three parts to analyse the effects of age, weight, estrus mating and growth rate (GR) on gilt reproductive performance. The first experiment was to analyze if gilts which had a high GR could be mated in advance without a decrease in reproductive performance or an increase in cull rate over 3 parities. Gilts were divided into 3 groups (G1-3) according to weight and age at insemination. G1 (n=168) had gilts with a GR ≥ 700 g/d and inseminated at < 210 d. G2 (n=160) had gilts with a GR ≥ 700 g/d and inseminated at ≥ 210 d and G3 (n=242) had gilts with a GR < 700 g/d and inseminated at ≥ 210 d. There was a higher total born (TB) at first farrowing in G2, however, after evaluating three parity results there was no difference in TB, farrowing rates (FR), and cull rates among gilt groups. The second experiment was to analyze if there is any difference in puberty age, ovulation rate and embryo survival rate among gilts with differences in GR. One hundred and twenty gilts were selected at 144 d of age and divided into two groups according to GR. Group one was made up of 60 gilts with a mean GR of 576 g/d and G2 of gilts with a mean GR of 722 g/d at selection. Higher GR gilts showed puberty earlier with a lower anestrus percentage. In the third study the importance of estrus insemination on reproductive performance at first parity of gilts with the same weight and age at insemination was evaluated. In this study gilts were divided into 4 groups according to estrus insemination. Gilts mated at first estrus farrowed lower TB and had a decreased FR compared to gilts mated at third or fourth estrus. There were no differences among gilts inseminated at second, third and fourth estrus.

Key Words: gilts, reproduction, age

32 Opportunities to use nutrition and novel feed ingredients to impact gilt reproduction. A. M. Gaines*, *JBS United, Inc.*, *Sheridan, IN*.

The U.S. swine industry has a lot of interest in achieving a performance goal of 30 piglets weaned/sow/year. This is a very lofty goal considering that high producing sows are only capable of having 2.45 litters per sow per year. In addition, many sows are removed from the herd well before they are most productive. With replacement rates in commercial herds averaging 50%, the gilt by default is a major contributor to overall herd reproductive performance. Because of the impact of the gilt on overall herd reproductive performance there needs to be more focus in this area. Though several factors influence gilt reproductive performance, nutrition is one factor that should be considered. A feeding program for the future breeding sow must start early in development. The young gilt needs the correct diet, feeding strategy, and time to accumulate the necessary body weight, body reserves, and body condition at first mating. In many production systems, the gilt is fed comparable to a commercial nursery or grow-finish pig until the time of mating. This practice will achieve reasonable reproductive performance as amino acid and energy needs of the gilt are often met. However, there is a considerable amount of research indicating that the breeding female requires additional nutrients or specific ingredients for optimal reproductive performance. The nutrients or specific ingredients that have been recently evaluated include: inorganic or organic trace minerals, vitamins, amino acids, antioxidants, omega-3 fatty acids, acidifiers, various fiber sources, and essential oils. Based on the research, the aforementioned nutrients or ingredients have the potential to increase litter size by a pig or more. As our industry continues to target 30 piglets weaned/sow/year, use of these nutrients or ingredients along with basic nutrition concepts will need to be considered in accomplishing this goal.

Key Words: gilts, reproduction, nutrition

33 Industry targets and benchmarks for the introduction of gilts into breeding herds. B. F. Wolter*, *The Maschhoffs, Inc.*, *Carlyle, IL*.

Animal management factors influencing growth and future reproductive performance of gilts have been evaluated in numerous experiments; however, many of the results of such studies lack either significant scale or an industry context from which to base practical management strategies for today's pig units. A number of factors, including, but not limited to; genetic makeup of animals, facility design, environmental stressors, animal health, and access to nutritional resources have been shown to impact growth and reproduction in gilts, and these factors are known to differ among production systems within the pig industry.

On that basis, it is difficult to develop broad targets and benchmarks that may apply to all pig units; however, science-based principles can be used in a systems approach to set and achieve targets that optimize gilt performance specific to an individual production system. Gilt management strategies aimed at achieving targets should consider system capacity for genetic multiplication, principles for selection of breeding animals, tissue composition of animals near puberty, and potential sources of variation in animal performance due to animal management procedures. In practice, key system cost and revenue drivers must be understood in prioritizing targets and for the proper application of production principles to achieve targets. The application of known concepts is critical to achieving targets successfully, but additional information on the impact of gilt growth and development strategy on subsequent productivity is needed for a more complete set of targets. To that end, researchers aiming to complete such research should consider the potential interaction among management factors, and therefore completion of these studies within commercial production units that provide adequate control of dependent variables and larger numbers of animals may be required.

Key Words: pigs, reproduction, management

34 The dollars and scents of effective gilt management programs. G. R. Foxcroft*, *Swine Research & Technology Centre, University of Alberta*, *Edmonton, Alberta, Canada*.

It has been said that the greatest limitation to effective breeding herd management is ″the gilt and sow not detected in estrus″. In the context of poor Gilt Development Unit (GDU) performance, the failure to detect gilts in estrus may have two origins: Firstly, a failure to effectively stimulate the first pubertal heat, and secondly, an inability to observe and record this and subsequent heat events. In both situations, effective use of primer and signaling pheromones provided by mature boars with good libido is frequently lacking, yet these stimuli should be the foundation of good GDU programs. Boar-derived stimuli should be applied early enough in the GDU program to allow credible breeding targets to be met. These targets should likely include breeding gilts at second or third estrus, and at a body weight exceeding 135kg (300lbs). Moreover, these targets need to be recorded on an individual gilt basis, in exactly the same way that detailed information is collected for weaned sows, because the costs of unrecognized non-productive days is exactly the same in both cases. The efficiency of the boar stimulation and estrus recording process should be very high, and the labor and manpower committed to GDU program must be both realistic and properly justified. However, virtually no meaningful economic analyses exist in the public domain to demonstrate the return on investment of increased input costs to the GDU and yet many GDU programs fail to consistently meet their targets for numbers of gilts bred and pigs weaned from first parity sows. Nevertheless, effective GDU facilities can usually be created that address these shortcomings, at relatively low capital cost. More information appears to be needed to justify the variable costs of labor and boar power, against agreed measures of GDU efficiency, before this critical aspect of breeding herd management receives the attention it deserves. However, preliminary cost-benefit analysis of data from large-scale GDU implementation projects appears to validate this approach.

Key Words: gilt management, puberty, economic

Breeding and Genetics

35 Heritability estimates for fatty acid quantity in Angus beef. R. Tait, Jr.*[1], S. Zhang[1], T. Knight[1], J. Minick Bormann[2], D. Beitz[1], and J. Reecy[1], [1]*Iowa State University*, *Ames*, [2]*Kansas State University*, *Manhattan*.

The objective of this study was to estimate the heritability of fatty acid quantity in beef. A facing of the longissimus dorsi with the external connective tissue removed was collected from 916 Angus-sired bulls and steers and used for this experiment. There were 87 sires with one to 41 progeny represented in these data. These samples were evaluated for fatty acid composition using gas chromatography and were expressed as fatty acid mg/g of beef. Harvest contemporary group was defined from herd of origin, sex, feedlot dietary treatment, and harvest date. Heritabilites of the fatty acids were estimated using the sire model option of MTDFREML using two models: I) harvest contemporary group as the only fixed effect or II) harvest contemporary group as a fixed effect and percent lipid as a covariate. Fatty acids of most interest for human health are: myristic acid (14:0), tetradecenoic acid (14:1), palmitic acid (16:0), palmitoleic acid (16:1), stearic acid (18:0), oleic acid (18:1), and linoleic acid (18:2). The table shows mean, standard deviation, Model I heritability, Model II heritability, and increase in heritability from Model I to Model II for each of these fatty acids. Heritability estimates for these seven fatty acids from Model II ranged from 0.108 to 0.454. With heritabilities of this magnitude it should be possible to change quantity of these fatty acids while accounting for differences in intramuscular fat of the beef through inclusion of lipid percent in the evaluation model.

Attributes of Fatty Acid Quantity in Angus Beef

Attribute	14:0	14:1	16:0	16:1	18:0	18:1	18:2
Mean, mg/g	1.24	0.31	11.26	1.51	5.38	17.83	2.25
SD, mg/g	0.60	0.19	4.84	0.71	2.33	7.97	0.76
Model I, h^2	0.188	0.104	0.169	0.266	0.110	0.157	0.060
Model II, h^2	0.352	0.108	0.281	0.455	0.151	0.440	0.171
h^2 increase, Model II - I	0.165	0.004	0.112	0.188	0.041	0.283	0.110

Key Words: beef, fatty acid, heritability

36 Estimates of genetic parameters and genetic trends of Nellore cattle in Sao Paulo State, Brazil. J. C. Souza*[1,2], L. Silva[3], A. Gondo[3], J. A. Freitas[1], C. Malhado[4], P. Filho[5], J. Sereno[6], R. L. Weaber[7], and W. R. Lamberson[7], [1]*Parana Federal Univ*, *Palotina, Brazil*, [2]*CNPq*, *Brazil*, [3]*CNPGC*, *Brazil*, [4]*Bahia State University*, *Brazil*, [5]*Mato Grosso do Sul Federal Brazil*, *Brazil*, [6]*CPAC*, *Brazil*, [7]*University of Missouri*, *Columbia*.

Genetic parameters and trends of weights were estimated for Nellore cattle from three regions of São Paulo State, Brazil. ABCZ / EMBRAPA provided weights (kg) at 120 (W120), 205 (W205), 365 (W365) and 540 (W540) for 86,852, 86,852, 61,637, 36,187 animals, respectively, from 1975 to 2001. Parameters were obtained using MTDFREML in single trait analyses. Fixed effects were contemporary group (dry or wet season), year, sex and farm and age of dam (linear and quadratic covariate). Random effects were direct and maternal genetic effects, their covariance, and the uncorrelated maternal permanent environmental effect. The analysis was restarted until twice the logarithms of the likelihoods changed no more than two decimal places. Estimates of direct and maternal genetic variances, direct-maternal covariance, and environmental and phenotypic variances were 51.1, 17.9, -12.0, 190.5 and 280.4 for W120; 128.6, 47.2, -25.9, 695.7 and 932.4 for W205; 435.9, 32.2, -27.4, 2,934.0 and 3,604.9 for W365; and 607.9, 177.7, -117.6, 5,637.7 and 6,602.5 for W540. Direct heritabilities ranged from 0.09 to 0.18, maternal heritabilities from 0.01 to 0.06, direct-maternal genetic correlations from -0.23 to -0.36, and permanent environmental effects from 0.05 to 0.12. Direct and maternal genetic and environmental trends from 1995 to 2001 were 10.1, 2.8 and 18.43 kg for W120; 15.9, 2.67; and 23.0 kg for W205; 20.9, 1.24 and 23.6 kg for W365, and, 24.6, 3.5, and 45.0 kg for W540, respectively. The direct genetic trends were positive and maternal trends were small. The importance of maternal performance for W120 and W205 suggests it should be considered in breeding programs although it has a low heritability and modestly adverse genetic correlation with direct genetic effects.

Key Words: heritability, weight, Zebu

37 Genetic parameter estimates of weights of crossbred beef cattle (European × Zebu) raised in Southern Brazil. J. C. Souza*[1,4], D. Perotto[2], J. J. Abrahao[3], R. L. Weaver[4], and W. R. Lamberson[4], [1]*Parana Federal University*, *Palotina, Brazil*, [2]*IAPAR/Polo de Curitiba*, *Brazil*, [3]*IAPAR/Est. Exp. Paranavai*, *Brazil*, [4]*University of Missouri*, *Columbia*.

Our objective was to estimate genetic parameters for birth (BWT, n=2,226), weaning (WWT, n=2,128) and yearling weights (W365, n=1,982) from a crossbreeding experiment conducted at the IAPAR Paranavaí Experimental Station – Brazil, between 1985 and 2005. Breed of bulls included Nellore, Guzerá, Red Angus, Marchigiana, and Limousin which were mated to cows of breed composition Nellore, Guzerá, 1/2 Red Angus × 1/2 Nellore, 1/2 Marchigiana × Nellore, 1/2 Simmental × 1/2 Nellore, 3/4 Nellore × 1/4 Red Angus, and 1/2 Red Angus × 1/4 Guzerá × 1/4 Nellore. Estimates of variances and covariances were obtained using single and multi trait analyses with MTDFREML. Fixed effects were contemporary group (dry or wet season, year, and sex combination), breed of calf and breed of dam and covariates age of dam (linear and quadratic), expected individual hybrid vigor (linear) and expected maternal hybrid vigor (linear). Random effects were direct and maternal genetic effects, their covariance, and the uncorrelated maternal permanent environmental effect. The estimates of direct and maternal genetic variances, direct-maternal covariance, permanent environmental variance, and the environmental and phenotypic variances were 2.6, 1.0, 1.2, 0.1, 12.0, 17.3 for BWT; 231.5, 120.1, -86.5, 15.1, 375.0, 655.2 for WT205; 336.9, 58.3, -68.5, 46.0, 644.5, 1017.1 for WT365. The genetic correlation between BWT and WT205 was 0.27; between BWT and WT365 was 0.17; and between WT205 and WT365 was 0.74. The direct and maternal heritabilities for BWT were 0.15±0.05, 0.06±0.05; for WT205 were 0.35±0.08 and 0.18±0.08; and for WT365 were 0.33±0.08 and 0.06±0.06. Heritability estimates were moderate and estimates of genetic correlations were positive. When models were used that adjusted for expected individual and maternal hybrid vigor resulting genetic parameter estimates were in expected ranges.

Key Words: beef cattle, crossbreeding, heritability

38 Evaluation of carcass EPD using single- vs. multi-trait analyses. J. M. Rumph*[1], W. R. Shafer[2], and R. J. Lipsey[2], [1]*Montana State University*, *Bozeman*, [2]*American Simmental Association*, *Bozeman, MT*.

Carcass EPD were estimated on 18,133 animals harvested through 2002 using data obtained from the American Simmental Association. Traits analyzed were 12th rib backfat thickness (FAT), hot carcass weight (HCW), marbling score (MRB), and longissimus muscle area (LMA). Data were analyzed in four separate single-trait analyses (ST) as well as a combined four-trait analysis (MT). Progeny phenotypes were then regressed on resultant EPD to evaluate their predictive value. Heritability estimates were similar for HCW, but were significantly different for other traits with MT producing an increased estimate of h^2 for FAT and decreased estimates of h^2 for MRB and LMA compared to ST. To evaluate each method data collected from 2003 – 2005 and not used in EPD estimation were analyzed with contemporary group fit as a fixed effect and age at slaughter and sire EPD fit as linear regressions. The additional data consisted of 690 progeny records from 48 bulls. The theoretical expectation of the regression of progeny phenotype on sire EPD is 1. For FAT and MRB, EPD calculated from MT were more predictive of progeny performance than those calculated from ST. Although standard errors were high, coefficient estimates from MT were not significantly different from 1; however, estimates from ST were significantly different from 1. Regression coefficients for FAT were 1.73 (0.52) and 1.52 (0.55) for ST and MT, respectively. For MRB, estimates were 0.61 (0.24) and 0.73 (0.32), respectively. For HCW, although MT resulted in an estimate closer to 1, both types of analysis resulted in estimates that were significantly different from 1 with estimates of 0.46 (0.27) and 0.56 (0.34) for ST and MT, respectively. For LMA, both analyses resulted in estimates that were not significantly different from 1 with estimates of 1.04 (0.41) and 1.43 (0.52) for ST and MT analyses, respectively. More data are needed to decrease the standard errors in these estimates; however it appears that MT is more predictive of progeny performance for FAT, MRB, and possibly HCW.

Key Words: carcass traits, multi-trait analysis, national cattle evaluations

39 Estimation of the effects of bovine respiratory disease treatments through the feedlot phase and the differences among sires of Angus cattle. M. Schneider*, R. Tait, and J. Reecy, *Iowa State University*, *Ames*.

Bovine Respiratory Disease (BRD) is the cause of significant economic losses in the cattle industry. The objective of this study was to examine the effects of BRD on economically important performance and carcass traits. In addition, we wanted to begin to examine the impact genetics has on susceptibility to BRD. We collected performance and health treatments records on 1714 Angus-sired calves fed at various feedlots over a three year period (2003-2005). Treatment for respiratory symptoms ranged from a high incidence of 18.8% in 2003 to a low incidence of 5.8% in 2004. Overall, a majority of the cattle were never treated (89.5%) whereas 4.6% of cattle were treated once or twice, and 1.5% were treated three to six times. Traits in this study were analyzed with general linear models to estimate significance and effects. Sire, % shrink upon entrance to the feedlot, and average disposition score were all shown to have significant effects ($P<0.05$) on the number of times an animal was treated for respiratory disease. Sex was not a significant predictor of number of BRD treatments ($P>0.10$). We then evaluated the extent to which number of treatments for BRD influenced performance traits such as overall ADG, weight per day of age (WDA), age at harvest, and carcass traits such as hot carcass weight (HCW), ribeye area (REA), ribeye area per 45.5 kg of carcass weight (REAcwt), calculated yield grade (YG), and marbling score (MS). Treatment for BRD was shown to significantly effect overall ADG and WDA ($P< 0.05$). There was no effect observed on age at harvest. In addition, number of treatments for BRD showed significant effects on HCW, REAcwt, YG, and MS ($P<0.05$), and REA ($P<0.10$). These results demonstrate that number of treatments for BRD has significant consequences on economically important performance and carcass traits over the feedlot phase.

Key Words: genetics, respiratory, bovine

40 Genetic analysis of incidence of porcine circovirus associated disease (PCVAD) in a composite swine population. J. S. Bates*, A. R. Doster, and R. K. Johnson, *University of Nebraska*, *Lincoln*.

The objective was to determine the importance of genetic and environmental effects on the incidence of Porcine Circovirus Associated Disease (PCVAD) in pigs. Pigs (1,340) were from Generation 24 of three lines selected for increased reproduction and growth and two control lines. From 60 d of age pigs were grown in confined buildings or outside lots containing bedded hoop structures. Pigs were scored on a scale of 0 (no symptoms), 1 (suspect), or 2 (positive) for symptoms of PCVAD, including muscle wasting, growth retardation, and rough hair coat, every 7 to 10 days from 70 to 180 d of age; 13.2% of the pigs received a score of 2. A random sample of 21 pigs with a score of 2 were necropsied and lung, lymph node, tonsil, kidney, and ileum tissues were microscopically examined for lesions suggestive of PCVAD. RT-PCR was used to confirm PCV-2 in lung, lymph node, and tonsil; all 21 pigs were positive for PCV-2. Pigs receiving one score of 2 were considered positive for PCVAD, all others were considered negative. This binomial score was analyzed with MTDFREML to estimate genetic and environmental effects and with SAS Glimmix to identify variables associated with incidence of PCVAD. Both methods produced similar estimates of importance for effects in the model. The probability of score 2 was 0.13 ± 0.07 greater for selection lines than control lines ($P< 0.10$). Direct and maternal heritabilities were 0.22 ± 0.11 and 0.03 ± 0.06, respectively. The proportion of variance due to common litter effects was 0.14 ± 0.06. Higher inbreeding coefficients were associated with scores of 2 in one selection line. Differences in weight between negative and positive pigs were 0.10 kg at birth, 0.55 kg at weaning, 5.74 kg at 70 d, and 22.1 kg at 180 d. Probability of score 2 was greatest in pigs in outside lots and least for pigs in confined buildings ($P < 0.05$). Genetic Variation for incidence of PCVAD exists, but environmental effects common to litters and rearing environment also affect its incidence.

Key Words: genetic variation, PCVAD, disease resistance

41 Relationship of juvenile IGF-I with performance traits in lines selected for residual feed intake. K. L. Bunter[1], W. Cai*[2], and J. C. M. Dekkers[2], [1]*University of New England*, *Armidale, NSW, Australia*, [2]*Iowa State University*, *Ames*.

The efficiency of feed use is an important factor influencing costs of production. However, feed intake (FI) is difficult and costly to measure. Previous work has shown that juvenile insulin-like growth factor-I (IGF-I) is genetically correlated with performance traits, but the direct consequences of selection for feed efficiency on IGF-I have not been demonstrated. The objectives of this study were to examine correlated responses in juvenile IGF-I to selection on residual feed intake (RFI) and to estimate associations between juvenile IGF-I, FI, performance measures and RFI. Data were from a line of Yorkshire pigs at Iowa State University that had been selected for reduced RFI (LFRI) for 3 generations, along with a randomly selected control line. IGF-I was measured on a total of 1240 pigs from generations 2 and 3 in blood samples collected between 35 and 42 d of age. In addition, average daily gain (ADG) to 105 kg and 10th rib ultrasound backfat (BF) were available on 2763 pigs along with average daily feed intake (FI) on 813 pigs from generations 0 to 3. Feed intake recording was mostly conducted in select line animals for selection purposes. Data were analysed by single trait models with appropriate fixed effects and covariates and a random animal genetic effect to estimate variance components and breeding values (EBV). In generation 3, compared to 0 for the common base population, average EBV of animals with records for RFI (g/d), FI (g/d), on-test ADG (g/d), BF (mm), feed conversion ratio (FCR) and IGF-I (ng/ml) were -110, -160, -13, -1.0, -0.10, and -9.9 for the LRFI line and 0, -4, 20, 0.8, -0.01, and 9.6 for the control line. All line differences were significant ($P<0.001$). Estimates of heritability were 0.37, 0.45, 0.27, 0.43, 0.23, and 0.20 for RFI, FI, ADG, BF, FCR, and IGF-I. Correlations of EBV for IGF-I with EBV for RFI, FI, ADG, BF, and FCR were 0.26, 0.24, 0.06, 0.36, and 0.08. These results provide supporting evidence for the previously reported genetic correlations between IGF-I and performance traits and show that selecting for lower RFI resulted in a correlated response in the expected direction for juvenile IGF-I.

Key Words: residual feed intake, IGF-I, pigs

42 Estimation of genetic parameters in selected lines of swine using models with competition effects. C. Y. Chen*[1], S. D. Kachman[1], R. K. Johnson[1], and L. D. Van Vleck[1,2], [1]*University of Nebraska*, *Lincoln*, [2]*ARS, USDA, U.S. Meat Animal Research Center*, *Clay Center, NE*.

Components of variance for average daily gain (ADG, g) were estimated from data provided by PIC on 11,235 pigs from 4 lines. Pigs with average age of 71 d were randomly assigned to pens of size 15 by line and sex and taken off test after approximately 89 days (weights ranged from 61 to 158 kg). Models included fixed effects of line, sex and contemporary group, with random direct genetic, competition (genetic and environmental) and pen effects. With the full model, estimates were 3630, 13 and 18 for direct (σ^2_d), direct-competition (σ_{dc}) and genetic competition (σ^2_c) (co)variance components. Pen (σ^2_{pg}), environmental competition (σ^2_{ce}) and residual (σ^2_e) effects could not be partitioned. Estimable combinations were $\sigma^2_{pg} +14\sigma^2_{ce}+ \sigma^2_e$ and $\sigma^2_{pg} +13\sigma^2_{ce}$ corresponding to the diagonal and off diagonal elements of the pooled environmental (co)variance matrix. Model 2 (without environmental competition effects) allowed variances to be partitioned (3636, 13, 18, 1746 and 6863 for σ^2_d, σ_{dc}, σ^2_c, σ^2_{pg} and σ^2_e) with the same likelihood as the full model. With Model 3 (pen effects ignored), 13 σ^2_{ce} (13×134=1742) corresponded to pen variance with Model 2 with a decreased estimate of σ^2_e(6734) but with similar estimates of genetic variances and the same likelihood as the full model. The smaller estimate of σ^2_e with Model 3 was associated with σ^2_{ce} compared with Model 2 (6734+134=6868 vs. 6863). With Model 4 (both pen and genetic competition effects ignored), the estimate of σ^2_{ce} (175) increased significantly (P<0.05) with little change in σ^2_d (3679) compared with Model 3. The impact of competition effects can be important depending on group size even with a relatively small estimate of σ^2_c. Including environmental competition effects as permanent environmental effects in the model did not change estimates of genetic (co)variances. Competition environmental effects seemed to be a cause of observed pen variance. Therefore including either pen or environmental competition as random effects in the model seems desirable to avoid bias in estimates of genetic variances.

Key Words: competition, genetic variances, swine

43 Correlated response in litter traits to selection for intramuscular fat in Duroc swine. A. L. Bushman*, T. J. Baas, C. R. Schwab, and K. J. Stalder, *Iowa State University*, *Ames*.

Data used in this study were from a selection project for increased intramuscular fat in purebred Duroc swine. Forty gilts were randomly mated to boars for two generations to form a base population of 56 litters. Littermate pairs of gilts were randomly chosen with one gilt assigned to the select line (SL) and the other to the control line (CL). Littermate gilts were then mated to the same boar in the base generation to establish genetic ties between lines. In each generation, intramuscular fat is estimated in the live animal using real-time ultrasound and selection is based on estimated breeding values (EBV) for IMF. After five generations of selection for IMF, the average EBV for SL pigs is 1.95% greater than for CL pigs. There were 172 pigs harvested in generation five. Least squares means for 10th rib backfat and loin muscle area in this generation were 20.10 mm and 45.01 cm2 in the CL, and 24.47 mm and 39.17 cm2 in the SL, respectively. Litter traits evaluated were total number born (TNB), number born alive (NBA), litter birth weight (LBW), preweaning mortality (PWM), number weaned (NW), and adjusted 21-day litter weight (LW21). Fixed effects in the analysis models differed depending on the trait of interest, but line and weaning date, a contemporary group variable, were common among all traits studied. Sire within line was a random effect in all models and least squares means for litter traits were estimated using PROC MIXED in SAS. A significant difference was found between lines for LBW, with dams in the CL farrowing litters that were 1.13 kg heavier at birth. The difference between lines for NBA (P < 0.01) showed females in the CL farrowing 1.63 more live pigs than females in the SL. Differences between the CL and SL were not significant for TNB, PWM, NW and LW21. Selection for IMF resulted in decreased litter birth weight and fewer pigs born alive for females in the SL, but did not have a significant effect on other litter traits.

Key Words: intramuscular fat, litter traits, selection

44 Carcass traits of 1980 vs. 2005 pigs when fed 1980 or 2005 feeding programs. J. S. Fix*, D. J. Hanson, E. van heugten, J. P. Cassady, and M. T. See, *North Carolina State University*, *Raleigh*.

The objective of this study was to assess changes over 25 yr in pig carcass traits. Pigs (n=162) representative of the current commercial industry were compared to pigs representative of the commercial industry 25 years ago. The 1980 genetic line was produced from dams selected to minimize genetic improvement and frozen semen from boars available in 1980. Pigs within sex, farrowing group, and genetic line (GL) were randomly assigned to a feeding program (FP) and placed 3 per pen (n=54) at an initial wt of 7±0.4 kg. The 2005 FP included a 7 phase FP (lysine from 1.51 to 0.73% and ME from 3428 to 3651 Kcal/kg), pelleted diets, and current diet formulation. The 1980 FP consisted of 4 meal diets (lysine from 1.05 to 0.62% and ME from 3262 to 3317 Kcal/kg) based on formulations from the 1978 PIH. Pigs were slaughtered on a weekly basis when average pen wt exceeded 116 kg. Bellies from pigs fed 2005 FP were thicker (P<0.01) than bellies from pigs fed 1980 FP. Pigs fed 1980 FP had longer (P<0.05) and firmer bellies (20.29 vs. 30.73 cm; P<0.01) as measured by the stick test than pigs fed 2005 FP. Bellies from 2005 GL pigs were firmer (23.72 vs. 27.31 cm; P<0.05) than 1980 GL pigs. A GL x FP interaction (P<0.05) was observed for LMA where 2005 and 1980 GL pigs had larger LMA when fed 2005 FP (49.73^a, 40.15^b cmï€‡) vs. 1980 FP (42.82^c,36.93^d cmï€‡). Pigs from 2005 GL were leaner at first rib (P<0.05), 10th rib (P<0.01) and last lumbar (P<0.01) than pigs from 1980 GL. Pigs fed 1980 FP were leaner at first rib (P<0.01) and last rib (P<0.05) than pigs fed 2005 FP. Pigs fed 1980 FP had longer carcasses (87.0 vs. 85.2 cm; P<0.01) than pigs fed 2005 FP. Pigs fed 2005 FP had heavier carcasses (87.7vs. 85.2 kg; P<0.01) but did not differ in slaughter wt from pigs fed 1980 FP and thus had a higher dressing % (73.7vs. 72.7; P<0.05). Over the past 25 yr genetics have led to improvements in LMA, leanness and belly firmness. Changes in nutrition have improved muscle and dressing percent but have had negative effects on carcass length, leanness and belly firmness.

Key Words: pig, genetics, carcass

45 Eating quality of pork loin chops from 1980 vs. 2005 pigs when fed 1980 or 2005 feeding programs. J. S. Fix*, D. J. Hanson, E. van Heugten, J. P. Cassady, and M. T. See, *North Carolina State University*, *Raleigh*.

The objective of this study was to assess changes over 25 yr in the eating quality and descriptive sensory characteristics of boneless LM. Pigs (n=162) representative of the current commercial industry were compared to pigs representative of the commercial industry 25 years ago. The 1980 genetic line was produced from dams selected to minimize genetic improvement and frozen semen from boars available in 1980. Pigs within sex, farrowing group, and genetic line (GL) were randomly assigned to a feeding program (FP). The 2005 FP included a 7 phase FP (lysine from 1.51 to 0.73% and ME from 3428 to 3651 Kcal/kg), pelleted diets, added fat and current diet formulation. The 1980 FP consisted of 4 meal diets (lysine from 1.05 to 0.62% and ME from 3262 to 3317 Kcal/kg) based on formulations from the 1978 PIH. Pigs were slaughtered on a weekly basis when avg pen wt exceeded 116 kg. Based on a consumer sensory evaluation LM from pigs fed 1980 FP had higher overall liking ($P<0.01$) and texture liking ($P<0.05$) than LM from pigs fed 2005 FP. Trained flavor and texture descriptive panels were conducted on a 16 point intensity scale. Stronger cooked pork aroma was found ($P<0.01$) for LM from pigs fed 1980 FP vs 2005 FP. LM from pigs fed 2005 FP had a higher cohesive mass than LM from pigs fed 1980 FP. There was GL x FP interaction ($P<0.01$) for cooked pork flavor where LM from 1980 GL pigs fed 1980 FP vs 2005 FP did not differ but LM from 2005 GL pigs had more cooked pork flavor when fed 2005 FP vs 1980 FP. Interactions of GL x FP were observed where LM from 2005 GL pigs did not differ when fed 1980 FP vs 2005 FP, however LM from 1980 GL pigs fed 2005 FP were juicier ($P<0.01$) and had more moisture release ($P<0.01$) than LM from pigs fed 1980 FP. Also GL x FP interactions were observed where LM from 2005 GL pigs were harder ($P<0.01$) and more fibrous ($P<0.01$) when fed 2005 FP vs 1980 FP while LM from 1980 GL pigs fed 1980 FP vs 2005 FP were harder ($P<0.01$) and more fibrous ($P<0.05$). Changes in genetics appear to have not affected the overall eating quality while changes in diet have, for the most part led to poorer eating quality traits in pork loin chops.

Key Words: pigs, genetics, taste panel

46 Logistic regression analysis to predict weaning-to-estrous interval in first-litter gilts. Y. Wang*[1], T. H. Wise[2], G. A. Rohrer[2], K. J. Hanford[1], and L. D. Van Vleck[1,2], [1]*University of Nebraska*, *Lincoln*, [2]*U.S. Meat Animal Research Center*, *Clay Center, NE*.

Delayed return to estrus after weaning is a significant problem for swine producers. In this study, we investigated the relationships between weaning-to-estrous interval (WEI) and body weight (BW), back fat (BF), plasma leptin (L), glucose (G), albumin (A), urea nitrogen (PUN) concentrations and litter traits to identify physiological traits associated with WEI. Data were collected from 845 gilts prior to farrowing (f, 110 d gestation), at weaning (w) and at first estrus (e) after weaning. A composite population of ¼ Duroc (D), ¼ Landrace (Lc), ½ white cross (W) was developed by mating W females to either D or Lc boars. The lines were crossed and subsequently inter se mated. Records collected in 2002 were from D or Lc sired gilts. All other records (2003-2005) were on DLcW composite gilts. Statistical analyses were performed using combined data with year as a fixed effect. Estimates of correlations showed that WEI was positively associated with BWe, Le, BWe-BWw and Le-Lw, and was negatively associated with Ge, Ae, Ge-Gw and Ae-Aw ($p<0.05$). At f, w and e, BW and BF were positively associated with L ($p<0.05$). With WEI classified as ideal (1-7 d, I), acceptable (8-14 d, A) or late/no estrus (>14 d, N), stepwise logistic regression was used to generate models with reduced sets of traits to discriminate between pairs of populations: I vs. A+N (M1) and I vs. A (M2). Because the goal was to predict WEI, only farrowing and weaning traits were included. With M1, yr 2002, yr 2004, BWw, BFw, Aw, Lw-Lf and number of pigs weaned in litter were positively associated with I, while yr 2003, BWf, PUNf and number of pigs fostered off (NF) were negatively associated. With M2, BFf, Lw, BFw-BFf, Aw-Af, NF and number of pigs alive at birth had positive associations with I, while BFw and Lf had negative associations. The results suggest physiological traits associated with WEI may be useful in predicting WEI of gilts.

Key Words: logistic regression, swine, weaning-to-estrous interval

47 Validation of flank-to-flank measurements for predicting boar weight. R. C. Sulabo*[1], J. Quackenbush[2], R. D. Goodband[1], M. D. Tokach[1], S. S. Dritz[1], J. M. DeRouchey[1], and J. L. Nelssen[1], [1]*Kansas State University*, *Manhattan*, [2]*Zoltenko Farms, Inc.*, *Hardy, NE*.

Previous work at Kansas State University showed a positive correlation between flank-to-flank measurement and sow body weight. Prediction equations were developed to estimate sow weight; however, it is not known if the same equation will be valid in estimating body weight among other groups of pigs such as boars. The objective of this study was to validate the use of flank-to-flank measurement in predicting boar weight and to determine if the allometric equation for gestating sows can also be used for adult boars. A total of 100 adult working boars from two genetic lines (83 TR4, 17 PIC 380) in a commercial A.I. boar stud were used in the study. Boars were selected specifically to obtain the widest possible range in weights (129 to 374 kg). Individual boars were weighed and a cloth tape measure was used to measure the distance from the base of the flank on one side over the back to the base of the flank on the other side of each boar. Regression equations to predict boar weight using flank-to-flank measurement were developed using PROC REG of SAS. Three equations were compared: Equation 1 – boar model with BW having no scaling factor, Equation 2 – boar model with BW expressed as $BW^{0.333}$, Equation 3 – sow model with BW expressed as $BW^{0.333}$. Residuals were used to estimate the accuracy of the equations. Flank-to-flank measurement was positively correlated to boar body weight ($R^2 = 0.84$, $P<0.01$). The fit of the model improved slightly ($R^2 = 0.86$, $P<0.01$) when body weight was expressed as $BW^{0.333}$. The boar equation was: $BW^{0.333}$, kg = 0.0458 x Flank-to-flank, cm + 1.1838. Based on the comparison of residuals, all three equations accurately predicted boar weight. The sow equation was as accurate as the boar equations in estimating boar weight. Therefore, the sow allometric equation can be used as the final model to predict both sow and boar body weight. The final model to estimate pig weights using flank-to-flank measurement is: $BW^{0.333}$, kg = 0.0511 x Flank-to-flank, cm + 0.5687.

Key Words: boars, prediction equations, weight

48 Effects of population structure on power and precision of regression-based linkage disequilibrium mapping of QTL. H. H. Zhao*, R. L. Fernando, and J. C. M. Dekkers, *Iowa State University*, *Ames*.

Least squares methods based on regression of phenotypes on marker genotypes or haplotypes are effective for linkage disequilibrium (LD) mapping of quantitative trait loci (QTL) in commercial breeding populations of livestock. The objective here was to evaluate the effect of population structure on power and precision of LD mapping using high density single nucleotide polymorphism (SNP) genotyping. An 11 cM region was simulated with 1000 SNPs and a central biallelic QTL with frequencies ½ and in equilibrium. LD was generated by drift in three random mating populations: (1) idealized population with effective size (Ne) = 100 for 100 generations, (2) idealized population with Ne = 500 for the first 85 generations and Ne = 100 for the last 15 generations, and (3) 30 sires each mated to 5 dams, which provides Ne = 100, for 100 generations (= population with relationships). For each population, 10,000 replicates with QTL allele frequencies between 0.3 and 0.7 in generation 100 were used for analysis. In generation 100, genotypes with known linkage phase for 10 segregating SNPs that were well-spaced over the QTL region were identified, and phenotypes were generated on 500 individuals with effects of the QTL set to explain 5% of the phenotypic variance. To detect and map the QTL, phenotypes were regressed on genotypes or (assumed known) haplotypes of 1, 2 or 4 neighboring SNPs. Empirical 1% region-wise thresholds were derived assuming no QTL effect. Compared to the idealized population with Ne = 100, power and precision of QTL mapping were much lower for population (2) and slightly lower for population (3). Differences in the extent of LD were found between populations. Therefore, population structure, including historical Ne and mating system, may be important for LD mapping.

Key Words: QTL, linkage disequilibrium mapping, effective population size

49 The effect of heritability estimates on high-density SNP analyses with related animals. A. Hassen*[1], S. Avendano[3], S. J. Lamont[1], W. G. Hill[2], and J. C. M. Dekkers[1], [1]*Iowa State University*, *Ames*, [2]*University of Edinburgh*, *Edinburgh, Scotland, UK*, [3]*Aviagen Ltd.*, *Edinburgh, Scotland, UK*.

The use of high-density SNP data for detection of genes affecting quantitative traits in outbred populations requires efficient computational methods for statistical analyses. Association studies often involve selected individuals that may not be representative of their populations. Although the use of heritability estimated from the sample in a mixed linear model analysis of SNP effects may be best, they may not be accurately estimated. Thus, the objectives of this study were to evaluate the influence of heritability used in analysis of SNP data on the significance and magnitude of SNP effects and their standard errors (SE) and to develop an approximation that would allow results for alternate levels of heritability to be obtained without reanalysis. Phenotypic data were mean performance of progeny of 186 sires for a trait under selection in a commercial broiler breeding population, each adjusted for fixed and some random effects. Both actual and simulated sire genotypes were used. Sire genotypes were simulated from a multinomial distribution assuming Hardy Weinberg Equilibrium, with 1000 replicates. Data were analyzed by a linear mixed model that included SNP genotype as fixed effect and random sire effects with pedigree relationships spanning 4 generations. Heritabilities used ranged from 0.02 to 0.37. Generally, SE of estimates increased with heritability, resulting in changes in the distribution of p-values ranging from highly skewed, with many significant p-values, to nearly uniform. However, rank correlations of 0.99 between SE values from different heritabilities indicated absence of re-ranking of p-values across SNPs. There was also a strong linear relationship of heritability with differences in model likelihood values, which allows p-values for alternate heritabilities to be computed by linear approximation. Thus, when estimates of heritability are inaccurate, the impact of alternate levels of heritability on SNP association results can be evaluated using linear approximations.

Key Words: heritability, SNP, mixed model

50 Associations of candidate SNP on age, leptin concentration, backfat, and body weight at puberty in gilts. L. A. Kuehn*[1], D. J. Nonneman[1], Z. Jiang[2], K. A. Leymaster[1], and T. H. Wise[1], [1]*USDA-ARS U.S. Meat Animal Research Center*, *Clay Center, NE*, [2]*Washington State University*, *Pullman*.

Body weight (BW), backfat thickness (BF), and leptin play important roles in livestock reproduction. The objective of this study was to determine whether polymorphisms in the leptin (*LEP*), leptin receptor (*LEPR*), *PAX5*, and *POMC* genes were associated with age, leptin concentration, body condition as backfat, and body weight at puberty in gilts. Age at puberty was monitored in three lines. The first two lines, born in 2001, were formed by crossing maternal White Cross (Yorkshire x Maternal Landrace) gilts to either Duroc (n = 210) or (lean) Landrace (n = 207) boars. The remaining line (n = 483), born in 2002, was formed by crossing progeny of the Duroc- and Landrace-sired lines. At estrus, BW and BF were recorded and blood collected for leptin assays. Seven SNP were detected in candidate genes/regions: 1 in *LEP*, 3 in *LEPR*, 1 in *PAX5*, and 2 in *POMC*. Animals were genotyped for each of the SNP; genotypes were validated using GenoProb. The association model included fixed effects of farrowing group, covariates of genotypic probabilities (from GenoProb), and random additive polygenic effects to account for genetic similarities between animals not explained by SNP. Variance components for polygenic effects and error were estimated using MTDFREML. Each SNP was fitted in a separate model. Leptin concentrations were logarithmically transformed for data analysis. Significant additive associations (a) were detected at *PAX5* for age at puberty (a = 4.0 d; $P < 0.05$). One SNP in *LEPR* was associated with leptin concentration (a = 0.38 log units; $P < 0.05$). The associations from *PAX5* correspond to a QTL peak for age at puberty detected on SSC1. While not necessarily the causative mutation, this result does imply that a QTL that can decrease age at puberty without increasing BF and BW may exist in this region.

Key Words: swine, puberty, leptin

51 Evaluation of molecular marker information to improve efficacy of selection for intramuscular fat via ultrasound in Duroc swine. C. R. Schwab*, B. E. Mote, M. F. Rothschild, and T. J. Baas, *Iowa State University*, *Ames*.

Opportunities for using molecular marker information within an established selection program for intramuscular fat (IMF) in Duroc swine were evaluated. Littermate gilts from the base generation were randomly assigned to either a select line (SL) or control line (CL) and mated to the same boar to establish genetic ties between lines. EBVs were generated with the use of a two-trait animal model that included observations of IMF measured in-plant and with the use of real-time ultrasound. Subsequent selection was based on EBV for IMF with the top 10 boars and top 50% of gilts used to produce the next generation. One boar from each sire family and 50 gilts representing all sire families were randomly selected to maintain the CL. After five generations, of the pigs harvested, line Least Squares means for IMF were 5.15% and 3.07% for the select and control lines, respectively. Both *Heart Fatty Acid Binding Protein (FABP3)* and *Melanocortin 4 Receptor (MC4R)* have been implicated to be associated with IMF from multiple research groups. Here we tested the published single nucleotide polymorphisms (SNPs) for both *FABP3* and *MC4R* in this unique population and an additional *FABP3* SNP was found in the 5' promoter region that was more informative, and thus was chosen for analysis. A total of 787 animals were genotyped for *FABP3* and it was shown to have no significant association with IMF in this population. Initial tests with *MC4R* (n = 95) illustrate previously published trends that faster growing, fatter genotypes tend to be associated with higher IMF. Further tests with additional candidate genes will be used to explore the use of molecular information in selection programs aimed at the improvement of meat quality.

Key Words: *FABP3*, *MC4R*, intramuscular fat

52 An A-optimal statistical design for post-hybridization washing procedures in Affymetrix micorarray experiments. L. Qu*, D. Nettleton, and J. C. M. Dekkers, *Iowa State University*, *Ames*.

Microarray data are noisy, with variability from many factors in various steps of an experiment that need to be carefully considered during the design. In this work, we focused on sources of variability in the post-hybridization washing step that have often been overlooked. The data came from a study on the effect of selection on residual feed intake and feed restriction in pigs. Before microarray analysis, the study followed a randomized complete block design. Using a genewise mixed linear model with treatments as fixed effects, and block (4 levels), processing day (3 levels), batch of wash (time between hybridization and washing, 3 levels/day), washing station (2 levels) and modules nested within station (4 levels/station) as random effects, we found that module variability was the largest (~50% of residual variances) based on REstricted Maximum Likelihood (REML) estimates of variance components. Hence, to design a future study on the effects of genotype of the MC4R gene and feed restriction, we used the A-optimality criterion and the estimated variance components to find the design that minimizes the average variance of the estimates of contrasts of interest. We found that the most efficient design is to completely confound modules with blocks for each station. Because in this design only one random effect is needed to account for both module and block effects, this design also decreases model complexity. Relative to naive completely randomized assignments of samples to day, washing batch, and modules within stations , the average variance of contrast estimates for the optimal design is >8% smaller on average, and >25% smaller than the worst case among 100000 randomized assignments. In conclusion, for the chip washing step in Affymetrix microarray experiments, modules within washing stations were the largest source of variation other than residuals. Experimental designs chosen based on A-optimality that take this variation into account will increase the power of an experiment, and could also decrease model complexity. (Supported by USDA-NRI-2005-3560415618.)

Key Words: design of experiments, microarray, Affymetrix

53 Correspondence of relationships between breeding lines based on marker allele frequencies and marker-marker linkage disequilibrium. C. Andreescu*[1], J. H. Ralph[2], A. Hassen[1], S. J. Lamont[1], and J. C. M. Dekkers[1], [1]*Iowa State University*, *Ames*, [2]*Aviagen Ltd.*, *Newbridge, Edinburgh, UK*.

High-density genotyping of single nucleotide polymorphisms (SNPs) enables detection of QTL associated with traits by linkage disequilibrium (LD) mapping using the existence of LD between markers and QTL. Use of associations detected in one population for use in other populations requires LD between loci to be consistent across populations. To investigate this, we used genotype data for 959 and 398 SNPs on chromosomes 1 and 4 on 96 to 244 individuals from each of 10 commercial broiler chicken breeding lines to evaluate similarities in LD across the lines and compare this to phylogenetic relationships between lines estimated using differences in SNP allele frequencies. Within each line, LD measured by r was computed for all pairs of markers with minor allele frequencies >.2 and that were within 500kb (about 1.4cM) of each other. To evaluate consistency of LD across lines, r values for corresponding pairs of SNPs were correlated between all 10 lines, separately for chromosomes 1 and 4. Resulting LD correlations ranged from 0.19 and 0.97, and values for chromosome 1 and 4 were correlated at a level of 0.75. Relationships between lines suggested by LD correlations were visualized by creating phylogenetic trees for each chromosome, with distances equal to the inverse of the correlation values, using two standard algorithms, UPGMA and Neighbor Joining. Using the same chromosomes and algorithms, we also obtained trees based on allele frequency-derived distances, using all SNPs that were segregating across the 10 lines The topology of trees derived from LD correlations and allele frequency were very similar, although the correlation based trees varied more by chromosome and algorithm in terms of branch distances. The topology also matched the known history of the lines very well. In conclusion, the correlation between LD measured by r between lines for SNPs at short distances is a good predictor of line relationships, although somewhat less so than the typical allele frequency-based distance.

Key Words: linkage disequilibrium, high-density SNPs, phylogeny

54 Genotype by environment interaction measured by reaction norms for Angus bulls in Brazil. E. A. Maricle*[1], J. C Souza[2,3], L. T. Campos[2], R. L. Weaber[1], and W. R. Lamberson[1], [1]*University of Missouri-Columbia*, *Columbia, Mo USA*, [2]*Parana Federal University*, *Brazil*, [3]*Scholarship of CNPq*, *Brazil*.

The effectiveness of selection can be impeded by genotype x environment interaction. Reaction norms are statistical tools useful for evaluating genotype x environment interaction because they can accommodate large numbers of environments with few parameters. The objective of this study was to examine genotype x environment interaction by comparing regressions from reaction norms among Angus bulls from southern Brazil. Dependent variables were birth and weaning weights and preweaning gain. Birth and weaning weights were adjusted for known fixed effects according to B.I.F. Guidelines. Environments were defined as progeny groups with breeder, year born, and season in common. Data were included based on the following criteria: a minimum of five progeny within an environment, four environments per bull, and four bulls per environment (progeny n = 13,758, bulls n = 99, environments n = 219). Reaction norms for each bull were calculated by regressing progeny means within an environment, weighted by number of progeny, on environment means (SAS PROC GLM). Bulls with progeny in ten or more environments had separate regressions calculated for each set of five environments to provide replication for testing differences among bulls. Proportion of variation accounted for by bull and environment were, respectively, for birth weight (R^2 = 0.11, 0.36), weaning weight (R^2 = 0.09, 0.32) and preweaning gain (R^2 = 0.09, 0.30). There were no significant differences among reaction norms which ranged from -1.77 to 4.45 for birth weight, -0.13 to 1.88 for weaning weight, and -1.74 to 1.95 for preweaning gain. Lack of significant differences among bulls for reaction norm may be due to relatively small differences among environments across the region.

Key Words: beef Cattle, genotype × envrionment interaction, reaction norm

55 Segregation of a molecular marker in the TRPC1 gene and itsassociation with growth and carcass traits in beef cattle. J. Bosques*[1], M. Pagan[1], E. Casas[2], D. Cianzio[1], and A. Casas[1], [1]*Univeristy of Puerto Rico at Mayagüez*, *Mayagüez, Puerto Rico*, [2]*USDA-ARS, Roman L. Hurska Meat Animal Research Center*, *Clay Center, NE*.

Genotypic and allelic frequencies of a single nucleotide polymorphism (SNP) in the transient receptor potential protein 1 (TRPC1) gene were determined in Senepol (n =60), Charolais (n = 62), Angus (n = 39), Charbray (n = 43), Brahman (n = 19), Zebu (n=17) and crossbred bulls (n = 132). Genotypic frequencies were 0.81, 0.17 and 0.02 for CC, CG, and GG, respectively. Allelic frequencies were 0.89 and 0.11 for C and G respectively. Frequency of the C allele was greater in Charolais, Senepol, Angus and crossbred bulls than the G allele. In Charbray, Brahman and Zebu animals, only the C allele was observed. Association of this SNP with growth traits was assessed in a subset of the population comprising Senepol, Charolais and Senepol×Charolais bulls (n=113). This marker was associated with estimated daily weight gain at 205 and 240 days, weight at 205 days and weaning weight ($P<0.05$). Animals inheriting the CC genotype grew faster than those inheriting the CG or GG genotypes. Carcass data was obtained from a subset of 24 crossbred bulls. Animals inheriting the CC genotype had heavier *Gluteus medius* and *Gastronecmius* muscle weights than animals inheriting the GG genotype ($P<0.05$). Evaluation of the findings from this study in larger populations needs to be ascertained before it could be used in selection schemes.

Key Words: TRPC1, SNP, beef cattle

56 Genetic relationships between swine maternal traits in different seasons. M. T. Knauer* and M. T. See, *North Carolina State University*, *Raleigh*.

The objective of this study was to determine the genetic relationship between swine maternal traits during different seasons. Records from 45 herds containing 12,102 first parity U.S. Yorkshire females were used in the analysis. Maternal traits including age at first farrowing (AFF), number born alive (NBA), number weaned (NW), litter weaning weight (LWT), and farrowing interval (FI) were divided into seasons using PROC GLM. All models contained herd, year, and farrowing month (birth month for AFF) as fixed effects. Covariates were included for NBA (AFF), NW (AFF and lactation length), LWT (AFF), and FI (AFF, NW, and lactation length). Litter weight was pre-adjusted for number after transfer and age at weighing according to NSIF. Number born alive was not different ($P > 0.05$) between farrowing months and therefore not analyzed further. Age at first farrowing was grouped by birth month into April to July (AFF1) and the rest of the year (AFF2). Number weaned and LWT were grouped by farrowing month into August to December (NW1 and LWT1) and January to July (NW2 and LWT2). Farrowing interval was grouped by farrowing month into June to August (FI1) and the rest of the year (FI2). Means for AFF1, AFF2, NW1, NW2, LWT1, LWT2, FI1, and FI2 were 371.8 d, 377.0 d, 9.0 pigs, 9.3 pigs, 120.5 lbs, 124.6 lbs, 164.2 d, and 158.0 d, respectively. Variance components were estimated with MTDFREML using a sire model and the effects previously stated. Estimated phenotypic variances for AFF1, AFF2, NW1, NW2, LWT1, LWT2, FI1, and FI2 were 1404.74, 1703.16, 3.80, 1.25, 763.46, 727.53, 711.31, and 535.13, respectively. Heritability estimates for AFF1, AFF2, NW1, NW2, LWT1, LWT2, FI1, and FI2 were 0.39, 0.35, 0.14, 0.11, 0.35, 0.31, 0.26, and 0.17, respectively. Estimated genetic correlations between AFF1/AFF2, NW1/NW2, LWT1/LWT2, and FI1/FI2 were 0.76, 0.40, 0.89, and 0.74, respectively. These results show heterogeneous variances for swine maternal traits measured in different seasons. Genetic selection for reduced seasonality in swine may be possible.

Key Words: season, maternal, swine

57 Association between corticotropin-releasing hormone receptor 2 genotypes and meat quality traits in pigs. I.S. Choi*, R. O. Bates, V. D. Rilington, D. B. Edwards, N. E. Raney, M. E. Doumit, and C. W. Ernst, *Michigan State University*, *East Lansing, MI, USA*.

Corticotropin-releasing hormone receptor 2 (CRHR2) is a G-protein-coupled receptor in the secretin family that functions in stress response and energy homeostasis. We have previously identified a *Nla*III

restriction fragment length polymorphism in the pig ortholog of CRHR2 and localized CRHR2 to SSC18. This study investigated the association of CRHR2 with carcass and meat quality traits in a Duroc x Pietrain F_2 population. A total of 443 F_2 pigs were genotyped for CRHR2 and allelic frequencies were 0.62 and 0.38 for the A and B alleles, respectively. The statistical model included the fixed effects of genotype, sex and harvest date, and covariates of carcass weight or harvest age. Additive effects were estimated by comparison of homozygote LS means, whereas dominance effects were calculated as deviations of heterozygotes from the average of homozygotes. Dressing percentage (%), ham and spareribs weights, and loin muscle pH at 45 min and 24 h postmortem, CIE b*, % moisture and protein, cook yield and taste panel analysis of off-flavor were significantly associated with CRHR2 genotype. The CRHR2 alleles exhibited a dominance effect for dressing % and additive effects for the other traits (Table 1). Results of this study revealed associations of CRHR2 genotype with meat quality traits previously shown to be impacted by environmental stressors. Since CRHR2 functions in stress mediated pathways, this gene warrants further study for its potential role to improve stress response and ultimately meat quality.

Table 1. Estimates of significant CRHR2 effects on meat quality traits.

Trait	N	Additive Effect	Dominance Effect
Dressing, %	438	-0.22±0.27	1.15±0.37**
Ham, kg	437	0.22±0.07**	0.03±0.09
Spareribs, kg	436	-0.05±0.02*	0.02±0.03
45 min pH	431	-0.10±0.04**	0.03±0.05
24 h pH	431	-0.05±0.02*	-0.05±0.03
CIE b*	421	-0.35±0.12**	0.31±0.16
Moisture,%	429	0.68±0.22**	0.15±0.30
Protein, %	428	-0.43±0.18*	0.01±0.24
Cook yield, %	434	-1.51±0.46**	-0.37±0.61
Off-flavor, 1-8	435	0.09±0.03**	-0.01±0.04

Key Words: CRHR2, polymorphism, pork quality

58 Principal components for indirect measures of feeding behavior in pigs. J. Young*[1], D. Casey[2], T. See[1], and J. Cassady[1], [1]*North Carolina State University*, *Raleigh*, [2]*PIC*, *Hendersonville, TN*.

The objective of this research was to determine if indirect measures of feeding behavior could be reduced into principal components. Seven indirect measures of feeding behavior, calculated using Feed Intake Recording Equipment (Osborne Industries Inc., Osborne, KY) data, were used in this analysis. They were average number of visits per day (NV), average occupation time per day (OTD) and per visit (OTV), average feed intake per day (DFI) and per visit (FIV), average feeding rate per visit (FR), and variability of daily feed intake (VFI). Data from crossbred gilts and barrows representing 3 sire and 2 dam lines and purebred boars representing 4 lines were analyzed and results were compared. Performance data included growth rate, feed conversion ratio, backfat, and loin depth. Principal component (PC) 1 and 2 collectively explained 89% of the total phenotypic variance associated with NV, OTD, OTV, FIV, and FR. It was determined that PC1 emphasized NV, FIV, and OTV whereas PC2 emphasized FR, OTD, and OTV. Pigs which scored high for PC1 ate longer and consumed more per visit but visited the feeder less often than pigs which scored low for PC1. Pigs which scored high for PC2 ate slower and spent more time in the feeder both by time and by day than those pigs which had low values for PC2. Increasing values for PC 1 were associated with decreasing NV, increasing FIV, increasing OTV, and decreasing OTD. Increasing PC 2 values were associated with decreasing FR, increasing OTV, and increasing OTD. Relationships as determined by regression of performance traits on PC1 and PC2 were variable and inconsistent among purebred lines. Likewise, relationships among performance traits, PC1, and PC2 were inconsistent among crossbred lines It was concluded that PC 1 and PC 2 loaded on similar indirect measures of feeding behavior for both purebreds and crossbreds, and relationships with performance traits were line dependent. It was further concluded that purebred populations differed in their feeding behavior, and these differences were also observed in the crossbred progeny.

Key Words: pigs, behavior, principal components

59 Heritabilities of indirect measures of behavior and their relationships with performance. B. Velie, E. Johnson*, and J. Cassady, *North Carolina State University*, *Raleigh*.

The object of this study was to estimate the heritability of the backtest, resident-intruder test, human approach test (HAT), and novel object test (NOT). Relationships among these indirect measures of behavior and birth weight (BW), weaning weight (WW), average daily gain from birth to weaning (ADGF), backfat depth (BF), and LM area (LMA) were estimated. Each behavior test was performed twice ($n \geq 474$) with a week separating the two tests. Between 7 to 21 days of age the backtest was performed by placing each pig in the supine position for 60 seconds. Total time spent struggling (TTS) and total number of attempts to struggle (TAS) were recorded. The resident-intruder test was performed in the nursery while the human approach (HAT) and novel object test (NOT) were performed on the finishing floor. The resident intruder test involves two pigs; a resident pig and an unfamiliar intruder pig. The resident pen is separated into two sections using a solid divider and all pigs are placed on one side. A resident pig is then moved to the opposite side of the divider for testing and an intruder pig is introduced. Latency until attack (LAT) and total number of attacks over the two tests (RIS) were recorded. The HAT and NOT consisted of recording the amount of time taken for each pig to make snout contact with an unfamiliar human or object. The TTS and TAS were found to have heritabilities of 0.5 and 0.55. Heritabilities of LAT, RIS, HAT, and NOT were low and not different from 0. The phenotypic correlations between TTS and TAS and between HAT and NOT were 0.61 and 0.34, respectively. Total time spent struggling (TTS) and TAS tended to be phenotypically correlated with WW and ADGF. Latency until an attack occurred was found to be phenotypically correlated with BW, WW, ADGFH, BF, and LMA. These correlations were -0.33, -0.38, -0.35, 0.5, and 0.92, respectively. Genetic correlations between TAS and ADGF and BF were 0.1 and 0.29, respectively. Genetic correlations between TTS and BF, and LMA were 0.22, and -0.22, respectively. It was concluded that the backtest is a heritable measure of behavior which is correlated with performance.

Key Words: pigs, genetics, behavior

60 Heritability of the backtest in pigs. K. Gray*, B. Velie, and J. Cassady, *North Carolina State University*, *Raleigh*.

Understanding the phenotypic and genotypic relationships among pig behavior and economically important traits is necessary for the design of welfare conscious swine improvement programs. The objective of this study was to estimate the heritability of the backtest in a Hampshire-Duroc Composite population of pigs. Data were available on two generations and two lines. One line was previously selected for an index including backfat and days to 105 kg (S) and the second was a control line (C) maintained by selecting individuals with index values as close to 0 as possible. The current study includes two generations consisting of 46 sires and 131 dams. All pigs (n=892) were tested two times for the backtest. The backtest is performed by placing the pig on its back in a supine position for 60 s. The pig's hind legs were gently extended and number of bouts of struggling (BTS) and the total amont of time struggling (TTS) over the course of two tests were recorded. Pigs were first tested between 7 and 15 days of age. The test was repeated 1 week later when pigs were between 14 and 21 days old. Variance components were estimated with MTDFREML using a two-trait Animal Model which included fixed effects of year and line and a maternal effect. Heritabilities of TTS and BTS were moderate, being 0.40 ± 0.08 and 0.33 ± 0.07, respectively. The genetic correlation between TTS and BTS was 0.78 ± 0.07. It was concluded that the backtest is a heritable indirect measure of pig behavior. Further analysis is planned to estimate the genetic relationship between TTS, BTS, ADG, days to 105 kg, backfat, and LM area.

Key Words: pigs, behavior, genetics

Dairy Extension

61 Research in applied dairy cattle nutrition. M. L. Eastridge*, *The Ohio State University*, *Columbus*.

Over the past several years, research has provided advancements in improving feed efficiency and animal health by improving quality of feeds, increasing feedstuff and overall diet digestibility, better defining interactions among feedstuffs in diets, identifying alternative feed ingredients, better defining nutrient requirements, and improving efficiency of ruminal fermentation. Forages have been studied more extensively than any other type of feed. Cereal grains continue to be the primary contributors of starch to diets, and processing of cereal grains has improved their utilization. Many by-products provide a considerable amount of protein, nonforage fiber, fat, and minerals (sometimes a detriment as in the case of P) to diets. The primary feeding system today is the total mixed ration, with still considerable use of the pasture system. Advancements have been made in feeding practices to minimize the risk of metabolic diseases, yet the periparturient period continues to present many challenges. Continued research in applied dairy nutrition is needed: 1) although milk production per cow increases about 2% per year and efficiency of this milk production has increased immensely, more efficient use of nutrients must occur to provide the metabolic needs of the animal and to control the costs of milk production, 2) feedstuffs continue to change with new cultivars and processing methods, 3) costs of production have been increasing with minimal improvement in prices paid to producers, and 4) new forces in animal welfare and environmental stewardship (air and water) will affect the design of feeding systems and dietary formulations. However, these needs for research continue to face challenges from lack of independent funding, rising costs of conducting research (direct and indirect costs), and less availability of resources (facilities and human capital) for controlled research. An inadequate number of students are being trained as scientists and for employment in the feed industry. Additional partnerships among universities and industry are necessary to identify the specific research needs and funding sources and to recruit students into dairy cattle nutrition programs.

Key Words: nutrients, feeding systems, research

62 Challenges for feeding dairy cows in the next decade. M. Hutjens*, *University of Illinois*, *Urbana*.

A survey of extension educators, consultants, and veterinarians was conducted in spring of 2006 to evaluate feeding challenges in the next five to ten years. A total of 54 electronic responses was summarized from 27 veterinarians, 17 consultants, and 16 educators (several individuals indicated more than one occupation). Each individual listed up to five feeding challenges and selected one topic that was their most important focus area. Forage quality was listed as first choice by 16 individuals with nitrogen and phosphorous excretion as the second choice (10 votes). Other areas were ethanol and distillers grain opportunities, ration formulation, and fiber digestion. A total 270 individual topics were listed by 54 respondents and summarized in the following broad areas (value listed in parenthesis indicate number of votes).

Feed nutrient applications (68)
Forage considerations (48)
Feed bunk management (44)
Economics of feeding (38)
Health applications (28)
General areas of interest (21)

Additional survey information will be presented based on a Hoard's Dairyman article and groups using the survey instrument. A parallel survey conducted in 2001 will be compared to the 2006 survey. Applications for dairy managers, researchers, agri-business personnel, and teachers will be discussed.

Key Words: dairy, survey, challenges

63 Evaluation of carnitine for fatty liver prevention in dairy cows. D. B. Carlson* and J. K. Drackley, *University of Illinois*, *Urbana*.

Key metabolic and physiologic adaptations occur during the periparturient period of dairy cows in preparation for the metabolic

demands of lactation. Suboptimal adaptation to lactation can result in excess liver triglyceride (TG) accumulation and a myriad of related metabolic disorders. Liver TG accumulation is influenced by the degree of adipose tissue lipolysis and the balance between hepatic fatty acid oxidation and TG export. Carnitine stimulates both hepatic fatty acid oxidation and gluconeogenesis in liver of nonruminants. We postulated that carnitine supplementation would stimulate hepatic oxidation of nonesterified fatty acids (NEFA), decrease liver TG accumulation, and enhance hepatic glucose output. To establish the effects of carnitine during negative energy balance, carnitine (20 g/d; 9-d duration) was infused into the abomasum of lactating cows fed for either ad libitum or restricted feed intake (50% restriction; 5-d duration). Carnitine infusion increased in vitro fatty acid oxidation by liver slices and prevented liver TG accumulation in feed-restricted cows. Abomasal carnitine infusion markedly increased carnitine concentrations in liver, muscle, milk, and plasma. Feed restriction increased carnitine concentrations in muscle and milk, but not liver, from cows infused with water. In periparturient dairy cows, carnitine was supplemented in the diet at 0, 6, 50, or 100 g/d from d -14 until d 21 relative to calving. All amounts of carnitine decreased liver TG accumulation, which resulted from enhanced hepatic fatty acid oxidation because carnitine did not affect serum NEFA concentration. Dietary carnitine increased in vitro conversion of alanine to glucose by liver slices as well as concentrations of liver glycogen and serum insulin. Dietary carnitine supplementation (50 and 100 g/d) markedly increased liver, muscle, milk, and plasma carnitine. Supplementation of 6 g/d increased milk carnitine and numerically increased carnitine in liver and muscle. By decreasing the incidence of fatty liver, peripartal carnitine supplementation might improve health and productivity of dairy cows.

Key Words: L-carnitine, dairy cow, liver

64 Utilization of amino acids for milk protein synthesis by lactating dairy cows fed distillers grains plus solubles (DDGS). D. H. Kleinschmit*[1] and D. J. Schingoethe[2], [1]*Agri-King, Inc.*, *Fulton, IL*, [2]*South Dakota State University*, *Brookings*.

The rapid growth of the ethanol industry in the Midwest has generated large quantities of DDGS that are available for dairy cattle. As a result, this coproduct is relatively inexpensive compared to other commonly used protein sources. However, manufacturing practices, particularly the drying process, vary among ethanol plants; therefore, the DDGS produced in one may differ considerably from that produced in another. Lysine is the first amino acid (AA) damaged during the drying process, which is a major concern in this coproduct because Lys is already the first-limiting AA in corn for milk protein synthesis. In a series of experiments, ruminal CP degradability and intestinal digestibility varied among sources of DDGS and Lys was the first-limiting AA in all sources, but no differences on lactation performance were observed among three of the DDGS sources when fed to dairy cattle. All three sources increased yields of milk, 4% fat-corrected milk, and energy-corrected milk and improved feed efficiency compared to soybean meal. Some field reports suggested milk fat depression when cows were fed DDGS, but our research and that of others showed no fat depression unless diets contained insufficient amounts of effective fiber. Feeding DDGS can decrease milk protein percentages, which, based on arterial Lys concentrations, was due to an AA deficiency. Past research indicated that DDGS may be complementary to alfalfa-based diets because alfalfa provides more Lys and RDP compared to that in corn silage. A final experiment evaluated diets containing increasing concentrations of alfalfa in place of corn silage when fed with DDGS at 15% of the diet. Milk yield, protein yield, and feed efficiency increased linearly with increasing alfalfa due to an increased uptake of essential AA, particularly Lys, by the mammary gland. Overall, good quality DDGS can be successfully used in dairy feeding programs as long as the diets are not limited in RDP or Lys and adequate effective fiber is provided.

Key Words: dried distillers grains plus solubles, amino acids, dairy cattle

65 Conducting on-farm research to generate good data. M. T. Socha*, D. J. Tomlinson, J. M. DeFrain, and T. L. Ward, *Zinpro Corporation*, *Eden Prairie, MN*.

Companies have interest in conducting research on commercial dairies. First, access to a large number of cows enables researchers to obtain sufficient replications to generate statistical power on parameters such as fertility and lameness while reducing the amount of time to obtain required cow numbers. Many universities are unable or unwilling to commit large numbers of cows to a single study. Secondly, researchers are able to examine response to products under commercial management, environmental and nutritional conditions. Tie stall/stanchion facilities used in some universities do not reflect housing conditions and social interactions encountered by cows on most commercial dairies. Finally, some dairy professionals desire data obtained on commercial dairies. Obtaining meaningful data from studies conducted on commercial dairies present a number of challenges including replication, obtaining equally matched treatment groups and having sufficient labor to insure study protocol is followed. A limited number of commercial dairies are capable of conducting adequately controlled studies. Commercial dairies that are good candidates for conducting research have the capability of assigning two or more groups of cows to each treatment or have computer feeders in pens to deliver treatments individually to cows, enabling cows from different treatments to be housed in the same pen. These dairies have a high level of management enabling them to carry out study protocol and devote either a full or part-time employee to the study to insure protocol is followed. These dairies are capable of collecting daily milk weights and are willing to collect milk samples, monthly if not biweekly. In the experience of the authors, equally matched groups of cows are best obtained when a large number of cows are randomly assigned to the study prior to calving. Due to research constraints and the requirement for extra labor, companies assessing efficacy of products on commercial dairies must provide financial support to commercial dairies conducting research, beyond providing product.

66 Statistical issues pertaining to on-farm and experiment station research. R. J. Tempelman*, *Michigan State University*, *East Lansing*.

Animal science research has been conducted under various environmental and management conditions, ranging from highly controlled

agricultural experiment stations to somewhat more variable on-farm settings. There are statistical issues raised in evaluating both types of research, such as inference space, experimental protocol compliance, definition of experimental units, randomization, validation of results, treatment by environment interaction and the nature and extent of response and concomitant variables recorded. A discussion of these and other topics, including the utility of combining both types of research, will be addressed.

Key Words: on-farm, statistical inference, experimental units

67 Best management decisions about the use of co-products from production of ethanol, bio-diesel, or human foods for managers of beef or dairy farms in Indiana. T. Johnson*, M. Schutz, K. Ileleji, K. Foster, and B. Joren, *Purdue University*, *West Lafayette, IN*.

Co-products from the production of bio-fuels and human foods like corn sweeteners and starch, has led to a highly distributed delivery of wet co-product feeds in a 50 to 70 mile radius around the site of co-product production. Grain producers located near sites of production have the opportunity to engage in marketing and distribution and setting up bagging and storage of corn co-products and other by-product feeds. This business practice has been successfully instituted by several producers in different area of Indiana. The great influx of new ethanol distilleries and the establishment of at least one large soy oil bio-diesel plant in Claypool, IN present a unique opportunity for additional parties to provide trucking, storage and feeding consultation services. The storage of wet distillers' grains becomes necessary because of it's short shelf life. The addition of fibrous diluents is needed to allow storage in silo bags for longer term storage on small and medium sized beef and dairy operations. Balancing diets fed on a dry matter, effective fiber and available P and N basis, and adjusting the amounts of diluent feeds included with wet DGS is necessary to manage diet N to P ratio, mineral and total ash level and encourages use of the Beef NRC 2000, Dairy NRC 2001, CPM 3.0, and other software for diet formulation or calculation of whole farm nutrient flows.

Key Words: dairy cattle, co-products, distillers' grains

68 Effect of feeding a commercial colostrum substitute on risk for transmission of mycobacterium avium subsp. paratuberculosis in newborn calves— descriptive preliminary data. P. Pithua*, S. M. Godden, and S. J. Wells, *University of Minnesota*, *St. Paul*.

The objective of this study was to determine the effect of feeding fresh bovine colostrum versus a commercial colostrum substitute on risk of onset of subclinical Mycobacterium avium subsp. paratuberculosis (MAP) infection. Participation was solicited from 12 commercial dairy herds from which calves were enrolled into the study between July and September, 2003. Within 30 to 60 minutes prior to having an opportunity to suckle, calves were separated from their dams and systematically assigned to be fed either 4 liters of fresh bovine maternal colostrum or 2 liters of a commercial colostrum substitute (Secure®, American Protein Corporation. Ames, IA), mixed and fed as per the manufacturers instructions. Calves were assigned to one of two treatment groups based on the colostrum received. The treatment group comprised of calves that received commercial colostrum substitute and the control groups were those calves that received fresh maternal colostrum. A total of 433 calves were recruited to the study at time of enrollment of which 232 (54%) were fed maternal colostrum (control group) while 201 (46%) were fed colostrum substitute (treatment group). Of these initial total, 103 (23.8%) were lost to follow-up due to a variety of reasons ranging from routine culling to death. At approximately 24 months of age, 330 (76.2%) cows were tested using conventional culture method for the isolation of MAP and ELISA (IDEXX Laboratories, Inc. Westbrook, ME) for detection of serum antibodies for MAP. Three hundred and twenty-two (322) cows had results for both ELISA and culture tests while 8 cows had results for fecal culture only. All the latter samples tested negative. The distribution of serum ELISA and fecal culture test results by group are shown (Table 1).It is worth noting that no conclusions can be drawn from the data presented here until the study is completed.

Distribution of fecal culture and serum ELISA test results by group

	Serum ELISA		
Group	Positive(%)	Negative(%)	Total
Maternal colostrum	9 (5.3)	162 (94.7)	171
Colostrum substitute	5 (3.3)	146 (96.7)	151
Total	14 (4.4)	308 (95.6)	322
	Fecal culture		
Group	Positive(%)	Negative(%)	Total
Maternal colostrum	14 (8.2)	157 (91.8)	171
Colostrum substitute	8 (5.3)	143 (94.7)	151
Total	22 (6.8)	300 (93.2)	322

Key Words: mycobacterium avium subsp. paratuberculosis, commercial colostrum substitute, fresh maternal colostrum

69 Statistical analysis of the effect of bovine somatotropin on reproduction and calving ease in commercial Holstein herds. M. Geha*[1], J. F. Keown[1], and L. D. Van Vleck[1,2], [1]*University of Nebraska*, *Lincoln*, [2]*U.S. Meat Animal Research Center*, *Clay Center, NE*.

Records involving 134 Holstein herds, having both bovine somatotropin (BST) treated and non treated cows, totaling approximately 100,000 cows in their second, third and fourth lactations from 1994 to 2002, were used to analyze the effect of BST on reproduction and calving ease. Using SAS MIXED and GLIMMIX procedures, records of cows in the same lactation with herd by year, season and milking frequency as a random factor, were analyzed for number of days open (DO), number of services (NS) and culling for reproductive problems (CRP). Similarly, records of cows, with herds by year treated as a random factor, were analyzed for calving ease (CE). The analyses showed that for all lactations, there was a significant treatment by year interaction ($P<.05$) for DO and NS, with noticeably greater estimates for the years 1994-1997 compared to later years, which could be interpreted as how

long it took management practices to adapt to requirements of treated cows, rather than as a direct impact of the treatment itself. For all lactations, treated cows had more days open and more services per breeding cycle than non treated cows. Year by treatment interaction was significant for CRP for lactation 2 ($p<0.01$) with slightly higher probabilities of problems for BST treated cows, but with no significant differences for later lactations. This result can be interpreted as a negative response of younger cows to higher production stress on their reproductive performance as compared to older cows. Culling frequencies seemed to drop after 1997 which may also indicate management adjustment. For calving ease, there was no direct treatment effect, but rather the sex of the calf had the greatest impact with twin calves having most calving difficulty followed by bull and heifer calves. Because of lack of data, it was not possible to look at the effect of BST on the size of the calf born.

Key Words: bovine somatotropin, reproduction, calving ease

70 Comparison of reticular and rectal core-body temperatures in lactating dairy cows. J. M. Bewley*[1], M. W. Grott[1], D. C. Batson[2], and M. M. Schutz[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*MaGiiX Inc.*, *Post Falls, ID*.

Automatic temperature recording may be used for dairy management and allow early detection of disease, estrus, heat stress, pregnancy, and the onset of calving. The MaGiiX™ Cattle Temperature Monitoring System (CTMS, MaGiiX Inc., Post Falls, ID) utilizes a passive bolus equipped with a temperature sensor, a panel reader placed at a parlor entrance or exit to query the bolus, and a software package to collect, analyze, and view data. The biologically inert bolus resides in the cow's reticulum and is queried each time the cow passes the reader (e.g. two or three times per day after milking). Reticular and rectal temperatures were recorded simultaneously in the exit lane from the milking parlor for eight milkings on four days (5/30/06, 5/31/06, 9/27/06, and 9/28/06) for all cows at the Purdue Dairy Research and Education Center. Reticular temperatures (CTMS) were obtained using the MaGiiX CTMS while rectal temperatures (GLA) were obtained manually with a GLA M750 thermometer. Data was cleaned by removing any observations where either CTMS or GLA differed by more than 3 standard deviations from the unedited means for the study period or where the time between recording of the two temperatures differed by more than 30 minutes. Unadjusted mean CTMS and GLA for the remaining 905 observations were 39.4°C (±0.4) and 38.9°C (±0.3), respectively. The CTMS and GLA were strongly and significantly correlated ($r=0.642$, $p<0.0001$). As dairy producers and veterinarians are accustomed to viewing rectal temperatures, equations to adjust reticular temperatures to a rectal-based scale may increase the utility of the MaGiiX CTMS. PROC GLM of SAS was utilized; and the following conversion equation was obtained: $GLA=415.95436-19.72644*CTMS+ 0.25776*CTMS^2$ ($R^2 =0.44$). The effects of both the linear and quadratic coefficients were highly significant ($p<0.0001$).

Key Words: temperature monitoring, reticular temperature, biosensors

71 Animal identification on the farm: Past, present, and future. E. D. Reid*, *University of Illinois*, *Urbana*.

Producers have used identification (ID) of livestock for over 3,800 years as a method of assigning ownership. However, the methods used to identify animals have seen little change during the past four millennia. In contrast, the past two decades have brought about the widespread use of personal computers, animal databases, genetic tracking, and new ways to use ID to manage animals on the farm. Despite the trend for production units to increase in size to capture efficiencies of scale, the need to provide individual attention to animals remains the same. Individual animal ID allows for efficient movement of animals at each stage of production in and out of contemporary groups or facilities as needed. This also allows producers to tailor programs to ensure each animal receives optimal management, but that level of decision making involves tremendous labor input. New technologies, such as radio frequency identification (RFID), allow for greater efficiency of data collection and also a reduction in the error involved with data collection. Today, it is possible to segregate individual animals within a large group at a walk-through collection point without someone present. In addition, current data can be linked to past data and be used cow-side to provide decision support to manage those animals more efficiently in real time. The technology continues to evolve and allows for additional value beyond individual ID. For example, previous work has shown a negative correlation between rectal temperature and the temperature of implanted microchips during a fever response in steers as well as positive correlations between the two methods during periods of heat stress in cows. Less labor is used collecting temperature data with RFID and allows more time to be spent on animal care. Future opportunities may allow for the ability to monitor real-time hormone fluctuations as well as for foreign DNA (disease identification). As these technologies advance, producers will be able to identify issues and opportunities faster and become more efficient in the management of their animals.

Key Words: identification, RFID, biosensors

72 The fire within: Does inflammation contribute to periparturient metabolic dysfunction? N. A. Janovick-Guretzky* and J. K. Drackley, *University of Illinois*, *Urbana*.

Despite several decades of research focused on management of cows during the transition period, there is still no consensus on how to nutritionally manage these cows. Increasing energy intake prepartum has been recommended to combat drops in dry matter intake that occur before parturition. Recent research, however, suggests that controlling energy intake before parturition results in a more favorable metabolic state postpartum. Over-consumption of energy prepartum is linked to greater risk for metabolic disease, even when cows are not over-conditioned during the dry period. But what is driving the problems observed with over-consumption of energy prepartum? In human and rodent research, overnutrition results in immunoactivation, triggering a catabolic state that ultimately interferes with insulin signaling. Adipose tissue contributes to circulating inflammatory cytokines such as TNF-α, IL-1, and IL-6, which are linked to insulin resistance. Over-consumption of energy prepartum might increase the release of cytokines from adipose tissue around parturition, creating an insulin resistance-like response and excessive lipolysis in adipose tissue.

These conditions ultimately contribute to fatty infiltration of the liver, causing tissue damage and interfering with the liver's ability to perform needed functions. We have conducted longitudinal studies of mRNA transcripts in liver from transition cows fed different amounts of energy prepartum. Our data have revealed evidence for an inflammatory-like response in the liver around parturition. It remains unclear if inflammation leads to fatty infiltration of liver and metabolic dysfunction, or if fatty liver results in inflammation which induces metabolic distress. Research is ongoing to sort out this puzzle and to discover the links among energy intake prepartum, liver health, and the role of adipose tissue in metabolic dysfunction.

Key Words: periparturient cow, energy intake, inflammation

73 Direct measure of the depression between *Ischial tuber* (hook) and *Coxae tuber* (pin), as an alternative to change in body condition score in assessing body tissue mobilization. M. J. Daehnert*, N. E. Lobos, R. R. Rastani, and M. A. Wattiaux, *University of Wisconsin*, *Madison*.

Our objective was to determine the feasibility of using the Ischium Ilium depression (IID) as an indicator of body tissue mobilization during the transition period. Ten primiparous and 11 multiparous Holstein cows were housed in tie-stall barn and fed the same pre- and post-calving diets. A measuring device was placed across the dorsal tips of the Ilium and Ischium. The distance and mid point between the bones was recorded. The vertical distance between the ruler and the surface of the skin was recorded at the midpoint and 10 cm on each side to capture the deepest depression. Measurements were performed on the right and left sides of the standing cow at -14, + 1, +21 d relative to calving. Body weight was recorded on the same day. In addition, body condition score (BCS, on a scale of 1 for emaciated to 5 for obese) was assessed weekly by two individuals. Statistical analysis was conducted using a mixed model with parity, time and interactions as fixed effects and cow within parity as the random effect. Spearman correlations were also determined. For multiparous cows, IID was greater than primiparous cows (5.45 and 4.37 cm, respectively; $P < 0.02$) and was 4.26, 4.84, and 5.64 cm at -14, +1, and +21 d respectively ($P < 0.001$). P value for interaction was 0.26. For multiparous cows, BCS was less than primiparous cows (3.0 and 3.2, respectively; $P < 0.10$) and was 3.3, 3.0, and 3.0 at -14, +1, and +21 d respectively ($P < 0.001$). P value for interaction was 0.52. The IID (n=63) was correlated with BCS (r= -0.44; $P < 0.001$), but not with BW (r= 0.11; P= 0.41). The difference in IID over time (from -14 to +21 d) was correlated with the difference in BCS over the same time period (r= -0.55; $P < 0.001$), but not with the difference in BW (r= -0.25; P= 0.27). The IID is less subjective than BCS. Validation of IID is required before using it as a tool to assess short term changes in body tissue reserves.

Key Words: body weight, body condition score, dairy cow

74 Managing the grazing wedge in a pasture-based dairy system. S. Hamilton*, T. Rickard, R. Kallenbach, B. Steevens, J. Horner, and R. Milhollin, *University of Missouri*, *Columbia*.

The most challenging aspect of dairy management-intensive grazing (MIG) is monitoring and measuring forages in the overall system. Traditional dairies can quantify the amounts of silage or hay and determine anticipated deficits or surpluses and develop feeding plans that will minimize purchased forages. MIG operations also maintain an inventory of stored forages, but attempt to minimize use since data indicates these stored forages cost four to five times more per pound of dry matter than that from pasture (excluding land costs). Several methods have been used to estimate dry matter yield of pastures. The most accurate, but time consuming method, is clipping and drying quadrants from each paddock. However, this procedure does not lend itself to repeated measurements on each paddock every seven to ten days due to time constraints. Another method involves a measuring stick and using assumed values of dry matter per acre inch. This procedure reasonably estimates yield, but a miss diagnosis of forage density will lead to large variance of estimated quantities. A new pasture measurement tool, a rising plate-meter, accounts for both forage density and height. During the 2006 pasture season seven MIG dairies in southern Missouri regularly measured paddocks using electronic rising plate-meters. Each weeks measurement was summarized in a graph and allowed the producer to visualize the quantity of dry matter available in each paddock. The graph allowed the producer to identify the order of paddocks to be grazed, whether paddocks were over or under-grazed and which paddocks should be pulled from the rotation and harvested as surplus forage. The graphs allow management to quickly access the total pasture system and make immediate changes to assure availability of high quality forages for the grazing animals.

Key Words: grazing, forage, dairy

David H. Baker Amino Acid Symposium

75 Role of amino acids in regulating muscle protein synthesis. R. R. Wolfe*, *University of Arkansas for Medical Sciences*, *Little Rock*.

We have performed a series of experiments to quantify the role of amino acids in the regulation of muscle protein metabolism in human subjects. Muscle protein synthesis is stimulated by an increase in plasma amino acid concentrations whereas it is suppressed by a decrease in plasma amino acid concentrations. An increase in only the essential amino acids is required to stimulate synthesis. There is a dose-response to amino acid intake, and a limitation in the extent to which amino acids can stimulate synthesis. In certain circumstances a disproportionate increase in leucine will further augment the synthetic response. Activation of eukaryotic initiation factors may play a role in the stimulation of muscle protein synthesis by amino acids, but availability and charging of tRNA may also play a role.

Key Words: human subjects, stable isotope tracers, essential amino acids

76 Effect of moderate reduction in dietary crude protein concentration with crystalline amino acid supplementation on intestinal protein synthesis in young growing pigs. R. Tabet[1], B. J. Bequette[2], J. Moore[1], J. Liesman[1], and N.L. Trottier*[1], [1]*Michigan State University*, *East Lansing*, [2]*University of Maryland*, *College Park*.

Ten barrows (14.6 kg ± 0.37) were used to test the hypothesis that moderate reduction in dietary CP concentration with crystalline amino acid (CAA) supplementation reduces intestinal protein synthesis. Pigs were offered feed twice daily at 0800 and 1600 of either a corn soybean meal-based Control diet (17.37% CP, analyzed) or a low crude protein diet (14.07% CP, analyzed) containing CAA (Low CP), i.e., L-lysine•HCl, DL-methionine, L-threonine, L-tryptophan and L-cystine. Pigs were surgically fitted with indwelling jugular catheters, and on d 21, a flooding dose containing L-[2H3-ring]-phenylalanine and unlabeled phenylalanine was administered into the jugular vein catheter to measure fractional rates of protein synthesis (FSR) along the small intestinal tract. Blood samples were collected 5 min prior to infusion, and 5, 10, 15, 25, and 35 min post infusion. Immediately following the 35 min blood sampling, pigs were euthanized and intestinal tissue samples, i.e., whole tissue (WT) and mucosa (M) were obtained from the duodenum, jejunum and ileum. Phenylalanine enrichment in plasma, tissue and tissue free pool was determined by gas chromatography mass spectrometry and FSR were calculated using the precursor pool estimated as the area under the isotopic enrichment v. time curve of plasma free phenylalanine. In the M and WT, FSR did not differ between the Low CP and Control diet (60.7 v. 57.71 ± 2.65% and 51.67 v. 52.18 ± 2.53%, respectively). In the M, FSR did not change across intestinal segments, but in WT, FSR was lower ($P \leq 0.1$) in the ileum compared to that of other segments for both diets. Overall, M FSR was higher than that of WT for both diets, i.e., Control ($P \leq 0.1$) and Low CP + CAA ($P \leq 0.05$). Our results demonstrate that 1) reducing dietary CP by 3.3 % with CAA supplementation does not affect intestinal protein synthesis, neither in mucosa nor in whole tissue; 2) whole tissue rather than mucosa FSR vary along the intestinal segments. Results indicate that reducing dietary CP by 3.3% with CAA supplementation maintains intestinal protein synthetic functions.

Key Words: intestine, protein synthesis, pig

77 New concepts in amino acid nutrition of gestating and lactating sows. G. L. Allee* and P. Srichana, *University of Missouri*, *Columbia*.

There is very little published data on the amino acid requirements of highly prolific dam lines fed corn soybean diets during gestation and lactation. Most of the published studies were done with sows that are considerably fatter and had much lower levels of production than our modern sows. This paper will review recent advances in the amino acid nutrition of modern prolific sows during gestation and lactation. Specific topics to be addressed will include: supplemental arginine during gestation, lysine requirement during various stages of gestation, use of crystalline amino acids and feeding frequency. Lactation studies will be presented utilizing a computerized feeding system that allows ″true ad libitum″ feed intake and determination of daily sow feed intake. Lactation studies will be presented on the lysine requirement of parity one females and the use of reduced protein, amino acid supplemented diets on litter performance and subsequent reproductive performance.

Key Words: sow, gestation, lactation

79 Peptide absorption — the physiological process and nutritional relevance. K. E. Webb, Jr.*, *Virginia Tech*, *Blacksburg*.

An important body of literature has accumulated over the last 20 yr that is helping to define the physiological relevance of peptide absorption. We are no longer limited to speculating about the possibility that peptide absorption occurs, we now are aware of the existence of special proteins that are responsible for transmembrane movement of peptides from the gastrointestinal tract and that peptide transport into the absorptive cells of the intestine likely accounts for the major portion of absorbed amino acids. The mRNA for some of these transport proteins have been cloned and the structural and functional characteristics of the encoded proteins have been determined. As the basis for understanding peptide absorption has grown, so also has the interest of animal scientists. The interest of animal scientists is to explore the appropriate dietary foundation of nutrient absorption that will result in the desired growth, development, and production in animals. Important in this regard is understanding peptide absorption from the gastrointestinal tract. Also, knowing what, if any, role peptides may have as sources of amino acids for protein synthesis in different tissues and how they might be involved in controlling this process is of interest. Understanding how intestinal transport of peptides may be regulated is also of interest. Results from studies designed to evaluate the efficacy of dietary peptide preparations are beginning to emerge. Understanding how amino acids are absorbed and distributed to tissues and how peptides contribute to this process will aid in our being able to develop feeding regimens to assure the desired animal growth, development, and production.

Key Words: amino acid, intestine, nutrient transporter

81 The Effect of Level of Starch in the Growing Phase on Performance and Carcass Traits. P.S. Bedwell*, D.B. Faulkner, D.F. Parrett, L.L. Berger, and F.A. Ireland, *University of Illinois*, *Urbana, IL*.

Two hundred Simmental x Angus steers (BW=155 ± 29 kg) were utilized to determine the effect of level of starch during the growing phase on performance and carcass traits. Four diets were investigated during the growing phase with six replications per treatment. Diets were: 1) High Starch (71% corn:0% soy hulls); 2) Intermediate Starch (47% corn:23% soy hulls); 3) Low Starch (23% corn:47% soy hulls); 4) No Starch (0% corn:71% soy hulls). The diets were isonitrogenous, with hay, soybean meal, and mineral mix making up the remainder of diet. Steers were early weaned at an average of 65 d and after a 57 d adaptation period, randomly assigned to one of the four diets. The growing phase lasted 105 d after which steers were placed on a common finishing diet (83% corn, 10% hay, and 4% soybean meal) for 172 d. Ultrasonic marbling, back fat, and rib eye data were collected after 105 d on feed. All steers were implanted three times with the last time occurring 90 d before harvest. Steers were harvested at 399 d of age and carcass measurements were obtained. During the growing phase, ADG and gain:feed decreased linearly (P<0.01) as amount of fiber increased. A quadratic response was observed (P<0.02) for DMI; low starch cattle were the highest and no starch cattle were the lowest. At the end of the growing phase, ultrasound percent intramuscular fat, back fat, and ribeye area/hundred weight linearly decreased (P<0.05) as fiber levels increased. During the finishing phase, ADG and DMI increased linearly (P<0.01) as the amount of fiber fed previously increased. For overall performance, no significant differences were observed. There were no significant differences in carcass characteristics at harvest. Higher rate of gains in the finishing phase, as starch was decreased, may have reduced the earlier marbling difference. Introducing high levels of starch during the growing phase increased 105 d IMF, but differing rates of gain during the finishing phase may have reduced these marbling differences at harvest.

Key Words: starch, steers, marbling

82 Nutrient digestibility in growing pigs fed wheat-based diets supplemented with phytase and xylanase alone or in combination. T. A. Woyengo*[1], J. S. Sands[2], W. Guenter[1], and C. M. Nyachoti[1], [1]*University of Manitoba*, *Winnipeg, MB Canada*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*.

An experiment was conducted to evaluate the effect of supplementing wheat-based diets with phytase and xylanase alone or in combination on nutrient digestibilities in growing pigs. Six crossbred barrows (Yorkshire-Landrace and Duroc; initial BW = 35.1 ± 1.6 kg) fitted with T-cannula at the distal ileum were fed 4 wheat-based diets in a 4 x 4 Latin square design with 2 added columns. Diet 1 was a basal diet with Ca and available P reduced by 16 and 30% compared with NRC (1998) values. Diets 2, 3 and 4 were the basal diet supplemented with phytase at 500 FTU/kg, xylanase at 4000 XU/kg, and phytase at 500 FTU/kg plus xylanase at 4000 XU/kg, respectively. Chromic oxide (0.5%) was added as a digestibility marker in all diets. No interactions were detected (P > 0.05) between phytase and xylanase on all parameters measured except ileal digestibility of Lys, Val, Ala, Asp and Gly for which the 2 enzymes interacted negatively (P < 0.05). Phytase did not affect (P > 0.05) DE, and apparent ileal and total tract DM, OM, and CP digestibilities, and ileal AA digestibilities, but increased (P < 0.05) ileal and total tract digestibility of Ca and P by 11.6 and 21.3% and 7.8 and 22%, respectively. Xylanase did not affect (P > 0.05) DE, and the apparent ileal and total tract digestibility of DM, OM, Ca and P, but increased (P < 0.05) the ileal digestibility of Lys, Leu, Phe, Thr, Asp, Gly and Ser by a mean of 3.3%. Inclusion of xylanase to a diet containing phytase numerically improved DE, and ileal OM, CP, Ca, Arg and Pro digestibilities, and total tract OM, energy and P digestibilities. The results suggest that phytase supplementation of a low Ca and available P wheat-based diet can improve Ca and P digestibilities whereas xylanase supplementation can improve apparent AA digestibilities. Further, supplementation with a combination of phytase and xylanase may improve the DE, and Ca, P digestibilities, and digestibility of some AA.

Key Words: phytase, pig, xylanase

83 In vitro maturation of porcine oocytes in two defined media with and without gonadotropins. JL Lowe* and RL Krisher, *Purdue University*, *West Lafayette, IN USA*.

To completely understand the energy substrate requirements of the oocyte, as well as to compare experimental results between laboratories, it is important to develop defined conditions for successful oocyte maturation. The objective of this experiment was to compare the efficacy of four defined media for porcine oocyte maturation. For comparison, a standard (STND) medium consisting of TCM199 supplemented with 10% porcine follicular fluid, 0.01UI/ml FSH and LH, and 10 ng/ml EGF was used. Two base media, TCM199 and Purdue Porcine Medium (PPM) were supplemented with fetuin and recombumin as protein sources, 100 ng/ml EGF, 0.5mM citric acid, and 0.5mM cysteamine and 1X ITS, with (TCM+G; PPM+G) and without (TCM; PPM) 0.01 UI/ml pFSH and pLH. Cumulus oocyte complexes were recovered from abattoir ovaries and matured 42-44hrs. After maturation, oocytes were fertilized in mTBM and cultured in NCSU23. Development was assessed at 144hpi. ANOVA was used to analyze results. A significantly higher average meiotic score (1=GV, 7=MII) was achieved after maturation in STND (5.9± 0.3), TCM (5.8 ± 0.3) and TCM+G (5.8 ± 0.3) than in PPM (4.2 ± 0.5) or PPM+G (4.2 ± 0.5). There were no differences in the mean number of pronuclei present after fertilization. A higher (P≤0.05) percentage of embryonic cleavage resulted after maturation in STND (53.9 ± 3.0) than any of the experimental media. However, the standard medium resulted in fewer (P≤0.05) blastocysts as a percentage of total oocytes than any other media tested (STND, 1.9 ± 0.7; TCM, 5.2 ± 1.1; TCM+G, 6.1 ± 1.6; PPM, 2.6 ± 0.8; PPM+G, 4.4 ± 1.2). Both TCM media tended (P≤0.09) to result in better blastocyst development as a percentage of cleaved embryos than the standard medium, but were not different than either PPM media (STND, 4.1 ± 1.6; TCM, 17.9 ± 4.1; TCM+G, 23.0 ± 6.6; PPM, 13.4 ± 5.1; PPM+G, 9.0 ± 3.0). There were no differences in cell numbers of the resulting blastocysts. These results indicate that porcine oocytes can be successfully matured in defined maturation media without gonadotropins, when the media contains fetuin, recombumin and EGF.

Key Words: oocyte, porcine, in vitro maturation

84 Conjugated linoleic acid (CLA) in milk increases in cows fed condensed corn distillers solubles and fish oil. M. Bharathan*, D.J. Schingoethe, A.R. Hippen, and K.F. Kalscheur, *South Dakota State University*, *Brookings,SD,USA*.

Twelve lactating Holstein cows were randomly assigned to one of four experimental diets in a replicated 4 × 4 Latin square design with 4-wk periods to ascertain the effect of feeding 0.5% fish oil (FO), 10% condensed corn distillers solubles (CDS) or both on milk production, milk composition including fatty acid profile of milk fat, feed intake, and feed efficiency. Diets contained either no FO or FO and either no CDS or CDS in a 2 × 2 factorial arrangement of treatments. Diets were fed as TMR for ad libitum consumption. The forage to concentrate ratio was 55:45 on DM basis for all diets. All diets were balanced for 17% CP. The ether extract concentrations for control, FO, CDS and FOCDS diets were 3.3, 3.8, 4.7, and 5.4%, respectively. Feeding FO and or CDS had no effect (P > 0.05) on dry matter intake (DMI), feed efficiency, body weight and body condition scores compared to diets without FO and CDS, respectively. Dietary factors had no effect on milk yield (32.6, 33.2, 35.0, and 32.3 kg/d), energy-corrected milk, protein yield and percentage, lactose yield, SCC and milk urea N. Feeding FO and CDS caused reductions (P < 0.05) in milk fat percentage (3.85, 3.39, 3.33, and 3.12%) and yield compared to diets without FO and CDS. Addition of FO to diets decreased (P < 0.05) 3.5% fat-corrected milk compared to diets without FO. No interactions were observed between FO and CDS. Inclusion of FO and CDS to diets increased (P < 0.05) proportions of vaccenic acid, trans-10 cis-12 CLA (0.07, 0.14, 0.13, and 0.16g /100g of fatty acids) and cis-9 trans-11 CLA (0.52, 0.90, 1.11, and 1.52g /100g of fatty acids) in milk fat compared to diets without FO and CDS. Increase in trans-10 cis-12 CLA was consistent with the observed milk fat depression for supplemental FO and CDS; however, addition of CDS to diets increased (P < 0.05) trans-10 C18:1 compared to diets without CDS. Feeding fish oil at 0.5% of diet DM with a C18:2n6 rich source such as CDS decreased milk fat percentages and increased the milk CLA content.

Key Words: fish oil, condensed corn distillers solubles, cows

85 Starch and protein digestion rates affect nitrogen retention in growing pigs. T.C. Schafer*[1], R.T. Zijlstra[2], and M.D. Drew[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*University of Alberta*, *Edmonton, AB, Canada*.

Two Exp. were performed to examine the effect of the rate of starch and protein digestion rate on protein utilization in growing pigs. In Exp. 1, the glycemic indices of corn, a malting barley (CDC Kendall) and a slow rumen degradable barley (Valier) were measured using 6 grower pigs. The glycemic indices were 104, 71 and 48 for the 3 grains respectively. In Exp. 2, N balance was measured with 36 grower pigs over 2 wk. Three levels of starch digestion rates (rapid, corn; medium, Kendall barley; slow, Valier barley) and two levels of protein digestion rates (rapid, soy protein hydrolysate (SPH); slow, soy protein isolate (SPI)) were tested in a 3 × 2 factorial arrangement. Diets were balanced to provide equal levels of digestible AA, starch and DE and pigs were fed 3 × DE maintenance requirement daily in two meals. Pigs were housed in metabolic crates to allow for separate total collection of feces and urine. After 2 wk, samples were collected from the stomach, and four equal divisions of the small intestine. The percentage of unabsorbed protein in the first 25% of the small intestine was greater in the pigs fed the SPI diets compared to those fed the SPH diets (170.3% vs 116.5%; $P < 0.05$). The percentage of unabsorbed starch in the second section of the small intestine was higher for pigs fed diets containing Valier barley compared to those fed CDC Kendall or corn diets (7.9%, 3.3% and 2.2% respectively; $P < 0.05$). In Exp. 2, the interaction between the main effects was significant so the experiment was reanalyzed as 6 separate treatments. Nitrogen retention was significantly lower for the Valier SPH fed pigs (40.7%) compared to the other five treatment groups (ranging from 50.6% for Valier SPI fed pigs to 52.6% for the Corn SPI fed pigs; $P < 0.05$). The results suggest that the combination of rapidly digestible protein combined with slowly digestible starch may reduce protein deposition in pigs.

Key Words: pig, starch digestion rate, protein digestion rate

86 Correlation of measures of disposition with gain performance of steers. F. E. Creason* and R. L. Weaber, *University of Missouri-Columbia*, *Columbia, MO USA*.

Data were collected on Angus cross steers (n=315) from four sources with known pedigree, to determine the effect of disposition on average weight (AVGWT) during the initial weighing of steers on a feedlot trial. Steers were weighed and disposition scores recorded through two facilities on the same farm. Disposition was measured by pen score (PS; 1=gentle, 5=aggressive) and exit velocity (EV; m/sec). Exit velocity was measured using infrared electronic triggers to start and stop an electronic recording device to time a steer as it traveled a fixed distance upon exiting a squeeze chute. Exit velocity data were recorded when the initial weights were recorded on two consecutive days, the weights and EV were averaged to produce AVGWT and AVGEV, and blood was drawn. Pen scores were recorded during the feeding trial. At the start of the trial steers in each facility weighed 342.60 ± 25.33 kg and 305.35 ± 32 kg, EV averaged 2.5 ± 0.68 m/sec and 2.68 ± 0.99, while PS averaged 1.95 ± 0.70 and 1.86 ± 0.81 respectively. Two models were developed using MANOVA features of SAS PROC GLM to compute partial correlation coefficients. The first model consisted of AVGEV and AVGWT as dependant variables with Collection Location (CL) and Source (SC) as fixed effects, and Sire (SID) as a random effect. Average EV was correlated with PS, r = 0.43 (p < 0.0001), and AVGWT, r = -0.34 (p < 0.0001). PS was correlated with AVGWT, r = -0.36 (p < 0.0001). The second model utilized repeated records of EV and WT. EV Day 1 (EVD1), EV Day 2 (EVD2), Weight Day 1 (WD1), Weight Day 2 (WD2), and PS were dependant variables with the same fixed and random effects. EV1 was correlated with EV2, r = 0.59 (p<0.0001). EV1 and EV2 were correlated with WT1 (r = -0.25, r = -0.36, both p<0.0001) and WT2, (r = -0.28, r = -0.38, both p<0.0001), respectively. PS was correlated with EV1 and EV2 (r = 0.38, r = 0.44, both p<0.0001); and with WT1 and WT2 (r = -0.35, r = -0.37, both p<0.0001). Increases in EV (faster flight times) and PS were negatively associated with AVGWT at the start of the feeding trial.

Key Words: beef cattle, temperment, gain

87 Effects of immunization against two inhibin antigens on hormone concentrations and daily sperm production (DSP) in ram lambs. J.L Voge* and J.E Wheaton, *University of Minnesota*, *St. Paul, MN*.

The gonadal hormone inhibin indirectly regulates DSP through negative feedback control of FSH secretion and may also affect DSP via direct

actions within the testis. Studies attempting to increase DSP through the immunization against inhibin have yielded equivocal results. The present study compared two different inhibin antigens on hormone secretion and DSP. Columbia ram lambs (BW = 42 ± 2 kg, mean ± SE; age = 113 ± 3 d) were assigned randomly to three groups: 1) control (CNT, n = 4, 5 lambs were assigned but one died), 2) α-peptide conjugate (αPC, n = 6), 3) α-subunit (αSB, n = 6). Antigen αPC consisted of an α-inhibin N-terminal 25 amino acid peptide conjugated to ovalbumin. Antigen αSB was the complete inhibin α-subunit. Lambs were immunized on days 0 (June 19, 2006), 18, 38 and 63. Scrotal circumference (SC) and BW also were recorded on immunization days. Blood samples were collected on days 0, 7, 14, 18, 28, 35, 38, 49, 56, 63 and 70. Rams were slaughtered on day 71. Testes were weighed and parenchyma was collected for DSP determination. Plasma α-inhibin antibody (αAb), LH, FSH, and testosterone concentrations were measured using RIA. In αPC-immunized rams, αAb titer was increased ($P < 0.01$) consistently following the third immunization. In αSB-immunized rams, αAb titer also was increased ($P < 0.01$) but was more variable than in αPC-immunized rams. Plasma FSH concentrations in αSB-immunized rams were greater ($P < 0.05$) than in CNT rams. Immunization against αPC did not increase FSH concentrations over those in CNT lambs. Compared to CNT animals, immunization against either antigen did not alter LH, testosterone, BW, SC or testes weight. Mean DSP per gram in CNT ram lambs was $1.15 \times 10^7 \pm 2.70 \times 10^5$. Mean DSP was increased ($P < 0.01$) by 26% in αPC- ($1.45 \times 10^7 \pm 3.82 \times 10^5$) and αSB- ($1.45 \times 10^7 \pm 4.31 \times 10^5$) immunized ram lambs. Findings indicate that 1) the two inhibin antigens increase DSP to similar extents, and 2) αAb may act at least in part through an intratesticular action as DSP was increased in some animals without a concomitant increase in FSH.

Key Words: inhibin, immunization, rams

88 Optimum Levels of Dry Distillers Grains with Solubles for Finishing Steers. C. D. Buckner*[1], T. L. Mader[1], G. E. Erickson[1], S. Colgan[1], K. K. Karges[2], and M. L. Gibson[2], [1]*University of Nebraska*, *Lincoln*, [2]*Dakota Gold Marketing*, *Sioux Falls, SD*.

A finishing study was conducted to evaluate increasing levels of dry distillers grains with solubles (DDGS, Dakota Gold Research, Sioux Falls, SD) in corn-based diets on feedlot performance and carcass characteristics. Backgrounded steer calves (n=240; 307 ± 24.5 kg) were used in a RCBD (four weight blocks, eight steers/pen, five pens/treatment) to evaluate ADG, DMI, and G:F. Steers were fed for 167 d, and were slaughtered at a commercial abattoir to collect carcass data. Treatments consisted of 0, 10, 20, 30, 40, and 50% (DM basis) DDGS during d 1-22, replacing dry rolled corn. Diets also included 10% corn silage, 2.5% alfalfa hay, and 6% liquid supplement (DM basis). After d 22, the 50% DDGS treatment was removed from the experiment due to sulfur. Quadratic trends were observed for final BW and ADG (P=0.04 and 0.08, respectively) as DDGS increased, with the most improved results at 20%. DMI was not affected by DDGS treatment level. A positive linear G:F trend (P=0.07) was observed as DDGS level increased. No differences in carcass characteristics were observed. Results showed DDGS can be fed in finishing diets to improve ADG and G:F with optimum level at 20% dietary inclusion.

Table 1. Performance for cattle fed DDGS levels.

DDGS Level	0	10	20	30	40	50	SE
Performance-22d step-up period							
ADG, kg	1.54	1.61	1.70	1.70	1.42	1.42	0.23
DMI, kg/d	8.75	8.85	8.66	8.89	8.66	9.21	0.58
G:F	0.177	0.180	0.195	0.191	0.165	0.155	0.012
Performance-145d finishing period							
Final BW, kg[a]	558	574	588	577	571	--	19.6
ADG, kg	1.49	1.61	1.68	1.61	1.61	--	0.03
DMI, kg/d	9.43	9.89	9.43	9.62	9.39	--	0.72
G:F	0.158	0.163	0.179	0.169	0.173	--	0.006

[a]Calculated from carcass weight, adjusted to a 63% common dress.

Key Words: dry distillers grains, corn, cattle

89 Dietary phosphorus and genetic background interact to affect growth performance and bone integrity in pigs. LS Alexander*, SA Cutler, MF Rothschild, and CH Stahl, *Iowa State University*, *Ames, IA, USA*.

Excessive phosphorus (P) in the excreta from swine production is of major environmental and financial concerns. The objective of this study was to determine the affect of genetic background on P utilization in gilts sired by two lines (PIC337 and PIC280). Gilts (n=94, 3wk old) were housed individually and allotted into 2 treatments based on litter and BW. They received either a P adequate (PA) or a 20% P deficient (PD) diet for 14wk. Diets were formulated 4 times over the 14wk study to reflect the changing nutrient requirements of the growing pig. Plasma was collected and BW and feed consumption was recorded monthly from individual pigs. Plasma P (PP), parathyroid hormone (PTH), 1,25 $(OH)_2$ Vitamin D (VitD) concentrations, as well as alkaline phosphatase activity (AKP) were determined monthly. Upon trial completion, radial bones were collected for bone strength analysis, intermediate carpals were collected for ash % determination, and kidney tissue was collected for gene expression analysis. Data were analyzed using the GLM procedure of SAS with sire line, treatment and sire line × treatment as fixed effects. Initial and final BW were used as covariates for growth performance and bone strength, respectively.

Significant differences ($P < .05$) were seen in ADG, G:F, PP, VitD, bone strength and ash %, as well as in the expression of the PTH receptor gene in the kidney based on the interaction between genetic line and dietary P. PIC337 sired PA pigs had higher ADG than the PIC280 sired pigs after 4wk and overall. They also had the highest bone strength and ash % among all groups. Pigs fed the PD diet had decreased PP and PTH and increased VitD after 4wk and throughout the study, demonstrating that this diet caused P deficiency. Corresponding to the increase in VitD, the expression of the 1α hydroxylase gene in the kidney of PD fed pigs was also increased (≈1.8 fold, $P < 0.05$). These data demonstrate an interaction between genetic background and dietary P utilization that could help lead to the identification of genotype specific feeding programs and breeding strategies to produce animals that require less dietary P.

Key Words: phosphorus, bone, pig

90 Lean growth of 1980 vs. 2005 pigs when fed 1980 or 2005 feeding programs. J. S. Fix*, D. J. Hanson, E. van heugten, J. P. Cassady, and M. T. See, *North Carolina State University*, *Raleigh, NC USA*.

This study assessed changes over 25 yr for lean growth in pigs. Pigs (n=162) representative of the 2005 commercial industry were compared to pigs representative of the industry 25 yr ago. The 1980 genetic line (GL) was produced from dams selected to minimize genetic improvement and frozen semen from boars available in 1980. Pigs within sex, farrowing group, and GL were randomly assigned to a feeding program (FP) and placed 3 per pen (n=54) at an initial BW of 7±0.4 kg. The 2005 FP included 7 phases (lysine from 1.51 to 0.73% and ME from 3428 to 3651 Kcal/kg), pelleted diets, added fat, and current diet formulation. The 1980 FP consisted of 4 meal diets (lysine from 1.05 to 0.62% and ME from 3262 to 3317 Kcal/kg) based on formulations from the 1978 PIH. Pig wt and pen feed consumption were measured every 2 wk and realtime ultrasound (RTU)(3 times) BF and LMA measured every 4 wk. Pigs were slaughtered weekly when avg pen BW exceeded 116 kg. ADG, ADFI, and G:F were calculated for on test to nursery (OTN) (26.9±0.7 kg) and nursery to slaughter (NS). Lean ADG (LADG) and Lean G:F (LG:F)were calculated for on test to slaughter (OTS) and first RTU (42.7±1 kg) to slaughter (FSS). Pigs from 2005 GL were leaner for all RTU ($P<0.01$) and had larger LMA ($P<0.01$) for the second RTU. Pigs fed 2005 FP were fatter ($P<0.05$) for the first RTU but had larger LMA for all RTU ($P<0.05$). 2005 GL pigs had lower OTN ADFI (0.82 vs 0.92 kg/d; $P<0.05$) and greater G:F (0.60 vs 0.56; $P<0.01$). 2005 GL pigs had higher NS G:F (0.39 vs 0.35; $P<0.05$) than 1980 GL pigs. Interactions of GL × FP were observed for NS ADG ($P<0.05$) and OTS LADG ($P<0.01$) where 1980 vs 2005 GL pigs showed a 4% and 9% increase in ADG NS and 8.7% and 14.8% increases in LADG OTS when fed 2005 vs 1980 FP. 2005 GL pigs had a higher LADG OTS (0.29 vs 0.24 kg/d; $P<0.01$) and FSS (0.32 vs 0.25 kg/d; $P<0.01$) along with higher LG:F OTS (0.14 vs 0.12; $P<0.01$) and FSS (0.12 vs 0.09; $P<0.01$) than 1980 GL pigs. Pigs fed 2005 GL had higher OTS LADG (0.28 vs 0.25 kg/d; $P<0.01$) and LG:F (0.14 vs 0.12; $P<0.01$) and FSS LG:F (0.11 vs 0.10; $P<0.01$). Changes in both genetics and feeding programs over the past 25 yr have led to improvements in lean growth.

Key Words: pigs, growth, genetics

91 Comparison of grazing stockpiled tall fescue versus traditional strategies for wintering spring-calving beef cows. A. M. Meyer*, R. L. Kallenbach, M. S. Kerley, and K. P. Ladyman, *University of Missouri*, *Columbia, MO, USA*.

One hundred six beef cows (avg BW = 616.2 ± 143.9 kg, avg BCS = 5.53) were allocated by weight, body condition score (BCS), age, and calving date to one of three treatments (3 reps each): grass hay only (HAY), grass hay with grain supplementation to meet NRC requirements (HS), and non-endophyte stockpiled tall fescue pasture (STF). The trial was conducted from mid November to late March. Hay was fed ad libitum to HAY and HS in 10 acre dormant, grazed pastures, and STF pastures were strip-grazed. The supplement for HS was .45 kg corn during gestation and 1.36 kg corn with 1.64 kg DDGS during lactation. The trial was split into two periods: from initiation to 2 weeks pre-calving (P1, d 1-81) and from pre-calving until conclusion (P2, d 81-130). Average nutrient composition of STF was better than that of hay (12.8% vs. 7.7% CP and 67.4% vs. 71.6% NDF). STF pastures had an avg yield of 1398 kg DM/A and avg utilization rate of 80.1%. Cows consumed on avg 10.8 kg DM/d STF. Total hay offered did not differ ($P>.05$) between HAY and HS (4869 and 6606 kg). Weight gain differed ($P=.005$) during P1 between HAY, HS and STF (54, 44 and 57 kg), with HS gaining less than HAY and STF. During P2 STF lost less weight ($P<.02$) than HAY and HS (-36 vs. -59 and -62 kg, respectively). Over the entire trial (d 1-130), STF gained weight while HAY and HS lost weight ($P=.0005$, 22 v. -3 and -18). From the trial′s end to the start of the breeding season and weaning, weight changes were not different ($P>.05$), although STF had higher numerical weight losses than HAY and HS. BSC changes did not differ ($P>.05$) at any measurement, although STF maintained a numerically higher BCS during P1 and P2. Calf birth weight and weaning weight, along with cow pregnancy rates were unaffected ($P>.05$) by treatment. Results indicated that grazing stockpiled tall fescue is a viable option for wintering beef cows. Quality differences in STF and hay suggest greater possible intake of STF, resulting in the observed higher weight gains pre-calving and lower losses post-calving.

Key Words: beef cows, hay, stockpile

92 Differential activity of the GnRH receptor gene promoter in lines of swine with divergent ovulation rates. J Smith*, E McDonald, R Cederberg, and B White, *University of Nebraska*, *Lincoln, NE USA*.

Binding of GnRH to its receptor is critical to normal reproductive function. Also, the porcine GnRH receptor (GnRHR) gene is near an identified QTL for ovulation rate. Thus, the GnRHR represents a physiological and positional candidate for genes influencing ovulation rate. We constructed reporter vectors containing 5000 bp of the GnRHR gene promoter (5000pGL3) from 3 lines of swine with divergent ovulation rates (Control, Index and Meishan). Transient transfections of these vectors into gonadotrope-derived αT3-1 cells revealed significant differences in luciferase activity among lines. Differential luciferase activity was maintained following reduction of promoters to 1400 bp; however, further reduction eliminated differences in promoter activity. We identified 4 single bp alterations among the lines located between 500 and 1000 bp upstream of the translational start site. To determine if these bp substitutions resulted in binding differences among lines, electrophoretic mobility shift assays were performed with radiolabeled oligonucleotides spanning the bp substitutions. An alteration located at -843 bp of proximal promoter resulted in a specific binding complex for the Meishan compared to Control/Index oligonucleotides, which was abrogated by an unlabeled oligonucleotide containing GATA consensus binding sites. The addition of antibodies directed against GATA1, 2 and 4 or an equal mass of rabbit IgG resulted in a supershift for GATA4. To examine the functional significance of this element, we constructed vectors containing a block replacement mutation of the GATA4 binding site within the context of the full length Meishan promoter (μGATA4pGL3). Transient transfections were performed in αT3-1 cells with Meishan 5000pGL3, μGATA4pGL3 and promoterless control. The GATA4 mutation significantly reduced luciferase activity compared to the full length Meishan promoter. Thus, enhanced activity

of the Meishan GnRHR gene promoter is partially due to a unique GATA4 binding site.

Key Words: GnRH receptor, promoter, porcine

93 Prediction of in vivo amino acid digestibility in dried distillers grains with solubles (DDGS) from crude protein, optical density and fluorescence. P. E. Urriola*[1], D. Hoehler[2], C. Pedersen[3], H. H. Stein[4], L. J. Johnston[1], and G. C. Shurson[1], [1]*University of Minnesota*, *St. Paul, MN, USA*, [2]*Degussa Corporation*, *Kennesaw, GA, USA*, [3]*Danisco Animal Nutrition*, *Marlborough, UK*, [4]*University of Illinois*, *Urbana, IL, USA*.

Standardized ileal digestible CP and AA content from 36 samples of distillers dried grain with solubles (DDGS) and 1 sample of distillers dried grain (DDG) were obtained from 5 in vivo experiments. Thirty four of the samples of DDGS were produced from corn (C), 1 sample was produced from sorghum, and 1 sample was produced from a corn-sorghum blend. The optical density (OD) of each sample was measured using a spectrophotometer (model color-Flex, Hunter Associated Laboratory) from 400 to 700 nm. Front face fluorescence (FFF) was determined at 360 nm excitation and recorded from 380 to 600 nm using a spectrometer (Aminco Browman II, Thermo Electron Corporation). Principal components (PC) analyses were performed on the spectral data to create a new data set in which the explanatory variables were independent. The OD had the highest correlation with digestible Lys (DLys) at 410 nm (r = 0.50) and lowest at 700 nm (r = 0.42). The FFF intensity had the highest correlation with Dlys from 400 to 460 nm (r = 0.29). The cross-validation indicated that 3 PC explained most of the variation in OD and FFF spectra (99.8% and 99.4%, respectively). However, 9 to 22 PC were required to predict digestible CP and AA from OD and FFF. The OD predicted ($P < 0.05$) digestible Lys, Met (DMet), Thr (DThr) and Trp (DTrp, $R^2 = 0.86$, 0.69, 0.73, and 0.88, respectively) from all 37 samples of distillers by-products. However, DLys and DThr were predicted ($P < 0.05$) with greater accuracy from OD when only the 34 sources of C were considered in the model ($R^2 = 0.97$ and 0.92, respectively), but DTrp and DMet predictions were lower ($R^2 = 0.77$ and 0.30; $P < 0.05$). When CP was included in the equations along with OD data, prediction of DCP and DLys were improved ($R^2 = 0.94$ and 0.89, $P < 0.05$). The FFF predicted DLys, DMet, DThr, and DTrp (R^2= 1.00, 0.97, 0.96, 1.00, respectively) in 37 distillers by-products. Prediction of digestible AA content in DDGS is feasible from OD and is accurate for DCP, DLys, and DTrp. The FFF was the most accurate method for predicting DCP and AA of DDGS.

Key Words: DDGS, optical density, fluorescence

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

94 Dietary supplementation of Colicin E1 prevents Escherichia coli F18 caused post-weaning diarrhea in pigs. SA Cutler*, NA Cornick, SM Lonergan, and CH Stahl, *Iowa State University*, *Ames, IA USA*.

The use of dietary prophylactic antibiotics to prevent post-weaning diarrhea (PWD) in pigs is common practice in the U.S. swine industry. Despite this measure, PWD still causes substantial losses to the swine industry due to both mortality and reduced growth performance in surviving pigs. With world-wide concern over the use of antibiotics in animal agriculture, alternatives to conventional antibiotics are desperately needed. Previously, we have shown the effectiveness of Colicin E1 (ColE1) against the E. coli strains responsible for PWD in vitro. In this study, we examined the efficacy of dietary inclusion of ColE1 in preventing experimentally induced PWD. Twenty-four weaned pigs (18d of age), all genetically susceptible to E. coli F18, were allocated into 1 of 3 treatment groups, based on body weight. They were fed corn-soy diets containing either 0, 11, or 16.5mg ColE1/kg diet. After 2d on the treatment diets, all animals were orally inoculated with 1×10^9CFU of 2 E. coli F18 strains isolated from pigs with PWD. Body weight, fecal swabs, and fecal scores were recorded daily. All animals were euthanized 4d post-inoculation and sections of the ileum were collected for histology, E. coli enumeration, and gene expression. The inclusion of ColE1 decreased ($p < 0.05$) the incidence and severity of PWD as demonstrated by an average fecal score of 3.7 in the controls, 2.6 in the 11mg ColE1/kg group, and 1.4 in the 16.5mg ColE1/kg group. By the completion of the study, 3 pigs not fed ColE1, 1 pig fed 11mg ColE1/kg diet, and none of the pigs fed 16.5mg ColE1/kg lost weight. Inclusion of ColE1 improved ($p < 0.05$) ADG for pigs fed 16.5mg ColE1/kg diet compared to those fed the diet without ColE1 (940g/d vs. 380g/d, respectively). Additionally, dietary addition of ColE1 affected the gene expression of the cytokines iNOS, IL-1β, and TNFβ in the ileal tissue of these animals, suggesting an increase ($p<0.05$) in inflammatory response in the control animals as compared to the 16.5mg ColE1/kg diet group. Dietary inclusion of ColE1 appears to be an effective alternative to conventional antibiotics in the diet of swine for the prevention of PWD.

Key Words: PWD, colicin, pigs

95 Caspase-3 is not activated in postmortem beef and lamb muscle. K. R. Underwood*, W. J. Means, and M. Du, *University of Wyoming*, *Laramie, WY, USA*.

Postmortem proteolysis is an important determinant in tenderness of whole-muscle, ruminant meat products. Although, the calpain/calpastatin and catheptic enzyme systems have been implicated in postmortem proteolysis, they may not be solely responsible for the changes seen in muscle proteins during the aging period. Caspase-3 is an enzyme that functions in apoptosis, programmed cell death, and has been shown to degrade myofibrillar proteins. Our objective was to evaluate the role of caspase-3 in postmortem proteolysis. Beef cattle from a commercial feedlot, less than 30 months of age determined by dentition; and Hampshire cross wether lambs, less than eight months of age, from the University of Wyoming flock were slaughtered in the University of Wyoming Meat Lab. *Sternomandibularis* muscle samples were obtained from each animal at 0 min, 15 min, 1 h, 3 h, 24 h, 3 d, and 7 d post harvest. Western blotting techniques were used to evaluate pro-caspase-3 (35 kDa) and the cleaved, active form of caspase-3 (17 kDa). Western blot analysis of muscle samples from both species showed only the pro-caspase-3 form and failed to detect the activated enzyme. Our results demonstrate that caspase-3 is not

activated in postmortem muscle of cattle and sheep through the 7 d postmortem period. Therefore, caspase-3 is likely not involved in postmortem proteolysis of muscle.

Key Words: proteolysis, caspase-3, postmortem beef and lamb muscle

96 Active phosphate uptake through the NaPi-IIb cotransporter is post-transcriptionally regulated in the jejunum of weanling piglets fed a low-P diet. K.L. Saddoris*, J. C. Fleet, and J. S. Radcliffe, *Purdue University*, *West Lafayette, IN, USA*.

Feeding low-P diets to pigs results in increased Na^+-dependent phosphate and glucose uptake in the small intestine independent of dietary Ca concentration. In rodents, the NaPi-IIb cotransporter has been identified in the apical membrane and is primarily responsible for regulating Na^+-dependent phosphate transport in the small intestine. However, the effects of feeding a low P diet on NaPi-IIb mRNA abundance in mice has been varied. Therefore, the objective of this study was to determine the effects of feeding a low P diet and the Ca:aP on NaPi-IIb, calbindin D(9k), and SGLT-1 mRNA levels (real-time PCR) in the jejunum of weanling pigs. Thirty-two, 17d old crossbred pigs (7.42 kg ± .58) were blocked by BW and sex and randomly allotted to diets. Diets were: 1) Control (0.40% aP and 1.00% Ca), 2) Low P, Adequate Ca (0.23% aP and 1.00% Ca), 3) Low P, Low Ca (0.23% aP and 0.58% Ca), and 4) Adequate P, Low Ca (0.40% aP, 0.58% Ca). Following a 5 d adaptation period to a dry diet, pigs were fed dietary treatments for 14 d, and then killed by asphyxiation with CO_2 followed by exsanguination. Jejunal mucosal scrapings were collected for RNA isolation. We previously reported a 46% and 36% increase in Na^+-dependent phosphate and glucose uptake in these pigs as dietary aP level decreased. No P × Ca interactions or sex effects were detected (P≥0.10) for mRNA levels of NaPi-IIb, calbindin D(9k), or SGLT-1. Feeding a low-P diet had no effect (P≥0.10) on the abundance of NaPi-IIb, calbindin D(9k), or SGLT-1 transcript. Additionally, feeding a low-Ca diet had no effect (P≥0.10) on mRNA levels of NaPi-IIb, calbindin D(9k) or SGLT-1. Overall, feeding a low-P diet and varying the Ca:aP from 2.5 to 4.3 by adjusting the Ca concentration in the diet, had no effect on abundance of the NaPi-IIb, calbindin D(9k), or SGLT-1 transcript in the jejunum of weanling pigs. In conclusion, regulation of active phosphate and glucose uptake in the jejunum is occurring post-transcriptionally in piglets fed a low-P diet and is independent of dietary Ca concentrations.

Key Words: phosphorus, calcium, small intestine

97 Factors affecting feed efficiency in feedlot steers. J.W. Homm*[1], L.L. Berger[1], S.L. Rodriguez-Zas[1], L. Forster[2], and T.G. Nash[1], [1]*University of Illinois*, *Urbana, IL*, [2]*Archer Daniels Midland Company*, *Decatur, IL*.

Profitability in beef production is a function of both inputs and outputs. The beef industry has focused on outputs such as weight, gain, and carcass merit. Feed costs are estimated to be approximately 60% of the total cost of production, and therefore represent an opportunity to increase profitability through improving feed efficiency (FE). Three hundred sixty steers (329.3 + 46.56 kg) originating from four different sources and from 29 different Simmental, Angus, and Simmental × Angus sires were used to determine factors affecting feed efficiency in feedlot steers. Six dietary treatments were used that were composed primarily of corn, corn-based co-products and/or soy hulls. Daily individual animal intakes were recorded by the Growsafe® feed monitoring system. All steers were weighed and ultrasound measurements of marbling score (MAR), backfat thickness (BF), and ribeye area were taken every 28 d through 140 d. Using general linear models, 66% of the variation in FE was accounted for. Sire, dietary treatment, backfat, and empty body fat (EBF) accounted for 25, 18, 10, and 7% of the variation respectively. Feed efficiency decreased as animals ate higher amounts over maintenance requirements. Endpoints were derived on a weight (WT), EBF, BF, and MAR constant basis. For each endpoint of interest least squares means were calculated for feed efficiency. Sire was considered the fixed effect whereas dietary treatment, pen, and ranch of origin served as the random effect. Spearman rank correlations were calculated between constant endpoints. Backfat constant and EBF constant were significantly ($p < 0.01$) correlated (r=0.70). Weight constant and EBF constant were significantly ($p < 0.01$) correlated (r=0.69). Empty body fat constant and MAR constant tended ($p = 0.12$) to be negatively correlated (r = -0.41). These data indicate that body composition does not greatly impact FE of steers whereas, sire and dietary treatment accounts for a significant amount of variation. Additionally, the ranking of sires for feed efficiency may change depending on the endpoint of interest.

Key Words: feed efficiency, steers, sires

98 Effects of reduced dietary crude protein and P on DM, N, and P excretion of finisher pigs. M. Lachmann*, S. Carter, S. Jenkins, J. Bundy, Z. Marable, and T. Buhay, *Oklahoma State University*, *Stillwater, OK*.

As a second step in a sequence of studies to determine the effect reducing dietary CP and P on DM, N, and P excretion during the finishing period, 48 Yorkshire barrows (34.5 kg BW) were blocked by BW and allotted randomly to two dietary treatments. Pigs were housed in 4 identical rooms (12 pigs/room, 2 rooms/trt) in an environmentally-controlled building, with a shallow pit, pull-plug system. The control was a fortified corn-soybean meal-based diet (18, 16, and 14% CP; 0.50, 0.45, and 0.40% P for Phases 1, 2, and 3, respectively). The experimental diet (LPP) was similar to the control with the exception that CP was reduced by 2% units, P by 0.1% units, and Lys HCl was added. Diets were formulated on a true dig. Lys basis (0.84, 0.71, and 0.57%). Pig weight, feed intake, pit volume, and pH were recorded weekly. Feed and pit samples were collected for DM, N, and P analysis. The DM concentration (1.95%) and pH (7.03) in the pit were not affected by treatment. However, N (10.3 vs. 8.5% DM basis), NH4-N (6.0 vs. 4.4% DM basis) and P concentration (2.16 vs. 1.74% DM basis) in the pit tended to decrease ($P < 0.10$) with LPP. Final weight (108 kg), F:G (2.84) and finishing period duration (106 d) were similar ($P > 0.10$) for treatments. Daily DM intake (1.8 kg/pig) was not affected ($P > 0.10$). However, daily N (52.0 vs. 42.4 g) and P intake (9.15 vs. 6.84 g) tended to decrease ($P < 0.10$) for pigs fed the LPP diet. Daily DM excreted (300 g) was similar ($P > 0.10$) for both treatments, but N (32.3 vs. 25.6 g) and P (6.63 vs. 5.14 g) excretion decreased ($P < 0.05$) for pigs fed LPP. Daily DM (16.7%) and P (73.9%) excretion (as % of intake) were similar ($P > 0.10$), but N excretion (62.1 vs. 60.3%) tended to decrease ($P < 0.10$) for pigs fed LPP. Total N (3.44 vs. 2.68 kg/finished pig) and P (0.71 vs. 0.54 kg/finished pig) excreted

during the finishing period tended to decrease (P < 0.10) with LPP. The LPP diet reduced daily and total N and P excretion by 20% and 24%, respectively, during the finishing period.

Key Words: diet, nutrient excretion, pigs

99 Effects of aging on tenderness and moisture loss of enhanced muscles from fed cull cows of known age. S. Hutchison*, J. A. Unruh, T. T. Marston, M. C. Hunt, and J. J. Higgins, *Kansas State University*, *Manhattan, KS, USA*.

Approximately 16% of the 31 million head of cattle harvested in the United States in 2005 were aged cows. Cow meat is generally ground because of problems with toughness and color, but it is possible that some muscles from aged cows could be improved for greater value. Therefore, the objective was to determine if aging (7 vs 28 d) before blade tenderization and injection enhancement would affect tenderness and moisture loss of cow meat. Cows (n=31) (age ranged from 3 to 15 yr) were fed a high-concentrate diet for 60 d prior to harvest. The *quadriceps* (knuckle), *gluteus medius* (top sirloin), and *infraspinatus* (top blade) steaks from the right and left sides were removed and assigned randomly to either 7 or 28 d of aging. After aging subprimals were frozen until they were thawed, blade tenderized, and enhanced with an enzyme solution containing 0.023% bromelin, 0.35% phosphate and 0.5% salt at 10% of thawed weight. Steaks (2.54 cm thick) from each treatment were used to determine moisture loss and Warner-Bratzler shear force values (WBSF). Moisture losses and WBSF were not different (P > 0.05) for steaks from the whole *quadriceps* due to either days of aging or cow age. However, when the *rectus femoris* and the *vastus lateralis* were analyzed individually the *rectus femoris* had lower WBSF (more tender, P<0.01) than the *vastus lateralis* (2.6 vs. 3.2 kg, respectively). Moisture loss of the *gluteus medius* steaks were not affected by aging or cow age. Aging the *gluteus medius* steaks for 28 d improved tenderness by 0.64 kg as compared to 7 d (P<0.01). Moisture loss and WBSF of steaks from the *infraspinatus* were not affected (P>0.05) by days of aging. Package losses increased (P<0.01) with (0.09 kg/yr); however, cooking losses did not appear (P>0.05) to be affected by cow age. The WBSF of *infraspinatus* steaks were similar between 7 and 28 days of aging, but as cow age increased the WBSF from the *infraspinatus* increased 0.06 kg/yr (P<0.01). This study provides evidence for aging the *quadriceps* and *infraspinatus* steaks for 7 d instead of the extended 28 d of aging, when the combination of blade tenderization and enzyme enhancement is used.

Key Words: cow, tenderness, enzyme

100 Tolerance of excess dietary cyst(e)ine in pigs and rats. R. N. Dilger* and D. H. Baker, *University of Illinois*, *Urbana, IL, USA*.

Previous work in our laboratory showed that 40 g/kg supplemental cysteine (Cys) but not cystine (Cys-Cys) was lethal when fed to young chicks. Therefore, a mammalian species investigation of the relative pharmacologic effects of Cys and Cys-Cys was conducted using the young rat and pig. During 14-d studies, rats were fed a casein-based diet (AIN-93G) containing 0, 3, 6, 12, 24, or 48 g/kg Cys or Cys-Cys, whereas pigs were fed a practical diet (corn, soybean meal, whey, and fish meal; 200 g/kg CP) containing 0, 20, or 40 g/kg Cys or Cys-Cys. Levels of excess Cys or Cys-Cys up to 40 g/kg caused no mortality in either rats or pigs. Regardless of cyst(e)ine source, dietary addition of 20 g/kg depressed ($P < 0.05$) weight gain in pigs by 28%, whereas 40 g/kg depressed ($P < 0.05$) weight gain by 81%. In rats, 48 g/kg excess Cys or Cys-Cys depressed ($P < 0.05$) weight gain by 74%, and levels of supplemental Cys-Cys of 48 g/kg and above caused some mortality. Pigs exhibited rapid recovery from growth depressing excesses of Cys or Cys-Cys, suggesting the effect of excess cyst(e)ine was partly explained by anorexia. Supplementation of pig diets containing excess cyst(e)ine with potassium bicarbonate at 10 g/kg did not attenuate the growth depression. Ingestion of excess Cys-Cys by rats caused pulmonary congestion, pleural effusion, and hepatic perilobular necrosis. Among plasma biomarkers evaluated, alkaline phosphatase and creatine phosphokinase were the most sensitive (i.e., elevated at the lowest dietary cyst(e)ine concentration) in the rat. Similar findings could not be verified in the young pig. Thus, excess cyst(e)ine did not affect these and other plasma enzymes in the pig. Additionally, necropsy of pigs fed 40 g/kg Cys or Cys-Cys for 14-d showed no histopathological lesions. These results lend credence to the acute toxic effects associated with ingestion of excess sulfur amino acids, and highlight the potential for excess dietary cyst(e)ine to be more pernicious than excess methionine in certain species. In contrast to the results with chicks, however, little difference in noxious effects was evident between excess Cys and Cys-Cys in pigs and rats.

Key Words: cysteine, cystine, toxicity

101 Effect of genistein on in vitro estradiol production by ovarian follicles from cows. Nicole Tinfo*[1], Lacey Luense[1], Steve Hopkins[2], and Carolyn Komar[1], [1]*Department of Animal Science, Iowa State University*, *Ames, IA, USA*, [2]*Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University*, *Ames, IA, USA*.

Phytoestrogens are biologically active plant substances with a chemical structure similar to that of estradiol. Genistein is a phytoestrogen that can cause reproductive problems in cattle such as cystic ovaries, irregular estrus, anestrus, and failure to conceive. Genistein is present in feeds commonly given to cattle including soybeans, clover, and alfalfa. Since cattle are exposed to genistein via grazing and feed, and the fact that this phytoestrogen can affect various aspects of ovarian biology, we investigated the effect of genistein on the ability of follicles to produce estradiol. Angus heifers were monitored daily by transrectal ultrasonography. Ovaries were removed by flank incision when a follicle from the first follicular wave measured approximately 8 mm (dominant follicle). The dominant follicle and second largest follicle (subordinate follicle) were dissected from the ovary, separated from stromal tissue, and pieces (1-3 mm) of follicle wall (theca plus attached granulosa cells) were cultured as follows: dominant follicle (n=4) – vehicle control (methanol), FSH (1ng/ml), genistein (10 μM) or FSH + genistein; subordinate follicle (n=3) – vehicle control (methanol) or genistein (10 μM). Tissues and media were collected 24 hours later and analyzed for levels of mRNA for aromatase, and progesterone, respectively. There was no effect of any treatment on estradiol production by cultured follicular tissue from dominant or subordinate follicles. There was however, a significant decrease in aromatase expression when tissue from the dominant follicle was treated with genistein in combination with FSH, compared to treatment with FSH alone (p≤0.05). These data suggest that genistein may not affect the production of estradiol acutely, but may alter the long-term response to gonadotropin-stimulated estradiol production.

102 Effect of ractopamine and lysine:net energy ratio on growth performance and plasma urea nitrogen concentration of late-finishing barrows fed low-protein amino acid-supplemented diets. R. Moreno* and P. S. Miller, *University of Nebraska, Lincoln*, *Lincoln, Nebraska, United States*.

A study was conducted to evaluate the effects of Ractopamine (RAC; Paylean) and lysine (Lys):NE ratio on growth performance and plasma urea nitrogen concentration (PUN) of late-finishing barrows fed low-protein AA-supplemented diets. Thirty-six late-finishing barrows (77.2 kg) were used in a 28-d experiment. Pigs were individually penned and had ad libitum access to feed and water. The pigs were randomly allotted to one of six dietary treatments consisting of one corn-soybean meal diet and two low-CP AA-supplemented diets with different Lys:NE (5.23 or 6.31) ratios and RAC inclusion (0 and 20 ppm). Body weight and feed disappearance were measured weekly and ADG, ADFI, and ADG/ADF were calculated. Blood samples were collected weekly. During the overall experimental period, RAC increased ADG (P = 0.019) and ADG/ADFI (P = 0.021). The inclusion of RAC decreased PUN on d 7 (P = 0.0286), 28 (P = 0.0069), and the overall experimental period (P = 0.0179). Growth performance was not affected by dietary CP concentration; however, PUN decreased in response to reduced dietary CP concentration for all sampling days and the overall experimental period (P = 0.0003). The increased Lys:NE ratio in low-CP AA-supplemented diets did not change growth performance or PUN for any of the experimental weeks or the overall experimental period. Inclusion of RAC increased ADG, and ADG/ADFI for wk 1, 2 (P = 0.025), and the overall experimental period (P = 0.017) when added to low-CP AA-supplemented diets. Increasing the Lys:NE ratio in low-protein AA-supplemented diets fed to finishing pigs did not improve growth performance or reduce PUN. The inclusion of RAC (20 ppm) increased growth performance and the efficiency of AA utilization for growth (as evaluated by PUN) in late-finishing pigs fed different dietary CP concentrations. These results suggest that feeding low-CP AA-supplemented diets can provide nutrients and energy sufficiently to allow RAC to increase growth performance of late-finishing pigs.

Key Words: ractopamine, pigs, protein

103 Use of digital images to compare color in beef. R Larraín*, D Schaefer, and J Reed, *University of Wisconsin*, *Madison, WI*.

he objective of this study was to compare the use of digital camera (DC) and chroma-meter (CM) to assess color changes in beef. Fifteen cores (12 cm^2) were cut from 5 strip loin steaks (1.27 cm thick) coming from 21 steers in a feeding trial with 4 diets (diets 1 to 4). Three cores were randomly selected and placed on styrofoam trays, wrapped with O_2-permeable film and displayed at 4°C and 1000 lux of deluxe cool white fluorescent light. On d 14, CIE Lab color coordinates were evaluated in the center of each core using a CM (Minolta CR-300, 1-cm aperture, illuminant C). Images of the trays were taken using a DC (Canon PowerShot A70). White balance was set using the custom option and the plate used to calibrate the CM. Trays were illuminated with 450 lux of indirect cool white fluorescent light. Shutter speed was 1/6 s and aperture was F5.0 at ISO 100. Red, green and blue (RGB) color intensity was measured from JPG files using ImageJ 1.37 software (NIH). A circular area (1.7 cm^2) at the center of each core was evaluated twice. Color palette of Photoshop CS 8.0 was used to transform RGB values to CIE Lab. There was significant correlation (P<0.001) between DC and CM values for all color readings. Cubic correlations were observed in L* and Hue (R^2=0.64 and 0.93), quadratic in a* and chroma (R^2= 0.95 and 0.93) and linear in b* (R^2=0.57). ANOVA for diet were significant (P<0.05) for a*, and chroma using both methods and for Hue (P=0.046) using CM but not using DC (P=0.092). Differences in a* were detected between diets 2 and 3 (P=0.032 for DC and 0.01 for CM) and 2 and 4 (P=0.006 for DC and 0.001 for CM). Different Hue was detected between diets 2 and 4 (P=0.009 for CM and 0.018 for DC, although ANOVA for DC was not significant). Differences in chroma were detected between diets 2 and 3 (P=0.019 for DC and 0.007 for CM) and 2 and 4 (P=0.004 for DC and 0.001 for CM), while diets 1 and 2 were different (P=0.04) according to CM but not to DC (P=0.055). Most differences detected with CM were also detected with DC. Use of DC could become a practical tool to follow changes in beef color.

Key Words: beef color, digital images, chroma-meter

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

A total of 512 pigs (22.1±0.5 kg BW) were blocked into 2 groups and allotted to one of 4 dietary treatments in a completely randomized block design. Dietary treatment and sex were the main factors in a 3-phase feeding program. Dietary treatments consisted of a corn-soybean meal control (Con), or a corn-soybean meal diet containing 10% (D10), 20% (D20), or 30% (D30) DDGS. Overall ADG (0.92±0.01kg) was not different among dietary treatments. Pigs fed D20 (P < 0.05) and D30 (P < 0.01) had lower ADFI and F:G compared with pigs fed Con, but there was no difference between pigs fed Con and D10. Gilts had lower (P < 0.01) ADG, ADFI, and F:G than barrows. Pigs fed D20 (P < 0.05) and D30 (P < 0.01) had a lower dressing percentage than pigs fed Con, while no differences between pigs fed Con and D10 were observed. Percentage of fat-free lean (PFFL), subjective loin color score, drip loss, and ultimate pH of loins were not influenced by diet. Compared to pigs fed Con, loin marbling score was reduced (P < 0.05) in pigs fed D20 and D30. Loin firmness was reduced (P < 0.05) for pigs fed D30 compared to Con. Belly firmness was reduced in pigs fed D20 (P < 0.05) and D30 (P < 0.01) compared to pigs fed Con. No differences in dressing percentage, loin marbling, loin muscle firmness, or belly firmness were observed between pigs fed Con or D10. Gilts had a lower loin marbling score (P < 0.001) and belly firmness (P = 0.01) compared to barrows. Belly fat Minolta L*, a* and b* color values were not different among dietary treatments. For backfat, Minolta L* values indicated a darker color for pigs fed D20 (P < 0.01) and D30 (P < 0.05) compared to Con, No differences were observed for Japanese color score in belly fat and back fat. Results from this study suggest that feeding diets containing up to 30% DDGS have no adverse effects on growth performance of grower-finisher pigs, but feeding diets containing 20% or higher levels DDGS appears to affect pork quality.

Key Words: DDGS, pork quality, pigs

105 Effects of roughage source and level in finishing diets containing wet distillers grains on feedlot performance. J.R. Benton*, G.E. Erickson, T.J. Klopfenstein, K.J. VanderPol, and M.A. Greenquist, *University of Nebraska*, *Lincoln*.

Three-hundred eighty five steers (BW = 346 ±29 kg) were used to evaluate roughage source and level compared to no roughage inclusion in finishing diets containing wet distillers grains plus solubles (WDGS). The effect of exchanging roughages on an equal NDF basis was also evaluated. Treatments consisted of a control (CON) with no roughage and three roughage sources (alfalfa hay, corn silage, and corn stalks) included at two levels each. Alfalfa was included at 4% (LALF) or 8% (HALF, DM basis) and diets containing corn silage or corn stalks were balanced to provide equal percentages of NDF relative to alfalfa hay. Therefore, corn silage and corn stalks were included at 6% (LCSIL) or 12% (HCSIL) and 3% (LSTK) or 6% (HSTK), respectively (DM basis). All diets contained 30% WDGS and a 1:1 mixture of dry-rolled and high-moisture corn (DM basis). Final BW and ADG of steers fed corn stalks were higher (P<0.05) compared with steers fed CON, LALF, or LSIL, but were not different from steers fed HALF or HSIL. There were no differences (P>0.05) observed for final BW and ADG among steers fed CON, LALF, and LCSIL or among steers fed alfalfa and HCSIL. No differences (P=0.09) in G:F were observed among treatments. In summary, a positive gain response was observed when roughage was added to finishing diets containing 30% WDGS. At low roughage levels, alfalfa and corn silage were not as effective as corn stalks. However, at high roughage levels, these data indicate roughage sources can be exchanged on an equal NDF basis in finishing diets containing 30% WDGS.

Table 1.

Treatment:	CON	LALF	LSIL	LSTK	HALF	HSIL	HSTK	SEM
Final BW, kg[1]	619^{a}	633^{abc}	631^{ab}	649^{d}	646^{cd}	645^{bcd}	649^{d}	5
DMI, kg/d	10.1^{a}	11.1^{b}	11.0^{b}	11.3^{bc}	11.7^{c}	11.5^{c}	11.6^{c}	0.1
ADG, kg/d	1.96^{a}	2.06^{ab}	2.05^{a}	2.17^{c}	2.16^{bc}	2.15^{bc}	2.18^{c}	0.04
G:F, kg/kg	0.195	0.186	0.186	0.192	0.185	0.188	0.188	0.002

[1]Calculated as hot carcass weight divided by a common dress of 63%.
^{abcd}Means with unlike superscripts differ (P<0.05).

Key Words: finishing cattle, distillers grains, roughage

106 Dietary protein level alters small intestine morphology and cecum microbial metabolites in weaned pigs. F Opapeju*[1], C Nyachoti[1], M Rademacher[2], and G Blank[1], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Degussa AG*, *Rodenbacher Chaussee 4, 63457 Hanau-Wolfgang, Germany*.

A total of 96 pigs (average initial BW = 6.44 ± 0.14 kg) were used to evaluate the effect of dietary protein levels on gut morphology, organ weights and microbial population and activity. Pigs were housed 4 per pen and assigned to 4 phase 1 diets (6 pens/diet) in a completely randomized design. The 4 dietary treatments were: 1) 21% CP diet, 2) 19% CP, Ile deficient diet, 3) 19% CP diet supplemented with crystalline Ile up to the level in diet 1, and 4) 17% CP supplemented with Ile and Val based on the ideal protein ratio. All diets contained the same amount of standardized ileal digestible Lys, Met + Cys, Thr, and Trp based on the ideal protein concept. Pigs had unlimited access to feed and water. On d 21, 24 pigs (6 pigs/treatment), representing average BW of each pen, were euthanized while under general anesthesia to determine organ weights and small intestine (SI) morphology. Cecum luminal content was analyzed for ammonia N and VFA concentration, and microbial populations. There were no effects of diets on organ weights except that pigs fed diet 4 had a lower (P = 0.02) weight of the SI than those fed diet 1. Similarly, this was the case when organ weights were expressed as a percent of final BW. Pigs fed diet 1 had deeper (P< 0.05) crypt depth in the duodenum and ileum than those fed the other diets while pigs fed diet 2 had shorter (P < 0.05) villus height than those fed diet 3 in the duodenum. Ammonia N concentration was higher (P < 0.05) in pigs fed diet 1 compared with those fed other diets. There was no effect of diet on VFA concentration except for propionic acid where pigs fed diet 4 had a higher (P = 0.01) concentration compared to those fed diets 1 and 3. Diet had no effect on both adherent and luminal microbial count. The results show that a reduction in dietary CP level from 21% to 17% with adequate crystalline AA supplementation reduced SI weight, crypt hypertrophy and toxic cecal microbial metabolites in weaned pigs.

Key Words: dietary protein, intestinal morphology, weaned pig

Growth and Development, Muscle Biology and Meat Science

107 Selection for intramuscular fat in Duroc swine. T. J. Baas* and C. R. Schwab, *Iowa State University*, *Ames*.

Numerous traits have been identified as indicators of meat quality in pork, including color, firmness, pH, tenderness, marbling or intramuscular fat, juiciness, and flavor. Pork quality is influenced by many factors and research has shown that up to 50 to 70% of the variation in pork quality can be attributed to genetics. Specifically, intramuscular fat (IMF) is moderately to highly heritable and has been shown to be accurately measured in the live animal. Greater amounts of IMF are requested by export markets and have been shown to positively impact juiciness and flavor of pork. A selection project to increase IMF percentage was initiated at Iowa State University in 1998. A select line (SL) and a control line (CL) in a population of purebred Durocs are maintained. In each generation, intramuscular fat is estimated in the live animal using real-time ultrasound (PFAT) and chemical analysis of IMF is obtained on 1-2 carcass pigs (CIMF) from each litter. Selection is on breeding values (EBV) for IMF from a two-trait animal model based on estimates of PFAT and CIMF. After five generations of selection for IMF, the average EBV for pigs in the SL is 1.95% greater than for CL pigs and analysis of performance data revealed a significant advantage for the CL in days to 114 kg, tenth rib backfat, and loin muscle area. A total of 172 pigs were harvested in generation five and LS means for 10th rib backfat and loin muscle area were 20.10 mm and 45.01 cm2 in the CL, and 24.47 mm and 39.17 cm2 in the SL, respectively. Subjective evaluation of marbling and firmness indicated a significant advantage for SL pigs. Line means for Hunter L and Minolta values were 48.17 and 23.23 in the CL,

and 46.23 and 21.47 in the SL ($P < 0.01$), respectively. Sensory panel evaluation of pork flavor and off-flavor revealed a significant advantage for pork from SL pigs compared to pork from CL pigs. Differences between lines were not significant for subjective color, 24 h pH, water holding capacity, cooking loss, Instron tenderness, and sensory evaluation of juiciness, chewiness, and tenderness.

Key Words: intramuscular fat, pork quality, selection

108 The influence of thiazolidinediones on marbling in pigs: in vitro studies of muscle stromal-vascular (S-V) cells from fetal and young pigs and in vivo studies of growing pigs. G. J. Hausman*[1], S. P. Poulos[2], T. D. Pringle[3], and M. J. Azain[3], [1]*USDA ARS*, *Athens,GA*, [2]*Coca Cola*, *Atlanta,GA*, [3]*University of Georgia*, *Athens*.

Thiazolidinediones (TZDs) are insulin sensitizing agents currently used for the treatment of type 2 diabetes and are widely used as adipogenic agents since they are ligands of PPAR gamma, a key adipogenic transcription factor. In vitro studies of porcine S-V cells from semitendinosus muscle and adipose tissue show that TZDs have the potential to modify intramuscular or marbling adipogenesis. Muscle S-V cultures respond differently to two TZDs, ie., ciglitazone and troglitazone whereas the response of adipose S-V cultures was independent of the thiazolidinedione. Therefore, marbling preadipocytes and adipose tissue preadipocytes may differ in regards to PPAR gamma affinity for TZDs. Fetal studies showed that TZDs induced adipocyte development in muscle and adipose S-V cell cultures from very young fetuses. Furthermore, TZDs induced adipocyte development in fetal muscle and adipose S-V cultures much earlier than glucocorticoids. Laminin pre-coated culture dishes markedly enhance myotube formation in muscle S-V cell cultures and were used to demonstrate that troglitazone induced marbling adipogenesis while not influencing myogenesis per se. Additionally, troglitazone treatment did not increase lipid content in adipose tissue or muscle S-V cell cultures. Gilts weighing approximately 70 kg were given 0, 4, or 12 mg rosiglitazone maleate, a thiazolidinedione, orally, once daily, for 49 d then slaughtered using conventional techniques. Rosiglitazone treatment did not influence carcass quality although there was a significant effect of slaughter day on marbling scores. Food intake, body weight gain and feed conversion ratio were also not influenced by rosiglitazone but several significant changes in the fatty acid composition of several tissues were observed. Treatment with TZDs during an earlier period of growth may be necessary to enhance marbling deposition in swine.

Key Words: marbling, porcine, thiazolidinedione

109 Industry perspective on marbling:packer/processor. C. M. Schultz Kaster*, *Premium Standard Farms*, *Milan, MO*.

This presentation will describe some of the current information on the impact of marbling in pork. The pork industry has dramatically changed its definitions of quality over the past twenty years progressing from weight to leanness to muscle quality and more recently to measures of palatability. Marbling is a means for a visual assessment of perceived product quality, and already has consumer meaning due to its use with quality grades in the beef industry. However, marbling had been allowed to diminish in pork as pigs were made leaner. The contribution of marbling to palatability has been debated particularly as it relates to tenderness. Color and pH are both key indicators of quality, and are widely used for selection in the meat industry. Marbling has emerged as a means to differentiate high end product, particularly for the foodservice industry driven by celebrated chefs and menu nomenclature. Ideal amounts of marbling may vary depending on the market, and increasing marbling may come with negative effects like steatosis in ham muscles, increased fat content for nutritional labeling, and negative consumer perceptions of too much fat. Increasing marbling comes at a cost that must be incorporated into a selection program, or segregated into a higher valued product line. Demand for this product is somewhat limited by the amount of pork that chefs include on their menu (usually 1-2 items), and so the additional cost of producing highly marbled product may limit it to the steakhouse or fine dining segments of foodservice industry.

Key Words: pork, marbling, quality

110 Why does a chef look for marbling in pork? P. Geoghegan* and A. T. Waylan, *Cargill, Inc.*, *Wichita, KS.*

Consumers look to chefs to introduce gourmet food solutions and current trends. Food trends begin in white-table cloth restaurants and migrate to the market. Chefs working abroad identified high quality pork as highly marbled, demanding availability from the US pork market. Highly marbled pork is associated with highly marbled beef and reminiscent or pork from the past. Today highly marbled pork is found on many restaurant menus and is becoming available in the service meat case. Customers expect to pay for quality instead of quantity.

Fresh, high quality food materials are expected by culinary and consumers. Within the pork industry, highly marbled pork programs provide a consistent premium pork supply. The premium supply provides culinary the marketing tool to menu pork. Culinary recognizes that marbling provides the anticipated deep, rich pork flavor. Additionally, marbling in pork provides and contributes to tenderness and juiciness.

Marbled pork performs consistently between restaurants regardless of the chosen traditional cooking technique of roasting, grilling, or braising. During cooking the marbling melts away leaving pockets of tenderness as well as bastes the meat with the savory pork flavor. Other advantages of marbled pork over non-enhanced commodity pork include faster cooking times and that marination is unnecessary to alter the flavor or mask undesirable flavors. Premium marbled pork is accented with simple seasonings of salt and pepper complimented with side dishes.

Culinary has brought pork back onto plates because marbling has provided a high quality, consistent eating experience.

Key Words: pork, marbling, culinary

111 Effect of swine diets supplemented with magnesium sulfate and electrolytes on pork quality. J. L. Humphreys*, M. S. Carlson, C. L. Bratcher, L. M. Pulz, and C. L. Lorenzen, *University of Missouri*, *Columbia*.

Market hogs (n = 160, BW=114.4 kg) were allotted to four dietary treatments to evaluate the effectiveness of magnesium sulfate and electrolytes on improving pork quality. The experiment was conducted in four seasons to evaluate seasonality (temperature) as an environmental stress. The temperature variations in the finishing barn for the four trials were: Trial 1, mean 9.4°C (max 17.6, min 3.1°C); Trial 2, mean 11.9°C (max 27.9, min 3.9°C); Trial 3, mean 21.0°C (max 31.5, min 11.7°C); and Trial 4, mean 23.8°C (max 34.2, min 14.6°C). Duroc and Berkshire x Duroc market hogs were grouped by weight, sex and breed into one of four dietary treatments. The dietary treatments were: 1) control (corn/SBM based; 13.5% CP and 0.8% total lysine), 2) control + 3.2g/pig/d of magnesium sulfate (MgSO4) for a minimum of 14 d prior to slaughter, 3) control + 1.5% electrolytes (sodium bicarbonate; NaHCO4) fed for 48 h prior to slaughter, and 4) control + 3.2 g/pig/d MgSO4 + 1.5% NaHCO4. Hogs were transported to the University of Missouri for slaughter. No differences ($P > 0.05$) in pork quality were found between dietary treatments. Live weight, carcass weight and dressing percentage did not differ ($P > 0.05$) by trial. Trial 4 had the highest 24 h loin and ham pH ($P < 0.05$) while hogs processed in Trial 2 had the lowest 24 h pH of the four trials. Trial 4 hogs had the lowest L value in the ham and loin while Trial 3 had the highest L value in the loin and Trial 2 had the highest L value in the ham ($P < 0.05$). According to NPPC color standards, Trial 3 had the lowest ($P < 0.05$) color value while Trials 1 and 4 had the highest values. Trial 4 loins had the lowest drip loss ($P < 0.05$) which corresponded to the highest pH and lowest L values. The highest values for Warner-Bratzler Shear force ($P < 0.05$) were found in Trials 1 and 2 while Trials 3 and 4 both had the lowest values. Overall, dietary treatment had no effect on pork quality. However, seasonal temperature played a significant role in pork quality.

Key Words: environmental temperature, pork quality

112 Distillers dried grains decreases bacon lean and increases fat iodine values (IV) and the ratio of N6:N3 but conjugated linoleic acids partially recovers fat quality. H. White*, B. Richert, S. Radcliffe, A. Schinckel, and M. Latour, *Purdue University*, *West Lafayette, IN*.

Distillers dried grains with solubles (DDGS), from Elkhart, Indiana plant, were fed during the final finishing phase of thirty-six market pigs at either 0%, 20% or 40%. During the last 10 days prior to slaughter, half of each group received a 1% inclusion of conjugated linoleic acid (CLA) (n=6). In addition to carcass measurements, fatty acid profiles and bacon quality tests were performed. There were no differences in loin eye area, tenth rib back fat depth, last rib midline back fat depth, loin-color, -marbling, -firmness or -drip loss. Fatty acid analysis showed a significant ($P<0.0001$) increase in the iodine value (IV) and the ratio of n6:n3 fatty acids with increasing levels of DDGS when compared to control animals. When CLA was added to diets containing either 20 or 40% DDGS there was a significant decrease ($P<0.002$) in IV and the ratio of n6:n3 fatty acids. In bacon slices, there was a significant ($P<0.002$) decrease in the percent lean when compared to bacon slices in control animals. Furthermore, the percent lean to fat of bacon significantly ($P<0.002$) decreased in the DDGS diets when compared to the control bacon slices. These data suggests that including either 20 or 40% DDGS decreases the amount of lean meat found in bacon. At the same time, the IV values and n6:n3 ratios increase in pigs fed DDGS, but can improved/reduced by including 1% CLA in diets.

Key Words: bacon, belly, CLA

113 Effects of aging on tenderness and moisture loss of several enhanced muscles from steers. S. Hutchison*, J. A. Unruh, T. T. Marston, M. C. Hunt, and J. J. Higgins, *Kansas State University*, *Manhattan*.

Enhancement of retail beef has become a common practice because it increases the weight of salable product and decreases the variability in tenderness and juiciness. Therefore, the objective of our study was to determine if additional days of aging (7 vs 28 d) before blade tenderization and injection enhancement would affect tenderness and moisture loss of steer meat. Twenty-four steers were fed a high-concentrate diet for 90 d prior to harvest. The *quadriceps* (knuckle), *gluteus medius* (top sirloin), and *infraspinatus* (top blade) subprimals from the right and left sides were removed and assigned randomly to either 7 or 28 d of aging. After aging subprimals were frozen until they were thawed, blade tenderized, and enhanced at 10% of weight with a solution containing 0.35% phosphate and 0.5% salt. Steaks (2.54 cm thick) from each treatment were used to determine moisture loss and Warner-Bratzler shear force values (WBSF). Moisture losses and WBSF were not different ($P > 0.05$) for steaks from the whole *quadriceps* aged for either 7 or 28 d. However, when the *rectus femoris* and the *vastus lateralis* within the *quadriceps* were compared, the *rectus femoris* had lower WBSF (more tender, $P < 0.01$) than the *vastus lateralis* (2.7 vs. 3.3 kg, respectively). Moisture loss for *gluteus medius* steaks aged for 28 d were greater ($P < 0.01$) compared to losses for steaks aged for 7 d. Aging of *gluteus medius* steaks did not affect ($P > 0.05$) WBSF. For the *infraspinatus*, moisture loss was not affected ($P > 0.05$) by days of aging. However, steaks that were aged for 28 d had lower ($P < 0.05$) WBSF values (2.1 vs 1.9 kg) than those only aged for 7 d. This study suggests that additional aging (28 vs 7 d) for the *quadriceps* and the *gluteus medius* steaks from subprimals that have been blade tenderized and enhanced is not necessary to improve tenderness. However, additional aging from 7 to 28 d for *infraspinatus* steaks from subprimals that have been blade tenderized and enhanced does improve tenderness.

Key Words: beef, tenderness, moisture loss

114 The impact of acidic marination concentration and sodium chloride on sensory and instrumental color characteristics of dark-cutting beef. J. T. Sawyer*, J. K. Apple, and Z. B. Johnson, *University of Arkansas*, *Fayetteville*.

The objectives of this study were to evaluate the effect of enhancement at varying levels of lactic acid (LA) with or without sodium chloride (0.5% NaCl), on muscle pH, percent denatured myoglobin (PDMb), and cooked color (instrumental and sensory) of dark-cutting beef. Dark-cutting (DC) beef strip loins (IMPS #180) were selected based upon postmortem pH values (mean pH = 6.64). DC and normal pH (NDC) strip loins (n = 52) were sectioned into thirds, and DC sections were injected to 110% of raw product weight with LA at 0.5, 1.0, 1.5, or 2.0% of product weight and 0.5% of NaCl. Steaks were cooked to an internal temperature of 71°C and evaluated for degree of doneness (DD; 1 = very rare to 6 = very well done), internal cooked color (CC; 1 = very red to 7 = brown), instrumental cooked color (L*, a*, and b*), and the reflectance ratio of 630nm/580nm (measure of cooked color change from red to brown). Post-enhancement pH values were 6.37^{a}, 5.81^{b}, 5.66^{bc}, 5.39^{cd}, 5.07^{de}, 4.99^{ef}, 4.69^{efg}, 4.67^{fg}, 4.55^{g}, and 4.10^{h} for DC, 0.5% LA, 0.5% LA/0.5% NaCl, NDC, 1.0% LA/0.5% NaCl, 1.0% LA, 1.5% LA, 1.5% LA/0.5% NaCl, 2.0% LA/0.5% NaCl, and 2.0% LA, respectively. Results suggest that LA enhancement can reduce muscle pH and improve the cooked beef color/degree of doneness of DC beef.

Treatment	DD	CC	PDMb	a*	630/580
NDC	3.93^{d}	4.05^{d}	60.14^{abcd}	19.80^{b}	2.63^{b}
DC	2.95^{e}	2.86^{e}	37.15^{e}	24.63^{a}	3.76^{a}
0.5% LA	4.28^{c}	4.56^{c}	54.57^{d}	16.20^{c}	2.26^{bcd}
1.0% LA	4.36^{c}	4.54^{c}	63.08^{abcd}	15.44^{cd}	2.34^{bcd}
1.5% LA	5.12^{ab}	5.75^{ab}	58.36^{bcd}	10.47^{e}	1.52^{e}
2.0% LA	5.43^{a}	6.09^{a}	71.45^{ab}	8.85^{e}	1.40^{e}
0.5% LA / 0.5% NaCl	3.91^{d}	3.89^{d}	57.26^{cd}	19.09^{bc}	2.77^{b}
1.0% LA / 0.5% NaCl	4.51^{c}	4.67^{c}	70.00^{abc}	16.51^{bc}	2.41^{bc}
1.5% LA / 0.5% NaCl	4.41^{c}	4.65^{c}	62.49^{abcd}	14.06^{cd}	1.91^{cde}
2.0% LA / 0.5% NaCl	5.07^{b}	5.68^{b}	72.79^{a}	12.15^{de}	1.74^{de}

$^{a\text{-}e}P < 0.05$

Key Words: beef, dark-cutters, lactic acid enhancement

116 Effect of oral electrolyte supplementation on blood acid-base status, carcass yield, and fresh pork quality traits. B. Yu*, M. Ellis, B. A. Fisher, B. A. Peterson, and M. J. Ritter, *University of Illinois*, *Urbana*.

Twenty four gilts were used in a completely randomized design to evaluate the effect of electrolyte supplementation (0.0% vs. 2.5% $NaHCO_3$) via the drinking water to improve blood acid-base status, carcass yield, and fresh loin quality traits. Pigs were allotted to treatments at ~97 kg and were subjected to an 8 d acclimation period. Electrolyte treatments were imposed for 2 d at the farm and during lairage at the plant. On d 2 of the treatment period, pigs were loaded onto a livestock trailer, mixed with unfamiliar pigs, and transported for 4 h to the UIUC Meat Science Laboratory. Pigs were unloaded, placed into lairage pens by treatment, and allowed to rest overnight (~10 h). The following morning, all pigs were subjected to aggressive handling immediately prior to harvest, which consisted of moving pigs up and down a ~20 m long passageway two times with 2 shocks per lap from an electric goad. Rectal temperature was measured and venous blood samples were collected for the determination of blood acid-base status 2 h prior to transport (baseline), after transport, after overnight lairage, and after aggressive handling (at harvest). Data were analyzed using PROC Mixed of SAS. Pigs on the electrolyte treatment had higher ($P \leq 0.01$) blood levels for pH, bicarbonate, and base-excess at all four sampling times than control pigs. However, electrolyte supplementation reduced ($P < 0.05$) live body weights before and after transport, and had no effect on rectal temperature, blood lactate, carcass dressing percentage, loin muscle pH (45 min and 24 h postmortem), loin Hunter L*, and loin chop drip loss. In summary, administering 2.5% $NaHCO_3$ via the drinking water for 2 d improved blood acid-base status and reduced live body weights, but did not affect carcass yield or fresh pork quality traits.

Table 1. Impact of electrolyte treatment on body weight and blood acid-base status

Trait	Control	Electrolyte	SEM	P-Value
Body weight, kg				
-Start of treatment	104.1	102.9	1.30	0.50
-End of treatment	106.3	101.6	1.28	0.02
-At harvest	101.1	95.8	1.25	0.01
Blood pH				
-Baseline	7.40	7.50	0.01	0.01
-After transport	7.39	7.48	0.02	0.01
-After lairage	7.43	7.53	0.02	0.01
-After handling	7.15	7.30	0.03	0.01
Blood bicarbonate, mmol/L				
-Baseline	31.9	48.7	1.67	0.01
-After transport	29.5	41.3	1.08	0.01
-After lairage	29.0	44.0	2.40	0.01
-After handling	22.2	31.5	2.07	0.01

Key Words: pig, sodium bicarbonate, acid-base balance

117 Empirical modeling for predicting objective tenderness of muscles from the beef round. J. T. Sawyer*, J. K. Apple, J.-F. Meullenet, B. Cheatman, W. K. Chung, and R. Xiong, *University of Arkansas*, *Fayetteville*.

The objectives of this study were to compare and analyze two spectroradiometers with two instrumental tenderness measures, and develop an empirical model that could accurately predict tenderness of semimembranosus (SM) and semitendinosus (ST) steaks. Beef top and bottom rounds were selected from one of four USDA quality grade categories (n = 10/quality grade), including Prime, upper 2/3 Choice (CAB), low Choice, and Select. Five 2.5-cm-thick steaks from each SM and ST were removed and allotted at random to be aged for either 0, 7, 14, 21, or 28 d at 4°C. Initially (d 0) and at the end of each aging period, steaks were first scanned from 400 to 2,400 nm with a NIRSystem (NIRS) spectroradiometer, then scanned from 350 to 1,050 nm with an ASD Field Spec Pro (ASD). All steaks were cooked to an internal temperature of 71°C, and allowed to cool to room temperature. Razor-blade shear force (RBSF) was measured allowing a 1-cm-wide razorblade to travel 50% of the steak thickness, and four peak force values were obtained from each steak. Then, six 1.3-cm-diameter cores, removed parallel to fiber orientation, were sheared for Warner-

Bratzler shear force (WBSF) determinations. Partial least squares (PLS) regression models on normalized spectra were able to explain 61 (ASD) to 85% in the SM and 45 (ASD) to 41% (NIRS) in the ST of the variability in WBSF values. PLS regression models for RBSF values were able to explain 67 (ASD) to 88% (NIRS) in the SM and 47 (ASD) to 46% (NIRS) in the ST of the variation in muscle tenderness. The spectroradiometers differed in predictive capabilities; yet, because there were no correlations between WBSF and RBSF values, these instrumental tenderness methodologies could not be accurately compared.

Key Words: beef, tenderness, near-infrared spectroscopy

118 Proteolysis, calpastatin activity, and μ-calpain autolysis in specific muscles from the beef round. M. J. Anderson*, K. Mou, C. Gregorich, E. Steadham, S. M. Lonergan, and E. Huff-Lonergan, *Iowa State University*, *Ames*.

Several muscles in the beef round could be marketed as individual value cuts and/or food service items if they are consistently tender. However, it is not known how these specific muscles tenderize. Therefore, the objective of this study was to understand the biochemical mechanisms that influence beef tenderness, specifically μ-calpain activation, calpastatin activity and subsequent muscle protein proteolysis in specific muscles of the beef round. It was hypothesized that the round muscles studied would demonstrate different rates of protein degradation. At 24 h postmortem, the longissimus dorsi (LD –control muscle), gracillus (GR), adductor (AD), semimembranosus (SM), sartorius (SAR), vastus lateralis (VL), and vastus intermedius (VI) muscles were removed from ten market-weight beef cattle. The pH was measured in each muscle. Heated sarcoplasmic protein extracts from each muscle were used to measure calpastatin activity. Whole muscle samples were made from all muscles for Western blot analysis of μ-calpain autolysis and SDS-PAGE analysis of titin degradation. Across muscles, pH was significantly correlated with 24-h calpastatin activity (0.475, $P<0.0001$) and with the percentage of μ-calpain as the 76 kDa autolysis product (-0.311, $P<0.05$). The AD, GR, and LD had a higher percentage of μ-calpain as the 76 kDa autolysis product, suggesting that calpain was activated earlier in those muscles. The SAR, SM, VL and VI had a lower percentage of the 76 kDa autolysis product at 24 hours postmortem. VI had the highest calpastatin activity, followed by GR, LD, and VL. The lowest calpastatin activity was found in the AD, SAR, and SM muscles. Differences in the degradation of titin, a substrate of μ-calpain, were found. The SAR had little, if any, detectable intact titin at 24 hours postmortem. The results of this study indicate that there are differences in the rate of proteolysis occurring in the muscles studied. These results will help guide progress in determining suitability of these muscles for various markets.

Key Words: calpain, calpastatin, titin

119 Interactions of mammalian synemin isforms with focal adhesion proteins vinculin and talin. N. Sun* and R. M. Robson, *Iowa State University*, *Ames*.

The type VI intermediate filament (IF) protein synemin is a unique, very large member of the IF protein superfamily. Previous results from our lab indicate that synemin associates with the major type III IF protein desmin, thereby forming heteropolymeric IFs, and also interacts with specific cytoskeletal proteins in muscle cells, including α-actinin, vinculin, and distrophin/utrophin. Mammalian synemin is expressed as at least two splice variants, namely α- and β-synemins, with the larger α-synemin having an extra 312 amino acid insert present near the end of the very long C-terminal tail domain. The functional differences between the two mammalian synemin isoforms have remained unclear. We have discovered that α-synemin, but not β-synemin, interacts with the proteins vinculin and talin, which are present within muscle cell structures such as the costameres located subjacent and periodically along the sarcolemma. Results of protein-protein interaction assays including blot overlay and GST pull-down assays show that the specific primary protein sequence present only in α-synemin binds to recombinant fragments from both vinculin and talin. Results of indirect immunofluorescence studies demonstrate that synemin co-localized with vinculin and talin at the focal adhesion sites within mammalian smooth muscle cells. Transient expression of the enhanced green fluorescent protein (EGFP) tagged recombinant 312 amino acid insert present in the larger α-synemin isoform within smooth muscle cells showed that this fragment was specifically incorporated into both the focal adhesions and actin stress fibers in these cells. The results in toto suggest that the larger α-synemin isoform can enable the desmin/synemin heteropolymeric IFs in muscle cells to link the peripheral layer of cellular myofibrils to the costameres located periodically and subjacent to the sarcolemma.

(Supported by USDA-CSREES-NRICGP Award 2003-35206-12823)

Key Words: intermediate filaments, synemin, myofibrils

120 Sarcomeric thick and thin filament overlap influences postmortem proteolysis. A. D. Weaver*[1], L. Jouault[1], B. C. Bowker[2], A. L. Grant[1], and D. E. Gerrard[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*USDA-ARS Food Technology and Safety Laboratory*, *Beltsville, MD*.

The interaction between sarcomere length (SL) and proteolysis on meat tenderness is not clear. Indeed, the extent of thick and thin filament overlap alters actomyosin binding and may alter substrate availability during aging. The objective of this study was to determine the influence of sarcomere length on proteolytic degradation in beef. In one study, beef carcasses were subjected to either hip (HS) or normal suspension (NS). At 24 h, longissimus dorsi (LD), semitendinosus (ST), and psoas major (PM) muscles were removed and aged for 2, 4, 7 or 10 d. In a second study, ST muscles were removed from carcasses and dissected into strips parallel to fiber orientation. Strips were

either stretched 40% and restrained or placed in an ice bath. After rigor completion, strips were divided into 2.5 cm cross sections and randomly assigned to 2, 4, 7 or 10 d aging treatments. Myofibrils were isolated and sarcomere length was determined. Additional samples were frozen for shear force analysis. Muscle proteins were extracted and subjected to SDS-PAGE and western blot analyses to determine troponin T (TnT) proteolysis. HS increased sarcomere length in the LD and ST samples and shortened sarcomeres in PM samples. Analysis of the four TnT-specific immunoreactive bands confirmed degradation increases with aging. An increase in the relative intensity of bands two, three and four confirmed TnT degradation; however, sarcomere length had no effect on the rate or extent of proteolysis in the LD and ST. Lack of significance was likely due to the small range in sarcomere lengths achieved using HS. Actomyosin bonds in the overlap region would not necessarily differ over the SL ranges generated. However, SL in PM samples was sufficient to alter the amount of actomyosin bonds. Disappearance of band one and a corresponding appearance of bands three and four was less evident between 4 and 7 d in normally suspended PM samples suggesting proteolysis may be hindered in muscles possessing long (~3.7 μm) SL. Western blot analysis indicated the appearance of bands three and four was greater in the 40%-stretched samples suggesting degradation of TnT is sarcomere length-dependent.

Key Words: tenderness, sarcomere, proteolysis

Nonruminant Nutrition

121 Total track digestibility of colostral proteins and amino acids by neonatal pig. C. Lin*[1], D. C. Mahan[2], G. Wu[3,1], C. Vasquez[1], and S. W. Kim[1,3], [1]*Texas Tech University*, *Lubbock*, [2]*The Ohio State University*, *Columbus*, [3]*Texas A&M University*, *College Station*.

The experiment was conducted to determine the total tract digestibility of proteins and amino acids in sow's colostrum by neonatal pigs. Twelve, 1-d-old, male piglets were selected from three litters (four per litter) and housed individually in metabolism crates with heating lamps to maintain the temperature at 35°C. Colostrum (13 L) was collected from 140 sows within 12 h postpartum after injection of oxytocin. All the piglets were fed colostrum containing 0.25% chromium oxide as an external marker based on the following feeding program: 6 meals per day for an entire 3 d period; with 40 mL per meal for d 1 (240 mL per day), 55 mL per meal for d 2 (330 mL per day), and 70 mL per meal for d 3 (420 mL per day). Colostrum was hand-fed using baby milk bottles. Entire fecal samples with chromium color were collected each day until the color faded in the feces. Fecal samples were weighed, stored in a freezer, freeze-dried, and thoroughly ground for chemical analysis. Blood samples were collected on d 3 to obtain plasma samples for immunoglobulin (Ig) G analysis. The average total tract digestibility of total amino acids (protein-bound plus free) in the colostrum was 98.3±0.1%, with the values being 98.5±0.26, 98.2±0.36, and 98.3±0.28%, respectively, for lysine, threonine, and arginine. Plasma and colostral IgG content were 3.44±0.29 and 3.76±0.65 mg/mL, respectively. In conclusion, protein-bound and free amino acids in sow's colostrum were highly digestible by neonatal pigs.

Key Words: amino acid, colostrum, pigs

122 Apparent absorption of methionine and 2-hydroxy-4-methylthiobutanoic acid in gnotobiotic pigs. G. Malik[1], M. D. Drew[1], D. Hoehler[2], and A. G. Van Kessel*[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Degussa Corporation*, *Kennesaw GA*.

Earlier, we reported lower apparent absorption of 2-hydroxy-4-methylthiobutanoic acid (MHA-FA) relative to DL-methionine (MET) in conventional (CV) pigs. To evaluate microbial contribution to differences in the bioefficacy of methionine sources, we report here the apparent absorption of MET and MHA-FA in gnotobiotic pigs. Caesarean-section derived pigs (n=24) were reared in HEPA-filtered isolator units (4 pigs/unit) according to an established germ-free protocol. From birth, pigs were fed irradiated sow's colostrum (120 mL/pig) followed by Similac® (2:1 with water) *ad libitum*. At 14 d of age pigs were weaned to an irradiated corn or wheat/barley-based diet supplemented with MET or MHA-FA on an equimolar basis. After an overnight fast at 24 d of age, ^{3}H-L-MET or ^{3}H-L-MHA-FA and chromic oxide were added to the diets and fed as a meal (20 g/kg BW). After 3 hrs pigs were killed and digesta was collected from stomach and locations corresponding to 5, 25, 50, 75 and 95% of small intestine (SI) length. Residual MET and MHA-FA in digesta were calculated as the ratio of ^{3}H:chromic oxide in digesta to the ratio of ^{3}H:chromic oxide in feed. Bacterial contamination occurred such that 8 pigs (2 isolators) were monoassociated with a bacteria closely related to *Providencia* spp. and 16 pigs (4 isolators) were monoassociated with *Enterococcus faecium*. Species of bacterial contaminant and diet composition did not affect retention of MET or MHA-FA. Both MET and MHA-FA were retained in stomach (96 and 99%, respectively) but disappeared rapidly in SI such that, respectively, apparent retention was 43 and 47% at 5% location,12 and 14% at 50% of SI length and 9 and 13% at 75% of SI length ($P < 0.01$). In contrast to CV pigs, apparent absorption of MET and MHA-FA was similar in monoassociated pigs, in accordance with our data in broiler chickens, supporting a contribution of microbial metabolism in explaining the differences in bioefficacy of these methionine sources.

Key Words: DL-methionine, methionine hydroxy analog, microbiota, pigs

123 Effects of dietary protein level on ileal amino acid digestibility, growth performance, incidence of diarrhea, and formation of microbial metabolites in the ileum and cecum of early-weaned pigs. J. Htoo*[1], W. Sauer[1,3], M. Rademacher[2], Y. Zhang[1], B. Araiza[3], M. Cervantes[3], and R. Zijlstra[1], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Degussa AG*, *Hanau, Germany*, [3]*Universidad Autónoma de Baja California*, *Mexicali, México*.

Diarrhea incidence in weaned pigs may be associated with intestinal microbial metabolites (ammonia, amines, VFA) that are influenced by dietary CP content. Three experiments were conducted to determine effects of a low-protein, AA-supplemented diet on ileal AA digestibility,

growth performance, diarrhea incidence, and concentration of microbial metabolites in the ileum and cecum of pigs weaned at 14 d of age. In Exp. 1, 10 piglets fitted with an ileal T-cannula were assigned in a cross-over design to two diets containing 24 or 20% CP using wheat, corn and full-fat soybeans; extra crystalline AA were added to the diets to meet AA requirements (NRC 1998). Chromic oxide was used as an indigestible marker. Diets were fed at 2.5 × ME requirement for maintenance. Reduced dietary CP decreased apparent ileal digestibility of all non-essential and most essential AA ($P<0.05$), except for Lys, Met and Thr. Dietary CP level did not affect ileal digesta pH and ammonia N, amine and VFA concentrations. In Exp. 2, 8 piglets fitted with a cecal T-cannula were assigned to two diets, similar to Exp. 1. Dietary CP did not affect cecal digesta pH. Reduced dietary CP decreased cecal ammonia N, acetic acid, isobutyric acid, total VFA, and putrescine concentrations by 28 to 39% ($P<0.05$). In Exp. 3, 32 piglets were assigned to two diets, similar to Exp. 1, according to a randomized complete block design. Pigs had free access to feed and water. Dietary CP did not affect growth performance or fecal consistency scores during the 3-wk study and diarrhea was not observed. Combined, diarrhea did not occur; however, reducing dietary CP with AA supplementation markedly decreased the production potentially-harmful microbial metabolites in the cecum but not the ileum without influencing growth performance.

Key Words: amino acid, metabolite, pig

127 Effects of egg antibody products on performance of weanling pigs. F. Ji*[1], V. G. Perez[1], M. Steidinger[2], and J. E. Pettigrew[1], [1]*University of Illinois*, *Urbana*, [2]*Swine Nutrition Services, Inc.*, *Forrest, IL*.

Phospholipase A2 catalyzes a step in the inflammatory process that draws nutrients away from muscle growth. Cholecystokinin is a hormone that regulates apetite. Providing antibodies against them may increase feed intake, growth rate, and feed efficiency. Such antibodies have been produced in eggs from laying hens hyper-immune to specific antigens. To determine the effects of antiphospholipase A2 (aPLA2) and antibody to cholecystokinin (aCCK) as growth promotants on the performance of nursery pigs, 1008 pigs weaned at 19 to 21 d were housed in a total of 48 pens in four rooms. Within each room, pigs were blocked by weight to 3 blocks. Each block had 4 pens with 21 pigs per pen and similar numbers of gilts and barrows. Four treatments were basal diet (B), B + 0.017% of aCCK, B + 0.15% of aPLA2, and B + 0.017% aCCK + 0.15% of aPLA2. There was a 4-stage feeding program, with phases of 1, 1, 2, and 2 weeks, respectively, in a 6-week experiment. Four experimental diets were used in each phase. Feed and water were available ad libitum. Pigs which were dead or sick were removed from the study and removal rate (RR) was calculated. There was no interaction between aCCK and aPLA2. Supplying aPLA2 improved G/F ($P < 0.05$) and tended to increase ADG ($P = 0.08$) during phase 1. The RR was not affected. Supplying aCCK did not affect any of these measures. In summary, the results suggest that aPLA2 improved G/F and increased ADG in early nursery, but not in late nursery.

Period	Measure	Control	aCCK	aPLA2	Both	SE	P[a]
Phase 1	ADG, g	418	426	449	438	12	0.079
	ADFI, g	532	544	543	533	12	0.972
	G/F	0.783	0.786	0.824	0.826	0.018	0.028
Overall	ADG, g	904	903	901	896	11	0.649
	ADFI, g	1395	1406	1390	1384	18	0.455
	G/F	0.657	0.645	0.652	0.651	0.006	0.965

[a]Probability of no main effect of aPLA2

Key Words: antibody egg, performance, nursery pigs

128 The effect of feeding pharmacological concentrations of zinc oxide on growth performance and fecal microflora of nursery pigs. L. M. Pulz* and M. S. Carlson, *University of Missouri*, *Columbia*.

The experiment was conducted to evaluate the effect of feeding pharmacological levels of zinc oxide (ZnO) on growth performance and fecal microflora in nursery pigs. Forty crossbred pigs (7.53 ± 0.14 kg; 24 ± 0.5 d) were weaned and allotted to one of four dietary treatments based on weight and ancestry (1 pig/metabolism crates and 10 reps), for the duration of the 28-d study. Phase 1 (d 1 to d 14) and Phase 2 (d 15 to d 28) nursery diets were fed in meal form. Both dietary phases utilized four treatments: (1) Basal diet contained 165 ppm Zn as $ZnSO_4$ which was supplied by the trace mineral premix, (2) Basal + 750 ppm Zn as ZnO, (3) Basal + 1,500 ppm Zn as ZnO, (4) Basal + 3,000 ppm Zn as ZnO. Body weights, feed disappearance, and fecal samples were collected weekly. Fecal samples were collected to determine the number of excreted Escherichia coli and Lactobacilli colonies. There was no effect of dietary Zn treatments on average daily gain, feed intake and feed efficiency (gain/feed) of nursery pigs during week 1, week 2, week 3, week 4, and overall ($P > 0.05$). The number of excreted Escherichia coli and Lactobacilli per gram of feces was not affected by the dietary treatment ($P > 0.05$). However, the number of Escherichia coli and Lactobacilli changed over time ($P \leq 0.05$). These results indicate that the positive performance improvements of feeding pharmacological concentrations of Zn as inorganic ZnO has no effect under conditions of minimal stress, minimal pathogen challenge, and high health status nursery pigs. Therefore, this may be a reason why no difference was observed in fecal microflora among dietary treatments.

Key Words: nursery pigs, zinc oxide, fecal microflora

129 Growth performance of nursery and growing pigs fed graded levels of red blood cells. A. Waguespack*, D. Dean, T. Bidner, and L. Southern, *LSU Agricultural Center*, *Baton Rouge, LA*.

Three experiments were conducted to determine the effect of graded levels of red blood cells (RBC) in diets for nursery (phase 2; 7 to

13 kg) and grower (24 to 46 kg) pigs. In Exp. 1 and 2, there were 5 treatments with 5 or 6 replicates per treatment with 4, 5, or 6 pigs per pen. The experiments lasted 14 d. The RBC were added at 0, 2, 4, 6, and 8% to a diet formulated to contain 1.4% total Lys in Exp. 1 or 1.2% true digestible Lys (tdLys) in Exp. 2. Supplemental Thr, Trp, Met, and Ile were added as needed to meet a constant ratio to tdLys in both experiments. The diets were corn-soybean meal (C-SBM) based and contained 10% whey, 5% fishmeal, 3% fat, and 0.10% L-Lys•HCl. In Exp. 1, increasing dietary RBC resulted in a decrease in ADG (460, 432, 478, 429, and 412 g/d; linear, $P < 0.06$) and ADFI (673, 609, 672, 618, and 601 g/d; linear, $P < 0.05$), and a quadratic effect on G:F (683, 708, 710, 694, and 683 g/kg; $P < 0.04$). In Exp. 2, increasing dietary RBC resulted in a decrease in ADG (383, 398, 366, 366, and 305 g/d; quadratic, $P < 0.01$), ADFI (598, 643, 600, 613, and 562 g/d; quadratic, $P < 0.02$), and G:F (645, 620, 611, 597, and 541 g/kg; linear, $P < 0.01$). Experiment 3 was conducted for 28 d to determine the effect of graded levels of RBC in 24- to 46-kg pigs. In Exp. 3, there were 5 treatments with 4 replicates (2 gilt and 2 barrow) per treatment with 6 pigs per pen. The RBC were added at 0, 2, 4, 6, and 8% to a diet formulated to contain 1.0% total Lys. Supplemental Thr, Trp, Met, and Ile were added as needed to meet a constant ratio to total Lys. The diets were C-SBM based. Increasing dietary RBC resulted in a decrease in ADG (765, 795, 754, 712, and 689 g/d; linear, $P< 0.01$) and ADFI (1.91, 1.83, 1.86, 1.71, and 1.75 kg/d; linear, $P < 0.01$) but no effect on G:F (404, 435, 410, 418, and 400 g/kg). The results of these experiments indicate that 6% or greater dietary RBC decrease growth performance of nursery and growing pigs. Although the effect was not significant, 2 or 4% RBC inclusion generally increased growth performance.

Key Words: red blood cells, pigs, growth

130 Zero-tannin fababean, field pea and soybean meal as dietary protein sources for growing- finishing pigs. C. Gunawardena*[1], W. Robertson[2], M. Young[3], R.T. Zijlstra[1], and E. Beltranena[1,4], [1]*University of Alberta*, *Edmonton, AB*, [2]*Agriculture and Agri-Food Canada*, *Lacombe, AB*, [3]*Gowans Feed Consulting*, *Wainwright, AB*, [4]*Alberta Agriculture, Food and Rural Development*, *Edmonton, Alberta, Canada*.

Nearly 1000 Fast™ crossbred pigs were used to compare locally-grown zero-tannin fababean (ZTFB) or field pea (PEA) to soybean meal (SBM), or 50% ZTFB and 50% SBM as dietary protein sources on growth performance (30 to 118 kg), carcass cutouts and pork quality of barrows and gilts. The four-phase, wheat-based diets provided 2.45, 2.45, 2.40 and 2.35 Mcal NE/kg and 4.0, 3.6, 3.2, 2.7g SID lys per Mcal NE, respectively. Diets were randomly allocated to pens of 21 barrows or gilts within six blocks of eight pens. Performance variables such as ADG (1.02 kg/d), ADFI (2.68 kg/d) and G:F (2.70) and carcass variables such as warm carcass weight (94.5 kg including head, kidney, leaflard and feet on) and fat (20.5 mm) and lean (65.2 mm) depth were similar among diets. Diet affected pork quality significantly for L. thoracis Japanese color subjective score, pH and drip loss: pork from pigs fed 50% FABA and 50% SBM was darker (0.37 points) than that of pigs fed either SBM or PEA ($P < 0.05$). Muscle pH for pigs fed PEA was lower (0.065 points) than for pigs fed FABA or 50% FABA and 50% SBM ($P < 0.05$). Chop drip loss from pigs fed FABA or 50% FABA and 50% SBM was lower (1.18 percentage points) than that of pigs fed SBM or PEA ($P < 0.05$). Diet did not affect the proportion of lean, fat or bone in each of the four leanest pork primal cuts (picnic, butt, loin, ham), all combined, adding the bacon piece and side ribs or on total lean as a proportion of carcass side weight. Barrows consumed more feed, grew faster, but had reduced G:F compared to gilts ($P < 0.05$). Gilts had greater lean and lower fat in carcass and primal cuts ($P < 0.05$). These results suggest that locally grown ZT fababean can fully or partially replace PEA or imported SBM as dietary supplemental protein source without negative effects on pig performance, carcass traits or pork quality.

Key Words: fababean, performance, pork

131 Ileal amino acid digestibility of a new high protein variety of soybeans fed to growing pigs. S. C. Pahm* and H. H. Stein, *University of Illinois*, *Urbana*.

The standardized ileal digestibility (SID) of AA in a new high protein variety of soybeans (SSeed HP′290) was determined using growing pigs and compared with the SID of AA in a commercial source of soybeans (CSB), with soybean meal (SBM), and with soy protein concentrate (SPC). Each of these 4 sources of soy products was included in 1 experimental diet. Two additional diets were formulated by adding soybean oil (7.55 and 7.35%, respectively) to SBM and SPC. The last diet was a N-free diet. Seven growing barrows (initial BW: 26.2 kg) were fitted with a T-cannula in the distal ileum and allotted to a 7 x 7 Latin square design. The SID for CP and all indispensable AA except Met in SSeed.HP were greater ($P < 0.05$) than in SBM, but there were no differences between SSeed.HP and SPC. The SID for Ile, Phe, and Val in SSeed.HP were also greater ($P < 0.05$) than in CSB, but for CP and all other indispensable AA, no differences between the 2 sources of soybeans were observed. The addition of soybean oil to SBM increased ($P < 0.05$) the SID for all indispensable AA, except Arg, His, Lys, and Thr. It is concluded that the SID for AA in the new high protein variety of soybeans, SSeed.HP, are greater than in SBM and similar to SPC when fed to growing pigs.

Standardized ileal digestibility (%) by growing pigs

Item	290F.HP	Commercial soybeans	Soybean meal	Soybean meal and oil	Soy protein concentrate	Soy protein concentrate and oil
Ile	93.1 zu	89.1 x	89.1 x	91.7 yz	93.6 uv	91.2 z
Lys	93.0 y	92.5 y	87.7 x	90.6 xy	93.2 y	97.9 z
Met	94.0 xy	92.2 x	92.6 x	95.5 yz	95.9 yz	97.0 z
Phe	93.7 z	90.7 y	88.9 x	91.5 y	94.4 zu	96.0 u
Thr	87.6 y	86.4 xy	83.6 x	86.1 xy	89.4 yz	91.2 z
Trp	90.1 yz	89.4 y	86.1 x	90.1 yz	95.6 u	95.6 u
Val	91.7 z	89.0 xy	87.3 x	90.6 yz	92.7 zu	95.2 u

[uvxyz]Means within a row without a common superscript differ ($P<0.05$).

Key Words: amino acids, pigs, soybeans

132 In vitro analysis to predict energy digestibility of cereals for grower pigs. R. T. Zijlstra*[1], M. N. Casano[1], J. H. Helm[2], L. Oatway[2], and E. Beltranena[3], [1]*University of Alberta*, *Edmonton, AB*, [2]*Field Crop Development Centre*, *Lacombe, AB*, [3]*Alberta Agriculture, Food and Rural Development*, *Edmonton, AB, Canada*.

Feed quality of barley for grower pigs has been shown to vary by over 25% for many of the feed quality characteristics of interest. For cereal grains, energy digestibility and DE content or other measures of energy value are considered most important for determination of economic value of individual samples; hence, analyses that determine or predict energy digestibility cost-effectively are of prime interest. Barley samples (n=57) with a range in chemical and physical characteristics (11.1 to 18.3% CP, 3.5 to 5.9% β-glucans, 54.6 to 66.4% starch, and 58.3 to 78.9 kg/hL test weight) were subjected to an in vitro analysis in quadruplicate. Briefly, the procedure involved subsequent digestions with pepsin (6 hr), pancreatin (18 hr), and cellulase (24 hr), and DM and GE analyses of the barley sample and residue. In vitro energy digestibility ranged from 80.6 to 91.5% and the relative error ranged from 0.1 to 1.9%; the in vitro DE content ranged from 3.65 to 4.23 Mcal/kg DM. For a subset of 16 barley samples, total-tract energy digestibility was measured in grower pigs in quadruplicate and ranged from 79.9 to 88.1% with a relative error ranging from 0.6 to 2.1%; the in vivo DE content ranged from 3.55 to 4.15 Mcal/kg DM. In vitro energy digestibility had a strong linear relationship with in vivo energy digestibility ($R^2 = 0.88$), unlike test weight ($R^2 = 0.51$). A calculation of curvilinear relationships did not improve the prediction, suggesting that neither substrate nor enzymes limited in vitro energy digestibility. In summary, in vitro energy digestibility was an accurate predictor of in vivo energy digestibility. In vitro energy digestibility can be successful as the core analytical procedure to calibrate rapid analytical equipment to predict in vivo energy digestibility and therefore DE content of barley for grower pigs.

Key Words: barley, energy digestibility, pig

133 Chemical characterization and digestible nutrient content of barley and oat starch ingredients derived via wet fractionation for grower pigs. I. R. Johnson, T. Vasanthan, F. Temelli, and R. T. Zijlstra*, *University of Alberta*, *Edmonton, AB, Canada*.

Wet fractionation of cereals may yield concentrated fiber fractions, such as β-glucans, from barley and oats that can be used for functional food applications. The major remaining fraction is starch-rich and has potential for feed or other applications. The nutritional value of barley and oat-derived starch ingredients are unknown for swine, and were compared to their parent grain, either hulless barley or oats, respectively. The hulless barley flour contained 69.9, 11.8, 1.7 and 5.9% (DM) starch, CP, EE, and NDF, respectively, and its starch fraction contained 90.0, 4.2, 0.8 and 0.6%, respectively. The hulless oat flour contained 63.6, 18.5, 5.5 and 6.1% starch, CP, EE, and NDF, respectively, and its starch fraction contained 74.3, 13.8, 5.6 and 0.9%, respectively. The four ingredients were each mixed in a ratio of 1:1 with a control diet into five diets containing 1% acid-insoluble ash as marker. Diets were fed to ileal-cannulated pigs; feces and ileal digesta were collected. Diet and test ingredient digestibility values were obtained using the indicator and difference methods, respectively. Ileal energy digestibility was lower for the barley than its starch (86.4 versus 91.4%; $P < 0.05$) and similar for the oats and its starch (89.0 and 90.2%). Total tract energy digestibility was 94.8 and 96.0% for the barley and its starch and 97.3 and 96.6% for the oats and its starch, respectively, resulting in a DE content of 4449, 4442, 4827 and 4744 kcal/kg DM, respectively. Standardized ileal digestibility for lysine was 97.1 and 97.9% for the barley and its starch and 99.9 and 97.8% for the oats and its starch, respectively. Combined, energy and AA digestibility of hulless barley and oats and their derived starch fractions were high. Wet fractionation of cereals to extract fiber fractions may therefore yield starch-enriched feedstuffs that have a digestible nutrient profile that will suit inclusion into diets for weaned pigs.

Key Words: barley, pig, starch

134 Influence of Nutridense® low phytate corn and added fat on grow-finish pig growth performance. S. K. Linneen*[1], R. O. Gottlob[1], S. S. Dritz[1], M. D. Tokach[1], J. M. DeRouchey[1], R. D. Goodband[1], J. L. Nelssen[1], and J. L. Snow[2], [1]*Kansas State University*, *Manhattan*, [2]*BASF Plant Science*, *Research Triangle Park, NC*.

Two experiments were conducted to determine the influence of NutriDense® Low Phytate corn in conjunction with increasing added fat on grow-finish pig performance. Both experiments were arranged as 2 × 3 factorials with main effects of either yellow dent (YD) or NutriDense® Low Phytate (NDLP) corn with either 0, 3, or 6% added fat. In Exp. 1, 1,162 gilts (44.6 kg) were used in a 28-d study. Diets were formulated to 2.80 g TID lysine:Mcal ME and a constant available P:energy ratio of 0.90 g/Mcal. Overall, there were no corn source × fat level interactions ($P > 0.79$) and no differences in ADG (872 vs 882 g/d; $P < 0.59$) or G:F (0.47 vs 0.46; $P < 0.48$) between pigs fed YD and NDLP corn. Average daily gain increased (854, 873, 904 g/d; linear, $P < 0.03$) and gain:feed improved (0.446, 0.467, 0.481; linear, $P < 0.01$) with increasing dietary fat. In Exp. 2, 1,128 gilts (81.6 kg) were used in a 28-d growth assay. Diets were formulated to 2.15 g TID lysine:Mcal ME and a constant available P:energy ratio of 0.75 g/Mcal. Overall, there was a tendency for a G:F corn source × fat level interaction ($P < 0.07$) because G/F was only improved when 6% fat was added to the diet for pigs fed yellow dent corn, while a linear improvement was found with increasing fat level for pigs fed NDLP corn. However, there were no differences in ADG (871 vs 857; $P < 0.50$) or G:F (0.33 vs 0.34; $P < 0.39$) between pigs fed YD and NDLP corn. Average daily gain increased (833, 846, 913 g/d; linear, $P < 0.01$) and G:F improved (0.319, 0.333, 0.358; linear, $P < 0.01$) with increasing dietary added fat. In conclusion, pigs fed NDLP corn, regardless of added fat level, responded similarly in growth performance to pigs fed YD corn. This combined with the environmental advantages of NDLP, make it a viable alternative to YD corn.

Key Words: pigs, fat, corn hybrids

135 Effect of low-phytate barley or phytase supplementation to a barley-soybean meal diet on phosphorus excretion by grower pigs. J. Htoo*[1], W. Sauer[1,2], M. Cervantes[2], Y. Zhang[1], J. Helm[3], and R. Zijlstra[1], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Universidad Autónoma de Baja California*, *Mexicali, México*, [3]*Field Crop Development Centre*, *Lacombe, AB, Canada*.

Low-phytate barley and phytase supplementation may improve P utilization. In Exp. 1, eight 25-kg barrows were assigned in a repeated

4x4 latin square to four 96%-barley diets in a 2x2 factorial arrangement: 1) covered barley (CB), 2) low-phytate CB (LPCB), 3) hulless barley (HB), and 4) low-phytate HB (LPHB). Inorganic P (iP) was added to diets 1 and 3 to meet available P (aP) requirement (NRC, 1998); diets 2 and 4 contained sufficient aP (>0.23%). Diets were fed at 2.5 × ME maintenance requirement. The apparent total tract digestibility (ATTD) of DM and OM, total excretion and retained P (g/d) were higher (P<0.05) for hulless than covered barley diets. The ATTD of P was higher, total P excretion was 35% lower, and retained P (g/d) was lower for the low-phytate barley diets (P<0.01), confirming that low phytate barley improved P digestibility and requires further characterization to maintain P retention. In Exp. 2, eight 25-kg barrows were assigned in a repeated 4´4 latin square to one of four diets: 1) CB-SBM, 2) CB-SBM + iP, 3) CB-SBM + phytase, and 4) LPCB-SBM. Diets 1 and 3 contained a suboptimal level of aP and diets 2 and 4 contained adequate aP (>0.23%). The feeding regimen was similar to Exp. 1. Phytase supplementation to the CB-SBM diet increased ATTD and retained P (g/d) and decreased P excretion (P<0.001). Adding iP to the CB-SBM diet did not affect ATTD of P but increased retained P (g/d) and excretion (P<0.001). Pig fed LPCB-SBM and CB-SBM + phytase diets did not differ in ATTD, retention and excretion of P, but excreted 29 and 32 % less P, respectively, than pigs fed CB-SBM + iP (P<0.001), confirming that low phytate is as effective as supplemental phytase in improving P digestibility. Low-phytate barley is a suitable alternative to improve P utilization, thereby reducing the need for supplementation of iP.

Key Words: low-phytate barley, phosphorus, phytase

137 Xylanase and (or) phytase improves digestible nutrient content of reduced nutrient-specified diets containing wheat and millrun to levels similar to a positive control in grower pigs. T. Nortey*[1,2], J. Sands[3], and R. Zijlstra[4], [1]*Prairie Swine Centre*, *Saskatoon, Saskatchewan, Canada*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*, [3]*Danisco Animal Nutrition*, *Marlborough, UK*, [4]*University of Alberta*, *Edmonton, Alberta, Canada*.

Wheat millrun contains more arabinoxylans and phytate than wheat, and might be a more valuable feedstuff if their anti-nutritive effects were reduced using enzymes. In a 5 × 5 Latin square, effects of supplementing xylanase (4375 U/kg feed) and (or) phytase (500 FTU/kg feed) on energy, DM and P digestibility of a wheat-based diet containing 20% millrun were investigated in a 2 × 2 factorial arrangement together with a positive control (PC) diet. The PC diet was formulated to 3.40 Mcal DE/kg, 2.7 g app. dig. Lys/Mcal DE, 0.65% total P and 0.80% Ca; contents of Lys, P, and Ca were reduced 10% and DE 150 kcal/kg in the other four diets, including the un-supplemented negative control (NC) diet. Diets contained 1.0% celite. Cannulated pigs (33.6±1.9 kg) were fed at 3 × maintenance in five periods for 5 observations per diet. Feces and ileal digesta were each collected for 2 d. Xylanase improved total tract digestibility of energy, DM, and P (P<0.01) and DE content (P<0.01). Xylanase supplementation of the NC resulted in energy, DM, P, and Ca digestibilities that were similar to the PC. Phytase improved total tract digestibility of P (P<0.05) but not energy digestibility or DE content. Xylanase and phytase interacted to improve (P=0.05) total tract P digestibility from 44.9 to 57.0%, similar to the PC (53.7%). Enzymes did not have strong significant effects in ileal digesta; however, xylanase and phytase tended to improve P and Ca digestibility, respectively (P<0.10). Xylanase and phytase enhanced nutrient digestibility of diets containing wheat and millrun with a reduced energy, Lys, P, and Ca content and therefore cost. Supplemental enzymes can therefore be used to reduce anti-nutritive effects of arabinoxylans and phytate, and thereby enhance nutrient digestibility and the use of wheat by-products such as millrun.

Key Words: phytase, pig, xylanase

138 Effects of dietary supplementation of an enzyme blend on the fecal digestibility of nutrients for growing pigs. F. Ji*[1], D. Casper[2], P. Brown[2], D. Spangler[2], K. D. Haydon[3], and J. E. Pettigrew[1], [1]*University of Illinois*, *Urbana*, [2]*Agri-King, Inc.*, *Fulton, IL*, [3]*Prince Agri Products*, *Quincy, IL*.

The objective of this experiment was to measure the impact of a beta glucanase/protease enzyme blend product (EBP) on total-tract digestibility of nutrients in growing pigs. Twelve growing barrows (38.2 ± 0.5 kg) were blocked on previous feed intake, and randomly assigned to 1 of 4 treatments using a 4 x 4 Latin Square design replicated 3 times. Treatments were hydrolyzed casein for measurement of endogenous N flow reported elsewhere, Basal (B), B + 0.05% EBP, B + 0.10% EBP. The B diet consisted of corn and soybean meal having 3.36 Mcal ME/kg and 1.2% total lysine. The experimental periods consisted of 4 d of dietary adaptation followed by 5 d of fecal collection. Chromic oxide (0.35%) was used to mark the beginning and end of the collection periods. Pigs were housed in individual metabolism crates with feeding and feces collected twice daily at 12-hr intervals. Feed intake of each group during the first period was 85% of the minimum feed intake of 4 pigs during the preliminary period and equalized within block. The feeding level was increased by 100g/d in each subsequent period. Pigs fed EBP at 0.05 and 0.10% demonstrated increased ($P < 0.05$) digestibility of DM, energy, CP, acid hydrolyzed oil, ash, Ca, and P compared to pigs fed B (Table 1). In conclusion, this study demonstrated that EBP fed to growing pigs improved the nutrient digestibility of a corn-soybean meal diet.

Table 1. Nutrient Digestibility (%)

Nutrient	Basal (B)	B + .05% EBP	B + .10% EBP	SEM
DM	87.42[a]	88.61[b]	88.50[b]	0.14
Energy	86.51[a]	87.42[b]	87.26[b]	0.17
CP	86.47[a]	88.08[b]	87.39[b]	0.28
Acid hydrolyzed oil	44.97[a]	48.27[b]	51.80[c]	0.78
Ash	57.79[a]	60.77[b]	60.95[b]	0.71
Ca	57.33[a]	65.31[c]	61.20[b]	0.87
P	53.80[a]	61.73[c]	57.83[b]	0.73

[a,b] Means within a row lacking a common superscript differ, $P < 0.05$.

Key Words: enzyme, fecal digestibility, growing pigs

139 The effect of replacing dietary wheat with triticale on growth performance and nutrient digestibility of weaned pigs. F. Omogbenigun[1], R. Zijlstra[2], D. Salmon[3], and E. Beltranena*[1], [1]*Alberta Agriculture, Food and Rural Development (AAFRD)*, *Edmonton, AB. Canada*, [2]*University of Alberta*, *Edmonton, AB. Canada*, [3]*AAFRD*, *Lacombe, AB. Canada*.

In a 28-d trial, 288 4-wk-old weaned pigs were offered diets with 66% Canadian Prairie Spring Red (CPS) or Hard Red Spring (HRS) wheat or with 66% Western Canadian spring or winter triticale varieties (AC Ultima, Pronghorn, Bobcat and Pika) to evaluate the effect on growth performance and nutrient digestibility.

Pigs were housed 12 pens/diet, 4 pigs per pen. Diets were formulated to meet NRC (1998) nutrient specification. Pigs were fed ad libitum. Individual pigs were weighed weekly. Fecal grab samples were randomly collected from one pig in each pen on d 25-27.

For the first 3 wk and overall (d 0-28), ADFI and ADG were similar among diets. During wk 4, pigs fed wheat diets consumed 3.5% more feed than pigs fed triticale diets ($P< 0.05$). Overall, pigs fed triticale diets had better G:F than pigs fed wheat diets ($P< 0.05$). Nutrient digestibility was higher ($P< 0.05$). in pigs fed CPS vs. HRS wheat. Digestibility of GE was lower ($P< 0.05$) in pigs fed HRS vs. pigs fed CPS wheat and triticale. Digestibility of CP, Ca and P was higher ($P< 0.05$) in pigs fed triticale vs. pigs fed wheat.

These results indicate that triticale may substitute wheat in late nursery diets without reducing growth performance. Feeding triticale to pigs may also lower feed cost due to improved feed conversion and nutrient digestibility, the latter resulting in reduced nutrient supplementation from other feedstuffs.

Growth performance and nutrient digestibility in young pigs fed wheat or triticale -based diets

	Wheat	Spring Triticale		Winter Triticale			
0 - 28 d	HRS	CPS	AC Ultima	Pronghorn	Bobcat	Pika	SEM
ADFI, g	811	819	798	789	789	786	11.2
ADG, g	535	549	541	543	550	546	10.4
Gain:Feed	0.68*a*	0.69*a*	0.72*b*	0.72*b*	0.72*b*	0.72*b*	0.01
CP,%	81.2*a*	83.5*b*	84.6*b*	84.9*b*	84.9*b*	84.9*b*	0.76
GE,%	87.2*a*	88.8*b*	88.5*b*	89.1*b*	89.0*b*	89.2*b*	0.39
Ca,%	51.8*b*	58.4*ab*	63.7*a*	52.0*b*	59.2*ab*	60.1*a*	2.88
P,%	53.7*a*	57.6*b*	64.1*c*	61.4*cd*	55.9*ab*	59.2*bd*	1.33

Means within a row with different letters differ ($P< 0.05$)

Key Words: pigs, nutrient digestibility, growth performance

140 Effect of adding water into the mixer on pellet quality of barley-oats-soy-based diets for finishing pigs. K. K. Lundblad*[1,2], J. D. Hancock[2], M. Sørensen[3,4], K. C. Behnke[2], E. Prestløkken[1], and L. J. McKinney[2], [1]*Felleskjøpet Fôrutvikling*, *Trondheim, Norway*, [2]*Kansas State University*, *Manhattan*, [3]*University of Life Sciences*, *Aas, Norway*, [4]*AKVAFORSK*, *Aas, Norway*.

Two experiments were used to determine the effect of adding water into the mixer on pellet quality of diets for finishing pigs. The first experiment was a pilot project with barley (67% of the diet) and oats (15% or the diet) ground to a mean particle size of 600 um and blended with soybean meal (9% of the diet), choice white grease (5% of the diet), crystalline amino acids, vitamins, and minerals. The resulting diet had 0.8% total lysine, 10% total moisture, and met or exceeded all NRC recommendations for nutrient concentrations. Treatments were none, 1.5, 3, 4.5, 6, 7.5, 9, 10.5, and 12% water added into the mixer after a ′dry-mix′ time of 60 sec. Total mix time was 240 sec. The mixed mash was steam conditioned at 82°C for approximately 20 sec prior to pelleting in a press (CPM Series 1000 Master Model HD) equipped with a 32-mm thick die having 4 mm openings. In the pilot project, diets with as much as 12% water added into the mixer still could be successfully processed though the pellet mill. Thus, for Exp. 2, selected treatments were none, 1.5, 3, 6, and 12% water added into the mixer. Diet composition and processing conditions were those used in the pilot project. Production rate (near 953 kg/h) was used as a covariate for analysis of data for motor load (amps) and production efficiency (kWh/t). Data analysis indicated 16, 15, 3, and 3% improvements in motor load, production efficiency, PDI% (tumbling box technique), and modified PDI% (five hexagonal nuts added into the tumbling box) as water addition into the mixer was increased from none to 12% (linear effects, $P < 0.02$). In conclusion, adding up to 12% water into the mixer prior to steam conditioning and pelleting improved pelleting efficiency and pellet quality of a barley-oats-soy-based diet for finishing pigs.

Key Words: pellet quality, barley, pig

141 Effect of adding water into the mixer on pellet quality of corn-soy-based diets for finishing pigs. K. K. Lundblad*[1,2], J. D. Hancock[2], M. Sørensen[3,4], K. C. Behnke[2], E. Prestløkken[1], and L. J. McKinney[2], [1]*Felleskjøpet Fôrutvikling*, *Trondheim, Norway*, [2]*Kansas State University*, *Manhattan*, [3]*University of Life Sciences*, *Aas, Norway*, [4]*AKVAFORSK*, *Aas, Norway*.

Two experiments were used to determine the effect of adding water into the mixer on pellet quality of diets for finishing pigs. For Exp. 1, corn (76% of the diet) was ground to a mean particle size of 600 um and blended with soybean meal (17% of the diet), choice white grease (5% of the diet), crystalline amino acids, vitamins, and minerals creating a diet with 0.8% total lysine and 11% total moisture. Treatments were none, 1.5, and 3% water added into the mixer after a ′dry-mix′ time of 60 sec. Total mix time was 240 sec. The mixed mash was steam conditioned at 82°C for approximately 20 sec prior to pelleting in a press (CPM Master Model HD) equipped with a 32-mm thick die having 4 mm openings. Motor load on the pellet mill (near 15 amps) was used as a covariate in the analysis of data for production rate (t/h) and production efficiency (kWh/t). There were 24, 18, 6, and 11% improvements (linear effects, $P < 0.02$) in production rate, production efficiency, pellet durability index (PDI%, tumbling box technique), and modified PDI% (five hexagonal nuts added into the tumbling box) as water addition into the mixer was increased from none to 3%. For Exp. 2, the diet, processing conditions, and treatments were the same except that production rate (near 953 kg/h) was used as a covariate for analysis of data for motor load and production efficiency. Data analysis indicated 7, 8, 10, and 14% improvements (linear effects, $P < 0.02$) in motor load, production efficiency, PDI%, and modified

PDI% when water additions at the mixer were increased from none to 3%. In conclusion, regardless of whether motor load is held constant to maximize feedmill output or production rate is held constant to minimize energy use, adding water into a corn-soy diet prior to steam conditioning and pelleting improved milling characteristics and pellet quality of a corn-soy diet for finishing pigs.

Key Words: pellet quality, conditioning, pig

142 Apparent digestible energy value of crude glycerol fed to pigs. P. J. Lammers*[1], B. J. Kerr[2], T. E. Weber[2], W. A. Dozier III[3], M. T. Kidd[4], K. Bregendahl[1], and M. S. Honeyman[1], [1]*Iowa State University*, *Ames*, [2]*USDA-ARS, Swine Odor and Manure Management Research Unit*, *Ames, IA*, [3]*USDA-ARS, Poultry Research Unit*, *Starkville, MS*, [4]*Mississippi State University*, *Starkville*.

The apparent digestible energy of crude glycerol, a co-product of biodiesel production, was determined in two studies conducted at the Iowa State University Swine Nutrition Research Farm, Ames, IA. In the first study, 24 barrows with an average BW of 11.0±0.5 kg were fed 376 g/d of a basal corn-soy-whey diet combined with either 0, 19, 38, or 75 g/d of crude glycerol. In the second study, 24 gilts with an average BW of 109.6±5.5 kg were fed 2.29 kg/d of a basal corn-soy diet combined with either 0, 115, 229, or 458 g/d of crude glycerol. Crude glycerol was obtained from AG Processing Inc., Sergeant Bluff, IA and contained 86.95% glycerol, 9.63% water, 3.13% sodium chloride, and 0.03% methanol. Dietary treatments for each study were equivalent of 0, 5, 10, or 20% glycerol addition to basal diets. Each diet was fed twice daily to 6 pigs in individual metabolism crates. Following a 10 d adjustment period, total collection of feces and urine occurred for 5 d. Feces and urine were separately collected following each meal and stored at 0°C. Gross energy of crude glycerol, diets, urine, and feces from each pig were determined by adiabatic bomb calorimetry. Apparent DE was calculated by subtracting the energy in feces from the GE of the diet fed.
Crude glycerol contribution to apparent DE of the diet was regressed against crude glycerol intake for each pig size using the REG procedure in SAS. In nursery pigs the apparent DE of crude glycerol was 3386 ± 149 kcal/kg. In market pigs the apparent DE of crude glycerol was 3772 ± 108 kcal/kg. Those values were not different (P = 0.02) from the GE of the crude glycerol examined. For the sample examined, the GE of crude glycerol was 3625 ± 26 kcal/kg. Crude glycerol may be a source of energy for growing pigs.

Key Words: glycerol, pigs, biofuels

215 Site of activity within the digestive tract of growing pigs of an evolved E.coli-derived and a fungal-derived commercial phytase. L. M. McGinnis*[1], M. R. Widmer[1], C. L. Wright[1], T. M. Parr[2], and H. H. Stein[3], [1]*South Dakota State University*, *Brookings*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*, [3]*University of Illinois*, *Urbana*.

An experiment was conducted to investigate the site of activity within the digestive tract for an evolved E.coli-derived phytase, Quantum™ phytase (QP), and for a fungal-derived phytase, Natuphos™ phytase (FP) when fed to growing pigs. Six barrows (initial BW: 31.1 kg) were fitted with T-cannulas in the anterior duodenum and in the distal ileum. Pigs were allotted to a repeated 3 x 3 Latin square with 3 diets and 3 periods. Three corn-soybean meal diets containing no inorganic P were formulated. The control diet (NC) contained no phytase, but the remaining 2 diets contained 500 FTU per kg of either QP or FP. Each period lasted 9 d with the initial 4 d being an adaptation period. Fecal samples (d 5), ileal digesta (d 6 and 7), and duodenal digesta (d 8 and 9) were collected. Diets, duodenal, ileal, and fecal samples were analyzed for P and myoinositol hexaphosphate (IP6), myoinositol pentaphosphate (IP5), myoinositol tetraphosphate (IP4), myoinositol triphosphate (IP3), and myoinositol biphosphate (IP2). Diets and ileal samples were also analyzed for CP and AA. Apparent duodenal (ADD), ileal (AID), and total tract (ATTD) digestibility of P and the AID for CP and AA were calculated. Results showed that there were no differences in AID for CP or any AA among the 3 diets. On the other hand, ADD for P was higher ($P \leq 0.05$) for QP fed pigs than for the NC or FP diets (14.7 vs. 1.0 and 2.3%). The AID of P for QP and FP were not different (41.2 and 36.9%, respectively) but both were higher ($P \leq 0.05$) than for NC (13.4%). The ATTD of P also was similar for QP and FP (42.2 and 45.3%, respectively), but greater ($P \leq 0.05$) than for NC (14.2%). prior to feeding, approximately 65% and 23%, respectively, of the dietary P was in the form of IP6 and IP2. In the duodenal and ileal digesta of pigs fed NC, more ($P \leq 0.05$) P was bound in IP6 than in pigs fed either phytase source, but in fecal samples no P was bound in any of the myoinositol forms regardless of dietary treatment. The present results indicate that QP is more effective than FP in releasing P in the upper tract (stomach and duodenal region) of pigs.

Key Words: activity, pigs, phytase

143 Ames assay, mouse lymphoma assay, and mouse micronucleus assay confirm chromium propionate to be non-genotoxic. V. J. H. Sewalt*[1], M. Mecchi[2], M. Cifone[2], Y. Xu[2], and K. Krafka[1], [1]*Kemin Industries*, *Des Moines, IA*, [2]*CoVance Laboratories*, *Vienna, VA*.

Chromium (III) is a required mineral for animal life, functioning in glucose entry to insulin-sensitive cells. It has various applications in improving animal performance and human nutrition. However, recent concerns regarding genotoxicity of one type of chromium compound (chromium picolinate) prompted Kemin to evaluate a concentrated form of its commercial product, KemTRACE® $_{\text{brand}}$ Chromium Propionate (CrProp), for genotoxicity in a standard battery of three assays under FDA guidelines (VICH GL23: Safety Studies for Veterinary Drug Residues in Human Food: Genotoxicity Studies, Draft Guidance, 2000). First, the *in vitro* Ames Assay quantified the frequency of reverse mutations at the *his* locus of 4 different *Salmonella typhimurium* strains and at the *trp* locus of *E. coli* strain WP2uvrA exposed to up to 435 µg Cr / plate. Second, the *in vitro* Mouse Lymphoma cell Assay (MLA) established the incidence of forward mutations at the TK locus in mouse lymphoma cell line L5178Y, with increasing doses up to 348 µg Cr /mL. Finally, the *in vivo* Mouse Micronucleus Assay (MMA) evaluated possible *in vivo* clastogenic activity or disruption of mitotic apparatus by observing polychromatic erythrocytes (PCE) harvested

from bone marrow of mice line CD-1® (ICR) orally dosed with 43.5-174 mg Cr /kg BW for cytotoxicity and micronucleation. Also tested were a chromium chloride control, vehicle control, and assay-specific positive controls. The outcome of all three assays was negative, indicating no genotoxicity of CrProp in the Ames assay, MLA or MMA. As neither micronucleation nor cytotoxicity was observed to bone marrow in the MMA, the concentration of Cr from CrProp in blood of mice receiving 87 mg Cr / kg BW was confirmed to ascertain exposure of bone marrow erythrocytes to the test article. In conclusion, KemTRACE Chromium Propionate was found to be non-genotoxic *in vivo* or *in vitro*, even in concentrations exceeding 30,000-fold the approved dose rate in swine.

Key Words: chromium propionate, genotoxicity

144 Effects of dietary chromium tripicolinate on growth performance, body temperature, respiratory rate, and plasma cortisol of pigs during immune stress. B. G. Kim*, M. D. Lindemann, and G. L. Cromwell, *University of Kentucky*, *Lexington*.

This experiment investigated the effects of dietary chromium tripicolinate (CrPic) on growth, rectal temperature, respiratory rate, and plasma cortisol in pigs challenged with lipopolysaccharide (LPS). A total of 24 pigs (BW: 26.0 ± 2.8 kg) were assigned to 1 of 4 treatments with 2 pigs/pen. Treatments were 1) phosphate buffered saline (PBS) injection, no CrPic; 2) LPS injection, no CrPic; 3) LPS injection, 1,000 ppb CrPic; and 4) LPS injection, 2,000 ppb CrPic. The CrPic levels were fed continuously in this study. At 0 h (0900 on d 35), PBS or LPS was injected intraperitoneally in each pig. During the first 12 h post injection, pigs challenged with LPS lost 951 g, while the PBS group gained 170 g ($P < 0.001$). This weight loss began to be recovered after 12 h and the weight gain (WG) of the LPS group tended to be higher (1,014 vs. 723 g; $P = 0.09$) than the PBS group during 24 to 48 h. However, cumulative WG of the LPS group still remained lower at 96 h (1,729 vs. 2,545 g; $P < 0.05$). Compared to PBS group, LPS challenged pigs had lower feed intake (FI; 886 vs. 2,197 g; $P < 0.01$), similar FI (1,780 vs. 1,795 g; $P = 0.81$), and higher FI (4,922 vs. 3,924; $P < 0.05$) during 0 to 24 h, 24 to 48 h, and 48 to 96 h, respectively. Dietary CrPic had no effect on WG or FI. Rectal temperature was higher in the LPS vs. the PBS group at 2 h (40.2 vs. 39.5°C; $P < 0.01$) and 4 h (40.2 vs. 39.5°C; $P < 0.05$). Respiratory rate was also higher in the LPS vs. the PBS group at 1.3 h (83.4 vs. 58.0 breath/min; $P < 0.05$) and at 8.5 h (55.1 vs. 43.0 breath/min; $P < 0.05$). Plasma collected at 3 h had higher cortisol levels in the LPS group than the PBS group (178 vs. 29 ng/ml; $P < 0.001$). Dietary CrPic did not affect rectal temperature, respiratory rate, or plasma cortisol level. These results demonstrate that LPS challenge affects WG, FI, body temperature, respiratory rate, and plasma cortisol, but dietary CrPic is unable to moderate the LPS-induced effects.

Key Words: immune stress, chromium, pigs

145 A surgical model for the kinetics and quantification of nutrient absorption in swine and its application in carbohydrate metabolism. S. Hooda*[1], J. J. Matte[2], T. Vasanthan[1], and R. T. Zijlstra[1], [1]*University of Alberta*, *Edmonton, AB*, [2]*Agriculture and Agri-Food Canada*, *Sherbrooke (Lennoxville), QC, Canada*.

Nutrient digestibility has been studied thoroughly in swine, but not kinetics of nutrient absorption. A catheterized grower pig model was tested for achievable independent series of portal vein blood collections and ability to separate effects of β-glucans on nutrient absorption patterns. Two pigs (35 kg BW) were surgically modified with catheters in the hepatic portal vein and carotid artery and an ultrasonic flow probe around the portal vein. Catheters and probe were exteriorized and secured dorsally. Fibrosis and adhesions were minimized by avoiding excessive manipulation and drying of viscera, confirmed by post mortem analysis. Catheter placement was secured using anterior modifications and non-absorbable suture. Pigs were fed parenterally until regular feeding resumed. Catheters were flushed regularly with heparinized saline (200 IU/L). After 10 d, pigs were fed diets with 0, 4 or 8% concentrated barley β-glucans for five consecutive 7-d periods, the 0 and 4% diets twice. On d 6, feces were collected. On d 7, blood was collected every 10 min from -10 to 60 min, 30 min to 240 min and 60 min to 420 min postprandially; flow was measured simultaneously. Plasma was analyzed for glucose and VFA, and their net absorption was calculated from blood (plasma x hematocrit) portal-arterial differences × blood flow. Specific surgical and post-operative procedures allowed completion of a fifth blood collection 7-wk post surgery. Dietary β-glucans did not affect energy digestibility. Peak portal glucose and net absorption of glucose were delayed by 30 min for diets containing β-glucans ($P<0.05$). Relative hydrolysis of starch to glucose was 89 and 85% for the 4% and 8% β-glucans diets, respectively, compared to the 0% diet. Portal VFA peaked 5 to 6 hr postprandial and was increased by β-glucans. This catheterized pig model will thus allow the study of absorption kinetics of carbohydrate metabolites (glucose, VFA).

Key Words: β-glucan, glucose absorption, pig

147 Effects of the dietary phosphorus concentration on phosphorus digestibility in monocalcium phosphate. H. H. Stein*[1], C. T. Kadzere[2], S. W. Kim[3], P. S. Miller[4], and J. T. Yen[5], [1]*University of Illinois*, *Urbana*, [2]*North Carolina A&T*, *Greensboro, NC*, [3]*Texas Tech University*, *Lubbock*, [4]*University of Nebraska*, *Lincoln*, [5]*Meat Animal Research Center*, *Clay Center, NE*.

An experiment was conducted at 5 experiment stations to determine if the dietary inclusion level of P influences the apparent total tract digestibility (ATTD) of P in monocalcium phosphate (MCP). A total of 66 barrows (initial BW: 22.02 ± 2.15 kg) were allotted to 6 treatments with 11 replications per treatment. All pigs were placed in metabolism cages that allowed for the total, but separate, collection of urine and feces. The basal diet was based on corn (54.2%), soybean meal (20%), and cornstarch and was formulated to contain 0.29% P without using inorganic P. Five additional diets were formulated by adding P from MCP in 5 increments of 0.07% to the basal diet. This created treatment diets that were formulated to contain 0.36, 0.43, 0.50, 0.57, and 0.64% P, respectively. Limestone was added to maintain a calculated Ca:P

ratio of 1.2:1. The ATTD and balance of P was calculated for each diet using the direct procedure. By subtracting the contribution from the basal diet to the treatment diets, the ATTD and balance for P in MCP was calculated using the difference procedure. Results of the experiment showed that increasing P intake from MCP increased (linear, $P \leq 0.001$) the excretion of P in feces (0.54, 1.03, 2.05, 3.51, and 3.68 g per 5 d) and urine (0.054, 0.049, 0.278, 0.750, and 1.867 g per 5 d). The quantity of P absorbed (2.74, 6.02, 9.65, 11.95, and 16.70 g per 5d) and retained (2.67, 5.97, 9.36, 11.19, and 14.84 g per 5d) also increased (linear, $P \leq 0.001$) as more P from MCP was added to the diet. However, when expressed as a percent of P intake from MCP, P retention was not affected by the dietary concentration of P (80.47, 82.81, 78.91, 73.01, and 73.50%). Likewise, the ATTD for P in MCP was not different among treatments regardless of the concentration of P in the diet (83.55, 83.73, 81.29, 77.31, and 82.22%). Results of this experiment demonstrate that the apparent digestibility (i.e., absorption) of P in MCP is not influenced by the dietary concentration of P.

Key Words: digestibility, phosphorus, pigs

148 Impact of growth-promoting antibiotics on growth performance in nursery and finishing pigs. J. Holt*, E. van Heugten, M.T. See, M. Morrow, A. Graves, and K. Zering, *North Carolina State University*, *Raleigh*.

A 15-week study was conducted using gilts from a commercial source (n=200; initial BW = 6.2 ± 0.003 kg) to determine the growth performance effects of growth-promoting levels of antibiotics in nursery and finishing diets. Pigs were allotted by BW to one of four treatments in a 2 × 2 randomized complete factorial block design. A three phase nursery diet program (1.6, 1.4, and 1.24 % lysine) was used, with treatments consisting of feeding no antibiotics (CON) or chlortetracycline (ANTI). Nursery diets did not contain growth-promoting levels of Cu or Zn. Pigs were weighed at the phase changes on week 1, 3, and 5. At the end of the nursery phase, one-half of the pigs receiving CON were switched to a diet containing antibiotic (Virginiamycin) and one-half of the pigs receiving ANTI were switched to CON for the remainder of the trial. Pigs were fed a four phase finishing diet program (1.05, 0.95, 0.85, and 0.75 % lysine) and were weighed at 4 week intervals at the phase changes. At the end of the trial, backfat and LMA were measured with real-time ultrasound. After one week, CON pigs weighed less (7.09 vs. 7.28 kg) and had lower ADG (148.8 vs. 179.8 g/d) and ADFI (174.4 vs. 191.6 g/d) than ANTI pigs (P<0.05). No performance differences were found at weeks 3 and 5 of the nursery, or for the overall nursery period. During the finishing period, no differences were found in ADG (920.4 vs. 957.7 g/d), ADFI (210.3 vs. 231.4 kg/d) or GF (0.44 vs. 0.43) between pigs receiving CON or ANTI, respectively (P>0.05). Backfat (2.12 vs. 1.66 cm) and LMA (19.2 vs. 17.2 cm2) measurements were not different between treatments (P>0.05). Over the entire 15-week trial, ADG, ADFI, and GF was not affected by antibiotic supplementation (P>0.05). Supplementation of antibiotics in the nursery improved growth performance during the first week only. No carry-over effects of antibiotics in the nursery were apparent in the finishing period, and antibiotic supplementation did not affect performance during the finisher or overall.

Key Words: antibiotics, pigs, performance

149 Effects of withdrawing ractopamine HCl 10 days prior to slaughter on growth and carcass performance of pigs. M. E. Johnston*[1], R. D. Boyd[1], and C. E. Fralick[2], [1]*Hanor Company of Wisconsin, LLC*, *Franklin, KY*, [2]*Swine Tek Research and Consulting*, *Van Wert, OH*.

A total of 463 TR4 × Camborough barrows (initial BW of 84.7±4.7 kg) were used to determine if a 10 d withdrawal from Ractopamine HCl (RAC) prior to slaughter effects growth and carcass performance. Pigs were blocked by weight and randomly allotted to 48 pens (16 pens/treatment, 9 or 10 pigs/pen). Corn–soy based diets were used. The Control diet contained 0.69% SID lysine and no RAC. The RAC diet contained 0.90% SID lysine and 5 ppm RAC. The treatments consisted of: 1) Control diet with no RAC fed for 35 d; 2) RAC diet fed for 25 d, then Control diet fed for 10 d; 3) Control diet fed for 10 d, then RAC diet fed for 25 d. All pigs were shipped to slaughter on d 35. Pigs fed the Control diet and those withdrawn from RAC 10 d prior to slaughter grew slower (P<0.01, 1.03 and 1.02 kg/d, respectively) than pigs fed the RAC diet for 25 d before slaughter (1.12 kg/d). Pigs fed the RAC diet until slaughter had a 3.2 kg heavier market weight (P<0.01) than the Control pigs (120.7 kg) and the pigs withdrawn from RAC (120.5 kg). Feed intake was similar (P>0.25) between the Control pigs (2.73 kg/d) and those fed RAC until slaughter (2.68 kg/d). Pigs withdrawn from the RAC diet ate less (P<0.02, 2.55 kg/d) than pigs on the other treatments. Control pigs had the lowest (P<0.0001) G:F and pigs fed the RAC diet until slaughter the highest (0.38, 0.40, and 0.42, respectively). Pigs fed RAC with no withdrawal had a heavier carcass (P<0.005, 92.2 kg) than the Control and RAC withdrawal pigs (89.6 kg). Control pigs had more backfat (P<0.0001, 22.4 mm) than the RAC withdrawal pigs (20.1 mm) and the pigs fed RAC until slaughter (20.5 mm). Both groups of RAC fed pigs had similar (P>0.80) percent lean (53.9 and 53.8%) and were higher (P<0.0001) than that of the Control pigs (52.3%). There was no advantage to ADG or carcass weight gain if RAC was withdrawn 10 d prior to slaughter however, the lean benefit was maintained.

Key Words: pigs, ractopamine, growth

150 Response to feeding 5 ppm ractopamine to finisher swine: Weekly and overall performance and carcass quality. J. Patience*[1], A. Beaulieu[1], P. Leterme[1], Z. Pietrasik[2], P. Shand[2], and J. Merrill[3], [1]*Prairie Swine Centre Inc.*, *Saskatoon, SK Canada*, [2]*University of Saskatchewan*, *Saskatoon, SK Canada*, [3]*Elanco Animal Health*, *Guelph, ON Canada*.

Ractopamine HCl (RAC) was recently registered for use in Canada, with a recommended diet inclusion level of 5 ppm for an average 28 days prior to market. Grading methods and standards tend to differ in Canada, so an experiment was undertaken to evaluate the impact of 5 ppm RAC on weekly and overall performance and on carcass quality using the Maple Leaf Foods Signature grading grid. Eight pens of barrows and 8 pens of gilts received a control diet (3.3 Mcal DE/kg; 0.63% TID lysine); an equal number of pens received the RAC diet (3.3 Mcal DE/kg; 0.83% TID lysine; 5 ppm RAC), providing 136 barrows and 132 gilts per treatment (initial weight 86.1 kg). Pigs were marketed when they reached a minimum of 116 kg resulting in an average live market weight of 118.3 kg and average dressed weight

of 94.4 kg with no differences between treatments (P>0.10). RAC increased overall average daily gain from 1.08 kg/d to 1.22 kg/d (P<0.001) and gain:feed from 0.32 to 0.36 (P<0.001); there was no RAC × gender interaction (P>0.10). Feed intake was unaffected by dietary treatment (P>0.10). RAC pigs reached market 3.6 days sooner than controls (26.5 vs. 30.1; P<0.05), again with no RAC × gender interaction (P>0.10). Irrespective of week marketed, RAC pigs grew faster than controls; however, the response to RAC was greater in magnitude when pigs were marketed within 4 weeks of treatment initiation. RAC reduced backfat thickness from 20.3 mm to 18.5 mm in barrows (P<0.05) but had no effect on gilts (P>0.10; 15.8 vs 15.6 mm for control and RAC respectively). RAC increased loin thickness from 68.3 to 70.8 mm (P<0.05); there was no RAC × gender interaction (P>0.10). RAC fed at 5 ppm resulted in expected increases in rate and efficiency of gain as well as in carcass composition. RAC was most effective in faster growing pigs, but also elicited a positive response in slower growing pigs as well.

Key Words: ractopamine, growth performance, carcass quality

151 Response to feeding 5 ppm ractopamine to finisher swine: Pork quality. Z. Pietrasik[1], P. Shand[1], D. Beaulieu*[2], P. Leterme[2], J. Merrill[3], and J. Patience[2], [1]*University of Saskatchewan*, *Saskatoon, SK Canada*, [2]*Prairie Swine Centre Inc.*, *Saskatoon, SK Canada*, [3]*Elanco Animal Health*, *Guelph, ON Canada*.

Ractopamine HCl (RAC) consistently shows benefits in growth performance and carcass composition. Its effects on pork quality are less clearly defined. An experiment was undertaken to evaluate the impact of feeding RAC for 28 days on pork quality, composition and sensory attributes. Eight pens of barrows and 8 pens of gilts received a control (CTL) diet (3.3 Mcal DE/kg; 0.63% TID lysine); an equal number of pens received the RAC diet (3.3 Mcal DE/kg; 0.83% TID lysine; 5 ppm RAC), providing 136 barrows and 132 gilts per treatment (initial weight 86.1 kg). Two pigs from each CTL and each RAC pen, closest to the mean weight for that pen that day, were selected on day 28 for detailed pork quality evaluation. Loins were harvested on the day following slaughter in a commercial packing plant and cut into one inch chops for measurement of drip loss, subjective color scores, proximate composition, sensory evaluation and Warner-Bratzler shear force (WBSF) analysis. To evaluate the effect of enhancement on WBSF and sensory characteristics, a portion of the loin was injected to 110% over the raw meat weight with brine (0.4% NaCl; 0.3% sodium tripolyphosphate). RAC had no effect on pH or on the CIE L* color score (P>0.10); both CIE a* and b* values were slightly reduced (P<0.05). RAC had no effect on Canadian, American or Japanese subjective color score systems, on purge losses or on cooking losses in either non-injected or moisture-enhanced loin samples (P>0.10). RAC increased the WBSF (64.9 vs. 72.8 N; P<0.05). There was no effect of RAC on juiciness, flavor desirability or overall acceptability in non-injected or moisture-enhanced loin chops (P>0.10). RAC reduced initial tenderness slightly, from 5.6 to 5.2 in non-injected loin chops and from 6.8 to 6.4 in moisture-enhanced loin chops (P<0.05). Overall, RAC had very limited effects on pork eating quality; tenderness was affected the most, while other sensory attributes were unaffected.

Key Words: ractopamine, taste panel, pork quality

152 Growth and carcass response to dietary fat for modern lean pigs. M. E. Johnston, R. D. Boyd*, and M. McGrath, *Hanor Company of Wisconsin LLC*, *Franklin, KY*.

To determine the response to dietary fat on growth and carcass of a modern lean genotype, TR4 × Camborough barrows and gilts (100 pens each, 23–26 pigs/pen) were blocked by weight and randomly allotted to treatments (initial BW 34.1 ± 2.3 kg, 50 pens/diet). Treatments consisted of corn–soy diets with 1.0, 2.5, 4.0, or 5.5% added fat. The lysine level was adjusted to a constant lysine:energy ratio. On d 84 all pigs were fed a common diet until marketed (0.90% SID lysine, 5 ppm Ractopamine). In the first 21 d, there was no ADG response (P>.10) for barrows (0.94 kg/d) or gilts (0.92 kg/d) due to fat level. There was a decrease (P<.001, linear) in ADFI with increasing fat. Gain:feed ratio improved (P<.0001, linear) for barrows (0.50 to 0.53) and gilts (0.49 to 0.52) as fat increased. From d 21–42, ADG improved (P<.0001, linear) with increasing fat level (barrows: 1.02 to 1.10 kg/d, gilts: 0.92 to 0.95 kg/d). Feed intake decreased (P<.0001) as fat level increased. Pigs had improved G:F (P<.0001, linear, 0.41, 0.44, 0.45, 0.47) with increasing dietary fat. From 73 to 95 kg BW (d 42–63) ADG and G:F were unaffected (P>.50) by fat level. Feed consumption continued to decrease (P<.01, linear) as fat level increased. From d 63 through 84, ADG for gilts was similar (P=.49) across all fat levels. Barrows had increased ADG (P<.05, 0.89 to 0.98 kg/d) and feed intake decreased (P<.001) as fat increased. Gilts G:F was not different but the barrows did show an improvement (P<.01, linear) in G:F (0.29 to 0.36) with increased levels of fat. From d 0 to 84, gain was improved (P<.0001, linear) for both genders when dietary fat was increased. Intake decreased (P<.0001, linear) and G:F improved (P<.0001, linear) by increasing dietary fat. These data indicate pig growth is improved by increasing the level of fat. However, after 73 kg BW gilts did not respond as well as barrows to increasing dietary fat. The value of increasing dietary fat seems to be limited to live performance as Ractopamine eliminated the adverse effect of increasing fat level on lean content of the carcass.

Key Words: pigs, growth, energy

153 Effects of choice white grease or soybean oil on growth performance and fat quality characteristics in finishing pigs. J. M. Benz*, M. D. Tokach, S. S. Dritz, J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband, *Kansas State University*, *Manhattan*.

A total of 144 barrows and gilts (PIC) with an initial BW of 44 kg were used to evaluate the effects of dietary fat source and duration of feeding on growth performance and fat quality. Dietary treatments were a corn-soybean meal control diet with no added fat or a 2 × 4 factorial with 5% choice white grease (CWG) or soybean oil fed from d 0 to 26, 54, 68, or 82. All pigs were fed the control diet after feeding the 5% fat diets. At the end of the study (d 82), jowl samples were collected. Pigs fed soybean oil had increased (P<0.01) ADG and G:F compared with the control (1.06 and 0.38 vs 0.99 and 0.36, respectively), and tended to have increased (P<0.08) ADG and G:F compared with pigs fed CWG (1.03 and 0.38). Increasing feeding duration increased (quadratic, P<0.01) ADG for soybean oil (1.03, 1.03, 1.07, 1.08 kg) and G:F for soybean oil (0.38, 0.38, 40, 0.40). Increasing feeding duration for CWG had no affect on ADG (1.02,

1.03, 1.04, 1.04 kg), but increased (quadratic, P<0.01) G:F (0.37, 0.38, 0.39, 0.38). Increasing feeding duration of CWG increased (quadratic, P<0.01) dressing percentage (72.1, 73.3, 73.5, 73.3%) compared with pigs fed increasing feeding duration of soybean oil (71.8, 73.1, 72.4, 73.1%) or the control (72.3%). Gilts had increased (P<0.01) IV compared with barrows (74.2 vs 72.9). Pigs fed soybean oil had increased (P<0.01) iodine value (IV) and C 18:2 fatty acids compared with pigs fed CWG (78.9 and 19.5%, vs 70.2 and 12.5). Pigs fed CWG had increased (P<0.01) IV and C 18:2 fatty acids compared with pigs fed the control (67.1 and 11.2%). Increasing feeding duration increased (quadratic, P<0.01) IV for pigs fed soybean oil (73.6, 79.1, 80.9, and 82.0) and CWG (68.8, 70.3, 70.2, 71.5) compared with pigs fed the control. In summary, adding fat to the diet increased pig performance and IV of jowl fat. Feeding fat during any stage influenced jowl IV at market with duration of feeding having the greatest response with soybean oil.

Key Words: iodine value, dietary fat, pigs

154 Supplemental effect of dried extracted brown seaweed (*Ascophyllum nodosum*) on growth and immunity of finishing pigs. D. A. Monson*, J. R. Blanton Jr, M. J. Anderson, S. O. Rao, and S. W. Kim, *Texas Tech University*, *Lubbock*.

Eighty pigs at 89.4±1.5 kg BW were selected and allotted to two treatments: CON or SW (diet containing dried extracted brown seaweed, Ascophyllum nodosum, at 0.5%). Each treatment had five replicate and there were three pigs per pen. The CON and SW diets were the same, only except for the supplements that replaced the same amount of corn (0.5% of the diet). The supplement for the CON was corn-starch, whereas it was dried extracted brown seaweed for the SW. Pigs were fed based on two phases until they reach the market weight (133.3±2.0 kg). Pigs had ad libitum access to the assigned feed and water. Body weight of pigs and feed intake were measured for each phase. At the beginning and the end of the study, two pigs of each pen were selected randomly to take blood samples to measure the number of immune cells including white blood cells, red blood cells, neutrophil, basophil, eosinophil, hemoglobin, hemotocrit, and platelets. Growth of pigs, feed intake, and gain:feed did not differ between the treatments. When the numbers of immune cells were measured, all the values were within normal range of healthy pigs regardless of the treatment groups. Number of white blood cells from pigs in the CON (24.3×10^6 cell/mL) tended to be higher (P = 0.052) than the SW (21.9×10^6 cell/mL). Considering that a normal range of a healthy pig is between 11.0 and 22.0 $x10^6$ cell/mL, pigs in the CON may have slightly higher white blood cell numbers whereas those from the pigs in SW were within a normal range of a healthy pig. Other cell numbers did not differ between the treatment. This may indicate that pigs receiving a diet with dried extracted brown seaweed may be more tolerant to typical immune challenges from farm than non-treated pigs.

Key Words: pigs, seaweed, growth

155 Effect of water suspendible natural vitamin E and SelenoSourceAF™ on finishing swine. T. E. Shipp[1], J. C. Sparks*[1], D. A. Hill[1], H. Yang[1], M. A. Engstrom[2], K. Larson[2], G. Gourley[3], and D. C. Mahan[4], [1]*ADM Animal Nutrition*, *Quincy, IL*, [2]*Diamond V Mills*, *Cedar Rapids, IA*, [3]*Swine Graphics Enterprises*, *Webster City, IA*, [4]*The Ohio State University*, *Columbus*.

Pigs (n=288; BW=100 kg) were supplemented with natural source vitamin E (NSE) in the drinking water and/or selenium yeast (SSAF) in the diet the last 28 days prior to slaughter to evaluate effects on pork quality and sensory characteristics. A 2×2 factorial arrangement of treatments in a randomized complete block desing was conducted with 12 replications. Dietary Se source (0.3 mg/kg sodium selenite or SSAF) and the addition of NSE to the drinking water (0 or 27.5 IU/l) were tested. All experimental diets contained 30 mg/kg dl-α-tocopheryl acetate and were formulated to meet or exceed NRC requirements. NSE was mixed in a stock solution and added via medicator to the drinking water daily. Pigs were allotted by sex and weight and two pigs were randomly selected per pen for further analysis and bled on the day of study termination. From the selected pigs, a loin was harvested and evaluated for quality and sensory characteristics. Each loin was core-sampled at the 10^{th} rib. Core samples and corresponding serum samples were analyzed for total Se and vitamin E. Statistical analysis was performed using the GLM procedure of SAS, 2000. NSE increased serum viamin E (P > 0.01) and improved F/G (P = 0.02), but did not affect (P > 0.05) ADG, % yield, muscling, fat thickness, or % lean. SSAF decreased fat thickness (P = 0.05), but did not increase loin Se (P = 0.20) or affect (P > 0.05) serum vitamin E, ADG, F/G, or other carcass measures. Most carcass sensory measures (% purge, reflectance/color scores, cooking losses, flavor, juiciness, tenderness, chewiness, and Instron scores) were unaffected (P > 0.05) by treatment. NSE lowered 24-hr loin pH (P = 0.02), which may have resulted in a trend (P =0.08) for increased off-flavor (sour) scores. Japanese color bar scores ranged from 2.4-3.0, and were reduced (P = 0.03) by NSE and tended to increase (P = 0.06) when SSAF was fed. In conclusion, short-term supplementation with NSE (approximately an additional 240 IU/hd/d) and SSAF resulted in minor changes in performance, some increases in loin and/or serum nutrient content, and minor changes in carcass sensory characteristics.

Key Words: vitamin E, selenium, selenium yeast

156 Effects of weaning age on growth performance, nutrient digestibility and integrity of small intestine in pigs. K. H. Cho*[1], W. S. Ju[2], H. K. Oh[2], H. B. Choi[2], S. K Jang[2], and Y. Y. Kim[2], [1]*TS Corporation*, *Incheon, Korea*, [2]*Seoul National University*, *Seoul, Korea*.

This study was conducted to determine the effects of weaning age on growth performance, nutrient digestibility, and the integrity of the small intestine in pigs. A total of 108 pigs were allocated into 3 treatments with 6 replicates, 6 pigs per pen, based on weaning age and sex by a randomized complete block design. The treatments included weaning litters at 14(A), 21(B), and 28(C) days of age. When the ADFI was divided by metabolic body weight (BW0.75), the results were 19, 29 and 28g in A, B, C, respectively. The intake of treatment B and C was not different during the first week after weaning. As weaning

age increased, ADG(226, 426, 486g, P<0.01) and ADFI(500, 599, 603g, P<0.01) and feed efficiency(2.21, 1.41, 1.24, P<0.01 for A, B, C respectively) were improved during the nursery period. Final body weights also increased (P<0.01) with increasing weaning age but there were no differences among body weights of treatment B and C. In the study of nutrient digestibility there were no significant differences. However, the digestibility of protein in treatment A tended to be lower than those of treatment B or C(82.7, 86.4, 86.3%, P=0.20 for A, B, C respectively). Also the nitrogen retention (g/day) of treatment A was lower than those of treatment B and C(1.78, 3.02, 3.58g/day, P < 0.05 for A, B, C respectively). To investigate the effect of different weaning ages on the integrity of the small intestine, a total of 48 weaning piglets were sacrificed at 0, 1, 2, and 7 days postweaning following treatments. The number of CD4+ T-cells tended to increase and then decrease after weaning, but there were no significant differences except for treatment C. The number of CD8+T-cells in treatment C was the lowest on weaning day when compared with other treatments(P < 0.01) but the values increased after weaning (P < 0.01). These results suggest, in a conventional and single-site production system, that the growth rate of early weaned pigs under 21 days of age is lower than that of older weaned piglets.

Key Words: weaning age, piglet, growth performance

157 Effects of weaning weight on growth performance, nutrient digestibility and integrity of small intestine in pigs weaned at 21 days of age. K. H. Cho*[1], H. K. Oh[2], W. S. Ju[2], J. H Yun[2], Y. D. Jang[2], and Y. Y. Kim[2], [1]*TS Corporation*, *Incheon, Korea*, [2]*Seoul National University*, *Seoul, Korea*.

This study was conducted to determine the effects of weaning weight on growth performance, nutrient digestibility and integrity of the small intestine in pigs. A total of 144 pigs were allocated into 4 treatments with 6 replicates, 6 pigs per pen, based on weaning weight and sex by a randomized complete block design. The treatments included weaning weights of 4.5(A), 5.5(B), 6.5(C) and 7.5(D) kg when weaned at 21 days of age. As weaning weight increased from 4.5 kg to 7.5kg, ADG (169, 174, 232, 213g, P<0.05) and ADFI(230, 250, 330 , 340g, P<0.01 for A, B, C, D, respectively) were increased but there was no statistical difference of feed efficiency during the 3 weeks after weaning. ADG(460, 487, 510, 616g, P<0.01) and ADFI(680, 790, 860, 900g, P < 0.01 for A, B, C, D, respectively) increased but feed efficiency did not change during the 3 to 7 weeks after weaning. Final body weights increased (20.91, 22.73, 25.65, 29.29 kg, P<0.01 for A, B, C, D, respectively) with increasing weaning weights from 4.5 kg to 7.5 kg. The digestibility of dry matter, protein, fat and ash did not differ significantly. The nitrogen retention and nitrogen digestibility in treatment D tended to be lower than those of other treatments. To investigate the effect of different weaning weights on integrity of the small intestine, a total of 48 weaning piglets were sacrificed following treatments at 0, 1, 2, and 7 days post-weaning. The villi height of the small intestine decreased and then increased after weaning but there was no consistant relationship between villi height change and weaning weight. Comparisons of the crypt depth between treatments showed no statistical differences. The number of CD4+ and CD8+ T-cells did not change after weaning except in treatment D. This study suggests that the growth rate of heavier weaning weight piglets is higher than those of lighter weaning weight piglets and that no growth compensation is seen in lighter weaning weight pigs up to 70 days of age.

Key Words: piglet, weaning weight, growth performance

158 Effects of a liquid (Neolac) and dry feed combination fed in varying durations on weanling pig performance. R. C. Sulabo*[1], C. N. Groesbeck[1], J. M. Benz[1], R. D. Goodband[1], M. D. Tokach[1], S. S. Dritz[1], J. M. DeRouchey[1], J. L. Nelssen[1], and D. McKilligan[2], [1]*Kansas State University*, *Manhattan*, [2]*TechMix Inc.*, *Stewart, MN*.

One hundred eighty pigs (5.2 kg and 18 d of age) were used in a 28-d growth assay to determine the effects of combining a liquid starter diet (Neolac) with dry feed for various durations on nursery pig performance. Pigs were blocked by initial weight and randomly allotted to the following experimental treatments: dry feed only (Control) or Neolac provided for a period of 3 and 7 d in combination with dry feed. There were 9 replications of the control and 3 d Neolac treatments and 18 replicates of the 7 d Neolac treatment. At the end of each allotted period, liquid feeders were removed and pigs were fed dry feed solely until the end of the study. Average daily gain of pigs fed the liquid-dry feed combination was greater (269 vs. 223 g; P<0.01) until d 7 post-weaning. Weight gains obtained during this period were not maintained until the end of the nursery period (d 28) regardless of the duration of liquid feeding. Dry matter intake increased (P<0.01) as a result of liquid feeding (269 vs. 152 g). Pigs provided liquid feed for 7 d also had a lower DM gain/feed (P<0.06) than the dry-fed controls in all periods (d 0 to 28 = 0.89 vs. 0.92). In the first week post-weaning, liquid feed intake contributed 72 to 95% of the total DMI but its contribution declined as the pigs aged. The contribution of dry feed to total DMI increased from 5% on d 2 to 28% on d 6. Total DMI of liquid-fed pigs decreased on d 4 and 8 after the liquid feed was removed, which resulted in a loss of the initial advantages in weight gain due to liquid feeding. In conclusion, feeding a liquid complete diet in varying durations in combination with dry feed had positive effects on growth rate immediately after weaning but did not have lasting gains to influence overall nursery performance. Further experiments are needed to determine whether the improvement in initial feed intake with liquid feeding will reduce starve outs and mortality.

Key Words: nursery pig, liquid feed, growth

159 The effects of supplementing litters with a 2-phase milk replacer strategy during lactation on piglet growth performance. J. R. Bergstrom*[1], J. K. Aldous[1], and R. Cabrera[2], [1]*Kerber Milling Company*, *Emmetsburg, IA*, [2]*Ralco Nutrition, Inc.*, *Marshall, MN*.

A total of 220 litters were used at a commercial sow farm to evaluate the effects of supplementing litters with a 2-phase milk replacer program on piglet growth performance. At placement into farrowing rooms, an equal number of first parity females were randomly assigned for litters to receive the control (non-supplemented) and

milk-supplementation treatments. An equal number of older parity sows (Parity 2 and above) were also randomly assigned to each of the 2 treatments. Ten farrowing rooms of 22 crates each were used with 11 crates per treatment in each room. There were an equal number of first parity females per treatment per room. Litters were equalized across treatments within 24 h post-partum. Individual piglet birth weights were collected after equalization of litters for 2,476 piglets. Litters receiving milk supplementation were supplemented with a phase 1 milk-replacer via a re-circulating system with a Crown Cup™ beginning 24 h post-partum for approximately 5 d, after which they received a phase 2 milk replacer until weaning at 20 d of age. At weaning, 2,272 pigs remained and were individually weighed. Weaning weight (6.39 kg vs. 6.11 kg) and ADG (240 g vs. 227 g) of pigs from litters receiving supplemental milk were higher ($P < 0.001$) than control litters. This resulted in a reduction ($P < 0.05$) in the percentage (2.08% vs. 4.30%) of lightweight (< 3.63 kg) pigs at weaning. In conclusion, milk supplementation improved performance of suckling pigs. Further research is needed to determine if there are subsequent reproductive benefits for sows with litters receiving supplemental milk.

Key Words: supplemental milk replacer, piglets, sows

160 Use of spray-dried red blood cells and isoleucine supplementation in pig starter diets. R. B. Hinson*[1], G. L. Allee[1], and J. D. Crenshaw[2], [1]*University of Missouri*, *Columbia*, [2]*APC Inc.*, *Ankeny, IA*.

Eight hundred forty weanling pigs (avg. initial weight = 4.73 kg; avg. age = 16 days) were used to determine the effect on pig performance of phase 1, 2 and 3 starter diets containing 0, 2, 4, or 6% spray-dried blood cells (SDBC) or 4% and 6% SDBC supplemented with L-Ile at a 62% SID Ile:Lys ratio. Fish meal (FM) was the primary protein source replaced by SDBC. Dietary phases 1, 2, and 3 were 7 d periods respectively after weaning. From d 21 to d 42 postweaning all pigs were fed a common corn-soybean meal diet. Pigs were allotted to treatments in a RCBD with 7 replicate pens/treatment and 20 pigs/pen. Average daily gain (phase 1-3) and ADFI (phase 1 and 2) were reduced ($P < 0.04$; Linear, $P < 0.04$) when more than 2% SDBC was included in the diet without the addition of L-Ile. Cumulative data for the phase 1-3 periods yielded similar results with ADG (197, 195, 152, and 143 g/d respectively for 0, 2, 4, and 6% SDBC) and ADFI (263, 252, 204, and 166 g/d respectively for 0, 2, 4, and 6% SDBC) being reduced ($P < 0.001$; Linear, $P < 0.001$) when SDBC was added to the diet at more than 2% without the addition of L-Ile. In all phases and parameters, when L-Ile was supplemented to the 4 and 6% SDBC diets, performance was restored to levels similar ($P > 0.05$) to the 0 and 2% SDBC diets (phase 1-3 ADG: 197, 195, 204, 190 g/d; phase 1-3 ADFI: 263, 252, 266, and 243 g/d respectively for 0 and 2% SDBC and 4 and 6% SDBC + L-Ile). Results by phase and cumulative data (phase 1-3) indicated that 2% SDBC effectively replaced FM and provided equal performance. However 4% or 6% SDBC without L-Ile reduced ($P < 0.001$) ADFI and ADG and this response resulted in lower ($P < 0.003$) final BW at 42 d. Supplementation with L-Ile to 4% and 6% SDBC corrected the reduction ($P < 0.001$) in ADFI and ADG. Spray-dried blood cells can be utilized as a protein source in phase 1-3 nursery diets at 2% without the addition of L-Ile. Higher levels of SDBC (i.e. 4 to 6%) can be utilized provided a minimum SID Ile:Lys ratio of 62% is maintained.

Key Words: spray-dried blood cells, pigs, isoleucine

161 Effects of humidity on flow ability of specialty protein ingredients used in weanling pig diets. E. E. Carney, C. N. Groesbeck*, R. D. Goodband, M. D. Tokach, S. S. Dritz, J. L. Nelssen, and J. M. DeRouchey, *Kansas State University*, *Manhattan*.

An experiment was conducted to determine the effects of humidity on flow ability of specialty protein sources as measured by angle of repose. Angle of repose is the maximum angle in which a pile of ingredient retains its slope. A large angle of repose represents a steeper slope and poorer flow ability. Five specialty protein sources were evaluated; fish meal, powdered and granulated blood meal, and powdered and granulated blood plasma. Specialty protein sources were added at 0, 2.5, 5.0, 7.5, and 10% to a 70:30 corn-soybean meal blend. The experiment was conducted at two humidity levels, 34 or 64%. Temperature was held constant at 32 degrees Celsius. The experiment was conducted in an environmentally-controlled nursery to minimize temperature and humidity fluctuations. All samples were placed into the barn 24 hr before the experiment was conducted to allow for acclamation to the environmental conditions. Humidity and temperature recorders measured the minimum and maximum temperature and humidity during the experiment. A specialty protein source × inclusion level × humidity interaction ($P < 0.01$) was observed. Angle of repose increased with increasing inclusions of powdered animal plasma and fish meal indicating poorer flow ability. There was little change in flow ability with increasing inclusions of powdered blood meal. Angle of repose decreased as granulated animal plasma and blood meal inclusions increased, indicating better flow ability. As humidity level increased from 34 to 64% angle of repose increased resulting in poorer flow ability. In conclusion, these data confirm that the humidity, inclusion percentage, and ingredient form (powder or granulated) will affect flow ability of diets when fed in meal form. Humidity increased angle of repose, decreasing flow ability of meal diets. Specialty protein sources in powder form reduce flow ability, while granulated specialty protein sources improve flow ability.

Key Words: angle of repose, flowability, humidity

162 Variation in maize particle size and pelleting in a Maillard Reaction Product containing complementary feedingstuff on the performance of post weaning piglets. M. J. Hutchinson*[1,3], M. E. E. McCann[1,2], and V. Beattie[3], [1]*Queens University Belfast*, *Belfast, Down, Northern Ireland*, [2]*Agri-Food and Biosciences Institute*, *Belfast, Down, Northern Ireland*, [3]*Devenish Nutrition Limited*, *Belfast, Down, Northern Ireland*.

The inclusion of synthetic amino acid in the diet of post-weaned pigs has advantages and disadvantages and other ways of delivering amino acids are of interest to the feed industry. The Maillard Reaction is the

chemical catalysis of the amine group of an amino acid, to the carboxyl group of a sugar giving Maillard reaction products (MRP). Devenish Nutrition Ltd. uses such compounds under the brand name Matan XL to deliver high quality protein and lysine (Lys), methionine (Met) and threonine (Thr) in pig diets. The aim of this study was to assess the effect of particle size of the maize base to which the MRPs solution is added, and interaction of pelleting on pig performance. Two complementary feedingstuffs were created using Matan XL formulated using MRP solution of Lys, Met and Thr and maize ground to pass through a screen size of either 2 or 8 mm. These feedingstuffs were then either pelleted or left as meal. These materials were then included in two starter diets at 50.0 g/kg. All diets were balanced for protein content and digestible energy. The performance trial utilised 96 post-weaning piglets over a 26-day period, in groups of 4, giving 24 piglets per treatment (6 groups). Average daily intake (ADI, g/d), average daily gain (ADG, g/d), and feed conversion ratio (FCR) were determined for each diet period. Statistical analysis was by ANOVA using Genstat v8.0. Significant differences ($p<0.001$) in ADI were observed between the use of 2 mm (421.8 g/d) and 8 mm (385.4 g/d) maize meal Matan XL products leading to a greater mean piglet final weight for the 2 mm products (16.71 kg, though not significant). The best ADI in post-weaning piglets was observed with the 2 mm ground maize base, and pelleting of this product had no effect on either ADI or final weight. The effect of MRPs used in complementary feedingstuffs on ADI is currently speculative, and could be due to flavour compound formation or other nutritional properties. These results indicate that the mechanism is linked to the interaction of the MRP solution and the surface area of the base employed.

Key Words: post weaning pig, maillard reaction product, pelleting

163 The effect of complementary feedingstuffs formulated using Maillard reaction products (MRP) solution on the performance of post weaning piglets. M. J. Hutchinson*[1,3], M. E. E. McCann[1,2], and V. Beattie[3], [1]*Queens University Belfast*, *Belfast, Down, Northern Ireland*, [2]*Agri-Food and Bioscience Institute*, *Belfast, Down, Northern Ireland*, [3]*Devenish Nutrition Limited*, *Belfast, Down, Northern Ireland*.

The Maillard reaction involves the chemical catalysis of the amine group of an amino acid to the carboxyl group of a sugar, and is one of the major chemical reactions that occur during cooking. The aim of this study was to assess the effect. of a solution of in vitro synthesised early Maillard reaction products (MRP) of lysine (Lys), methionine (Met) and threonine (Thr) added to commercially available ingredients. Four complementary feedingstuffs were created using MRP solution, synthetic amino acids, and either maize, HiPro soya, rice protein or wheat Gluten at standard concentrations. Each was included in two starter diets at 50.0 g/kg. All diets were balanced for protein content and digestible energy. The performance trial utilised 96 post-weaning piglets over a 24-day period, in pens of 4 pigs, giving 24 piglets per treatment (6 groups). The average daily intake (ADI, g/d), average daily gain (ADG, g/d), and feed conversion ratio (FCR), were determined for each diet period. Statistical analysis was by ANOVA using Genstat v8.0. The maize base resulted in the heaviest piglets at the end of the measured period, with highly significant differences ($p<0.001$) in final weight between use of the maize (14.84 kg) and the HiPro soya (13.59 kg) and wheat gluten (13.34 kg) bases. These differences were driven by significant increases ($p<0.001$) in ADI (395.1, 372.4 & 351.1 g/d overall, respectively) rather than feed conversion. The difference in ADI between the worst (wheat gluten) and best (maize) performing bases was 44.0 g/pig/day over the trial period (days 1 to 24), equivalent to a overall mean decrease in intake of 1.06 kg/pig. The formation of MRP in vivo in cooking is well documented and they can have a major effect on nutritive value and other factors. The employment of de novo MRPs of Lys, Met and Thr, with maize in complementary feedingstuffs improves post weaning piglet performance (through increases in ADI) over that of other bases. The exact mechanism by which MRP solution exerts its effect on ADI and piglet performance is currently under investigation.

Key Words: post weaning pig, maillard reaction products, amino acid delivery

164 Effects of added natural and synthetic vitamin E in the drinking water of weanling pigs. E. Wilburn*[1], D. Mahan[1], D. Hill[2], and H. Yang[2], [1]*The Ohio State University*, *Columbus*, [2]*ADM Alliance Nutrition*, *Quincy, IL*.

Previous trials indicated that providing weaning pigs vitamin E in their drinking water was effective in increasing blood and tissue tocopherol than adding it to the diet. This experiment investigated the effect of supplementing various levels of natural (d α-tocopheryl acetate) or synthetic (dl -α-tocopheryl acetate) vitamin E to the drinking water of weanling pigs. The experiment was a 2×3 factorial in a RCB design in 4 replicates. Vitamin E sources were each evaluated at 3 levels (50, 100, 150 IU/L) in drinking water for 21 d postweaning. Drinking water was mixed daily and provided as needed. A total 96 pigs averaging 6.2 kg BW at 17 d of age were allotted by weight and litter to treatment pens. The diets were conventional complex nursery diets and fed for 7 and 14 d, respectively. The diets had 8.2 mg α-tocopherol per kg complete feed. Pigs were bled via cardiac puncture at periodic intervals. At the 21 d period, 2 pigs per pen were randomly selected and killed and samples of liver, lung, heart, and loin removed and analyzed for vitamin E. No performance differences occurred between treatments. Serum tocopherol initially averaged 3.5 µg/mL and declined in all treatment groups by 7 d postweaning. At 3, 7, 14 and 21 d postweaning serum α tocopherol increased linearly ($P<0.01$) as vitamin E in the drinking water increased. Serum tocopherol concentrations were approximately 10% greater when natural vitamin E was provided at each measurement period. Tocopherol concentrations of lung, heart and loin were each greater ($P<0.05$) for pigs fed the natural source of vitamin E than when fed synthetic vitamin E. Although the tissue concentration increased linearly ($P<0.01$) as the supplemental level increased for both sources, the data suggest a plateau when 100 IU /L was provided. These results suggest that providing vitamin E in the drinking water of weaned pigs was an effective method of rapidly incorporating the vitamin into body tissue.

Key Words: pigs, vitamin E, water

165 Digestible energy content of corn- vs sorghum-based distillers dried grains with solubles in finishing pigs. C. Feoli*[1], J. D. Hancock[1], C. Monge[1], T. L. Gugle[1], S. D. Carter[2], and N. A. Cole[3], [1]*Kansas State University*, *Manhattan*, [2]*Oklahoma State University*, *Stillwater*, [3]*USDA/ARS*, *Bushland, TX*.

A total of 120 finishing pigs (avg initial BW of 111 kg) was used in a 19-d experiment to determine the DE content of corn- vs sorghum-based distillers dried grains with solubles (DDGS). The reference diet was 97.5% corn with vitamins, minerals, and amino acids added to meet or exceed all NRC suggested nutrient concentrations. Treatments were corn-based (Sioux River Ethanol, Hudson, SD and MGP Ingredients, Atchison, KS) and sorghum-based (US Energy Partners, Russell, KS and Western Plains Energy, Oakley, KS) DDGS substituted as 50% of the reference diet in place of corn. The pigs were sorted by sex and ancestry and blocked by BW with 12 pigs/pen and two pens/treatment. Feed and water were consumed on an ad libitum basis. The pigs were allowed to adjust to the experimental diets for 4 d. Each morning for the next 2 d, grab samples of feces were collected from at least six of the pigs in each pen via rectal massage. The pigs were fed a common diet for 7 d and the treatments were reassigned with the only restriction to randomization being that a pen could not receive the same treatment twice. The end result was four observations per treatment for determination of DE. For the reference diet, digestibility of DM, N, and GE were 87.4, 74.5, and 85.4%, respectively, and DE of the corn itself was determined to be 3,322 kcal/kg. Comparisons among the treatments indicated that DDGS from corn had greater DE (223 kcal/kg) than DDGS from sorghum ($P < 0.04$). Additionally, DE was different among the sources of corn-based DDGS (3,628 vs 2,940 kcal/kg for Hudson vs Atchison, $P < 0.001$) and sorghum-based DDGS (3,205 vs 2,918 kcal/kg for Russell vs Oakley, $P < 0.05$). In conclusion, our results indicate that both substrate used in the fermentation process and plant of origin affect the energy value of DDGS when fed to finishing pigs.

Key Words: distillers dried grains, DE, pigs

166 Effects of corn- and sorghum-based distillers dried grains with solubles on growth performance and carcass characteristics in finishing pigs. C. Feoli*[1], J. D. Hancock[1], C. Monge[1], T. L. Gugle[1], S. D. Carter[2], and N. A. Cole[3], [1]*Kansas State University*, *Manhattan*, [2]*Oklahoma State University*, *Stillwater*, [3]*USDA/ARS*, *Bushland, TX*.

A total of 176 finishing pigs (avg BW of 64 kg) was used in a 72-d experiment to compare the effects of corn- and sorghum-based distillers dried grains with solubles (DDGS) on growth performance and carcass characteristics. Treatments were a corn-soybean meal-based control diet and diets with 40% high-energy DDGS from Sioux River Ethanol, Hudson, SD (corn-based, crude fat of 10.2%, mean particle size of 353 um, and DE of 3,628 kcal/kg), 40% moderate energy DDGS from MGP Ingredients, Atchison, KS (corn-based, crude fat of 8.5%, mean particle size of 796 um, and DE of 2,940 kcal/kg), and 40% moderate energy DDGS from US Energy Partners, Russell, KS (sorghum-based, crude fat of 6.8%, mean particle size of 563 um, and DE of 3,205 kcal/kg). There were 11 pigs/pen and four pens/treatment with feed and water consumed on an ad libitum basis until the pigs were slaughtered at an avg BW of 130 kg. For the control, high-energy DDGS, moderate-energy corn DDGS, and moderate-energy sorghum DDGS, ADG was 943, 891, 918, and 908 g/d, ADFI was 3.14, 2.92, 3.13, and 3.24 kg/d, and G:F was 300, 305, 293, and 280 g/kg, respectively. Data analyses indicated that pigs fed the control diet had greater ADG compared to pigs fed the DDGS treatments ($P < 0.003$). Among the DDGS treatments, the high-energy product supported lower ADG with less ADFI, but gave greater G:F than the moderate energy DDGS sources ($P < 0.06$). As for carcass data, dressing percentage (74.8, 73.7, 72.7, and 73.6%, respectively) was greater ($P < 0.001$) for pigs fed the control vs DDGS treatments but percentage carcass lean (53.9, 53.5, 53.6, and 53.7%, respectively) was not affected ($P > 0.49$) by treatment. In conclusion, there was noteworthy variation among pigs fed diets with DDGS from different processors.

Key Words: distillers dried grains, sorghum, pig

167 Effects of dried distillers grain with solubles on grow-finish pig performance. S. K. Linneen*, M. D. Tokach, J. M. DeRouchey, S. S. Dritz, R. D. Goodband, J. L. Nelssen, R. O. Gottlob, and R. G. Main, *Kansas State University*, *Manhattan*.

Three experiments were conducted to determine the effects of increasing dried distillers grains with solubles (DDGS) sourced from the same ethanol manufacturing facility on growth performance of grow-finish pigs. All experiments were conducted in the same commercial research facility using 7 (Exp. 1), 10 (Exp. 2), and 9 (Exp. 3) replications per treatment with 24 to 26 pigs/pen in Exp. 1 and 2, and 25 to 28 pigs/pen in Exp. 3. Diets were formulated on a total amino acid basis in Exp. 1 and a TID basis in Exp. 2 and 3. In Exp. 1, 1,050 pigs (50.1 kg) were used in a 28-d study in a 2×3 factorial with either 0 or 15% DDGS with 0, 3, or 6% added fat. Overall, there were no DDGS × fat level interactions ($P > 0.14$). Adding DDGS to the diet did not affect ($P > 0.74$) ADG (942 vs 942 g/d), ADFI (2,140 vs 2,148 g/d) or G/F (0.44 vs 0.44). Adding fat to the diet increased (linear, $P < 0.01$) ADG (908, 943, 976 g/d) and G/F (0.422, 0.440, 0.457). In Exp. 2, 1,038 pigs (46.3 kg) were used in a 56-d study and fed diets with 0, 10, 20, or 30% DDGS. Increasing DDGS level in the diet decreased ADG (849, 858, 834, 835 g/d; linear, $P < 0.09$) and ADFI (1,946, 1,975, 1,913, 1,900 g/d; linear, $P < 0.05$). Although responses were linear, the negative response only occurred with greater than 10% DDGS. There were no differences in G:F (0.437, 0.435, 0.437, 0.440; $P > 0.38$). In Exp. 3, 1,112 pigs (50.1 kg) were used in a 56-d study and fed diets with 0, 5, 10, 15, or 20% DDGS. Pigs fed the control diets had increased ($P < 0.05$) ADG (934, 925, 939, 921, 894 g/d) compared to pigs fed diets containing 20% DDGS with others being intermediate. Increasing DDGS level in the diet tended to decrease ADFI (2.27, 2.20, 2.24, 2.18, 2.16 kg/d; linear $P < 0.09$). There was a quadratic ($P<0.04$) improvement in G:F with increasing DDGS (0.41, 0.42, 0.42, 0.42, 0.41). In conclusion, approximately 15.0% DDGS sourced from this manufacturing facility can be added to diets before growth rate is reduced.

Key Words: dried distillers grain with solubles, pigs, growth

168 Use of corn distillers dried grains with solubles (DDGS) in finishing pigs. A. M. Gaines, G. I. Petersen*, J. D. Spencer, and N. R. Augspurger, *JBS United, Inc.*, *Sheridan, IN*.

The purpose of this research was to evaluate growth performance and carcass characteristics of finishing pigs fed high levels of DDGS. A total of 880 pigs (Ausgene; 43.7 ± 0.23 kg) were allotted to one of three dietary treatments in a randomized complete block design with 12 replicate pens/treatment. Dietary treatments included a corn-soybean meal diet with 0% DDGS, corn-soybean meal diet with 30% DDGS, and a corn-soybean meal diet with 30% DDGS plus a commercial cellulase enzyme (100 mg/kg). Experimental diets contained no supplemental fat and were formulated in excess of requirement to the same standardized ileal digestible (SID) lysine level. Pigs were fed from 44 to 129 kg BW in a 5 phase feeding program. At trial termination, pigs were marketed by intact pen for carcass data collection at a commercial processing facility. For the overall finishing period, there were no differences in ADG ($P < 0.16$) or ADFI ($P < 0.34$). Though it was not statistically significant, ADG was numerically lower for pigs fed DDGS, irrespective of enzyme supplementation. As a result, G/F was lower ($P < 0.05$) for pigs fed DDGS (0.318, 0.310, and 0.310, respectively). There were no differences in carcass weight ($P < 0.33$); however, feeding DDGS reduced ($P < 0.04$) carcass yield (76.9, 76.0, and 76.3%, respectively). Carcass yield of pigs fed DDGS plus enzyme was not different from pigs fed 0 ($P < 0.45$) or 30% DDGS ($P < 0.08$). There were no differences in fat depth ($P < 0.92$). Feeding DDGS reduced loin depth ($P < 0.001$; 68.3, 66.3, and 65.5 mm, respectively) and carcass percent lean ($P < 0.05$; 54.9, 54.5, and 54.5%, respectively), irrespective of enzyme supplementation. There were no improvements in morbidity ($P < 0.55$) or mortality ($P < 0.95$) when feeding DDGS. This research demonstrates that finishing swine can be fed high levels of DDGS, but a reduction in carcass yield and lean should be considered when determining their economic value.

Key Words: swine, DDGS, finishing pigs

169 Evaluation of different strategies for supplementing distiller's dried grains with solubles (DDGS) to nursery pig diets. J. D. Spencer*, G. I. Petersen, A. M. Gaines, and N. R. Augspurger, *JBS United, Inc.*, *Sheridan, IN*.

Two trials were conducted to evaluate DDGS (10.2% crude fat, 25.4% CP, 0.86% lys) supplementation to nursery pig diets. In trial one, 1500 weaned pigs (6.4 kg BW, 18 to 21 d of age) were allotted to one of four treatments in a RCBD with 15 replicate pens per treatment (20 to 27 pigs/pen). Treatments consisted of introducing DDGS at different phases in a 4 phase corn-soybean meal based nursery program for 6 wks: 1) Control, 0% DDGS; 2) 7.5% DDGS phase 1, and 15% DDGS throughout; 3) 15% DDGS starting in phase 2; and 4) 15% DDGS starting in phase 3. Diets within each phase were formulated to the same SID lysine, but other nutrients varied with DDGS replacing corn and SBM in phase 2, 3 and 4. Trial two utilized a total of 300 pigs (9.0 kg BW, approximately 31 d of age), and evaluated the impact of supplementing 30% DDGS with and without the addition of a combination enzyme (alpha-galactosidase, galactomannanase, xylanase, beta-glucanase) on pig growth performance for 3 wks. Pigs were allotted to one of three treatments in a RCBD with 10 replicate pens per trt (10 pigs/pen). Treatments consisted of 1) corn-soybean meal control; 2) 30% DDGS replacing corn and soybean meal; and 3) as 2 + 0.05% exogenous enzyme combination. In trial one, pigs fed diets containing DDGS had greater ($P < 0.01$) G:F than pigs fed no DDGS, irrespective of when DDGS supplementation was initiated (0.682, 0.695, 0.690, 0.697, respectively; SEM = 0.005). In trial two, pigs fed diets formulated with 30% DDGS had greater ($P < 0.01$) G:F than pigs not fed DDGS (0.665, 0.722, 0.713, respectively; SEM = 0.007). Enzyme supplementation to the diet containing 30% DDGS improved ($P < 0.05$) ADG (0.53, 0.54, 0.56, respectively; SEM = 0.011) over treatments one and two. These data suggest that DDGS can be supplemented to pig diets (7.5 to 15%) at any time in the nursery period without reducing piglet growth rate, and may result in improved G:F. Additionally, the supplementation of exogenous cellulase enzymes offers further opportunities to improve animal performance when using high levels of DDGS in nursery diets.

Key Words: DDGS, enzyme, pig

172 Use of dried distillers grains with solubles in diets for lactating sows. M. Song*, S. K. Baidoo, G. C. Shurson, and L. J. Johnson, *University of Minnesota*, *St. Paul*.

A study was conducted to evaluate effects of adding up to 30% dried distillers grains with solubles (**DDGS**) to corn-soybean meal based diets for lactating sows. Mixed parity sows (n = 307; 222 ± 15 kg BW) were assigned randomly to one of five dietary treatments based on parity. The treatments were: 1) a corn-soybean meal based diet (**CON**), 2) **CON** + 10% **DDGS** (**DG10**), 3) **CON** + 20% **DDGS** (**DG20**), 4) **CON** + 30% **DDGS** (**DG30**), or 5) **CON** + 30% **DDGS** high protein (**DGHP30**). The **DGHP30** diet was formulated without use of synthetic amino acids. Sows were introduced gradually to their lactation diets beginning on d 109 of gestation. Feed offered was gradually increased through d 5 then sows were allowed *ad libitum* intake until weaning at d 19. Sows and litters were weighed on d 2 of lactation after equalizing litters to 10 pigs within dietary treatments. Dietary treatments did not affect **ADFI** of sows, backfat thickness, wean-to-estrus interval (**WEI**), pre-weaning mortality of piglets, or litter **wt** gain. However, sows fed **DGHP30** lost **BW** ($P<0.05$) compared to sows fed **CON**. These results indicate that addition of up to **DG30** in the lactation diet will support sow and litter performance similar to that of a corn-soybean meal diet.

Dietary effect of DDGS on lactating sow performance

	CON	DG10	DG20	DG30	DGHP30	PSE
No. of sows	60	61	63	61	62	
ADFI, kg	6.48	6.57	6.98	6.65	6.47	0.16
Wt change, kg	5.43[a]	4.17[ab]	0.66[ab]	2.40[ab]	-0.63[b]	1.42
Backfat change, mm	-0.55	-0.64	-0.95	-0.59	-1.09	0.19
WEI, day	4.93	5.00	5.12	5.02	5.25	0.12
Piglet mortality, %	10.26	8.37	8.48	8.48	7.97	1.22
Litter gain, kg/sow	45.51	46.84	46.75	45.52	46.08	0.86

[a b] Means with different superscripts differ ($P<0.05$)

Key Words: DDGS, sow, lactation

173 Determining the accuracy of gestation feed drops. J. D. Schneider*, M. D. Tokach, S. S. Dritz, R. D. Goodband, J. L. Nelssen, and J. M. DeRouchey, *Kansas State University*, *Manhattan*.

An experiment was conducted to determine the accuracy of three different styles of gestation feed drops (Econo, Accu, Ultra; Automated Production Systems, Assumption, IL). Each drop was tested at three different angles (90, 75, 60°) from the feed line. Drops were attached to a 5 cm diameter feed line and feed was collected and weighed at settings of 0.91, 1.82, 2.73, 3.64, and 4.55 kg for the Econo and Accu feed drops. Due to the smaller feed storage capacity, settings of 0.91, 1.82, 2.73, and 3.64 kg were used for the Ultra feed drop. A typical corn-soybean meal diet was used. There were five replicate drops of each type and two replicates at each angle and feed setting. Data was analyzed as a split plot design with the feed drop as the whole plot and angle as the subplot. Feed drops were blocked based on type and analysis of variance was performed using the PROC MIXED procedure of SAS. There was a drop type by angle interaction ($P < 0.01$) for the feed settings versus the actual amount dropped. The amount of feed dropped at each setting was influenced more by angle to the feed line with the Econo than the Accu or Ultra feed drops. At 90 degrees, the relationship between the feeder setting (x) and actual quantity of feed dropped was best described by the equation (1.11x + 0.54) for the Econo; (1.01x+0.16) for the Accu; and (1.01x + 0.51) for the Ultra. At 75 degrees, the equations were (1.05x - 0.31) for the Econo; (1.00x+0.13) for the Accu; and (1.01x + 0.34) for the Ultra. The Accu and Ultra had a lower ($P < 0.10$) slope and less change ($P < 0.05$) in slope and intercept when the angle to the feed line changed from 90 to 75 degrees compared to the Econo indicating they more accurately dropped the correct amount of feed. This study demonstrated that the Accu and the Ultra feed drop are more accurate than the Econo feed drop.

Key Words: feed, equipment, gestation

174 The effects of feeding schedule on body condition, aggressiveness, and reproductive failure in group housed sows. J. D. Schneider*, M. D. Tokach, S.S. Dritz, R. D. Goodband, J. L. Nelssen, and J. M. DeRouchey, *Kansas State University*, *Manhattan*.

A total of 208 sows and 288 gilts (PIC Line C29) were used to determine the influence of feeding frequency (two versus six times per day) in gestation on performance and welfare measurements. Treatments consisted of feeding similar amounts of feed to each sow or gilt divided equally between two (07:00 and 15:30) or six meals per day (07:00, 07:30, 08:00, 15:30, 16:00, and 16:30 h). There were 8 sows or 12 gilts in each pen. Gilts and sows were moved to pens after breeding and randomly assigned in a balanced incomplete block design. In sows, there were no differences ($P > 0.10$) between treatments in ADG (0.47 vs 0.42 kg), backfat change (3.30 vs. 3.32 mm), or variation in final body weight (14.9 vs 17.22%). There was a trend ($P < 0.08$) for sows fed twice a day to farrow more total pigs (14.6 vs. 13.6), but pigs born alive (12.0 vs 11.3) or other reproductive performance were not affected ($P > 0.21$) by treatment. Sows fed 6 times a day had increased vocalization during the morning ($P < 0.07$) and afternoon ($P < 0.01$) feeding periods compared with sows fed twice a day; however, sows fed twice a day had more skin ($P < 0.01$; 1.51 vs 1.34) and vulva ($P < 0.04$;1.08 vs 1.03) lesions as well as a small, but significant, increase in feet/leg ($P < 0.01$; 1.21 vs 1.12) and hoof ($P < 0.02$; 1.05 vs 1.01) lesion scores. From d 0 to 42, gilts fed two times a day had lower ADG ($P < 0.07$; 0.27 vs 0.36 kg), and d 42 backfat ($P < 0.09$; 18.8 vs 19.7 mm). From d 42 to farrowing, ADG was similar ($P = 0.39$) for gilts fed twice or six times per day (0.47 vs 0.42 kg). Gilts fed twice a day had lower CV for weight at farrowing ($P < 0.10$; 10.4 vs 15.1%). In gilts, there were no differences ($P > 0.17$) for reproductive performance, skin and vulva lesions, and leg/feet and hoof scores. Increasing the feeding frequency from two to six times per day does not appear to have a dramatic negative or positive impact on performance or welfare of group housed gilts and sows. Research supported by National Pork Board.

Key Words: group housed, gestation, welfare

175 Evaluation of crystalline amino acid supplementation and feeding frequency in gestating sows. P. Srichana*[1], A. M. Gaines[1], J. L. Usry[2], R. D. Boyd[3], and G. L. Allee[1], [1]*University of Missouri*, *Columbia*, [2]*Ajinomoto Heartland LLC*, *Chicago, IL*, [3]*The Hanor Company, Inc.*, *Franklin, KY*.

Five experiments were conducted to study the effects of dietary L-Lysine.HCl inclusion and feeding frequency on N balance in gestating swine. Nitrogen balance trials were conducted in early gestation (d 50 to 650; Exp. 1); mid-gestation (d 80 to 90; Exp. 2); and late gestation (d 100 to 110; Exp. 3) to investigate the effect of L-Lysine.HCl inclusion and feeding frequency (Exp. 4 and 5). In Exp. 1, 2, and 3 a total of 72 gilts (24, Monsanto Choice Genetics Genepacker, and 48, PIC Camborough 22) were assigned to one of four levels of dietary L-Lysine.HCl inclusion (0, 0.1, 0.2, and 0.3%, respectively). In Exp. 4 and 5, a total of 24 gilts and 16 parity 1 sows (Monsanto Choice Genetics Genepacker) were assigned to one of two levels of L-Lysine.HCl inclusion (0 and 0.2%, respectively) and fed either one or two times/d. The diets were formulated to be isocaloric (3.30 Mcal ME/kg) and contained 0.64% total lysine. Crystalline L-threonine was used to keep the ratio of total threonine:lysine at 77%. The level of feed intake in all experimental diets were held constant at 2,041 g/d, in early gestation period (Exp. 1), 2,359 g/d in mid gestation period (Exp. 2, 4, and 5), and increased to 2,813 g/d in late gestation period (Exp. 3). Similar nitrogen retention was observed ($P > 0.05$) when the level of L-Lysine.HCl was held at 0.2% or less at each state of gestation. However, nitrogen retention was reduced ($P < 0.05$) when averaged over three stages of gestation 60 to 70, 80 to 90, and 100 to 110 d) 25.13, 24.73, 22.95 and 16.80 g/d when L-Lysine.HCl was increased in the diet from 0.0, 0.1, 0.2 and 0.3%, respectively. For every 0.1% of L-Lysine.HCl inclusion, N excretion decreased approximately 8 to 10%. Feeding sows in gestation two times/d did not improve N retention with either a corn soybean meal or a crystalline amino acid supplemented diet. Based on these data, L-Lysine.HCl can be used up to 0.2% in corn soybean meal based gestation diets when fed either once or twice per day.

Key Words: sow, gestation, lysine

176 Effect of Progenos on placenta and fetal development in pigs. W. Hazeleger[1], P. Ramaekers*[2], C. Smits[2], and B. Kemp[1], [1]*Department of Animal Sciences, Wageningen UR*, *Wageningen, The Netherlands*, [2]*Nutreco Netherlands BV, Swine Research Centre*, *Boxmeer, The Netherlands*.

In previous experiments Progenos treatment during early pregnancy resulted in approximately 1 piglet extra born (JAS 84; Suppl. 1; Abstr. 462; 2006). In this experiment cyclic Hypor gilts were treated with Regumate (18 d), eCG (Folligonan; 600 or 100 iu i.m.) and hCG (Chorulon; 500 iu i.m.) to synchronize their moment of ovulation and to induce variation in ovulation rate and thereby variation in intra-uterine crowding. Progenos dressing (100 g daily, containing 25% L-Arginine) was fed to pregnant gilts (n=42) from day 16 throughout day 28 of gestation. Control animals (n=46) received a placebo dressing without L-Arginine. Gilts were slaughtered at Day 35 and Day 70 of pregnancy to evaluate placental development and fetal development and survival. Placental development was evaluated by weight, length, color (Minolta system measuring L, a, b) measurements and at Day 35 by subjective vascularisation score (scale 1-5). Fetal parameters were number, vitality, weight and length. The number of CL was counted as measure for ovulation rate. Data were analyzed by Proc GLM (SAS 9.1.2; 2004). At Day 35, Progenos treatment increased % vital fetuses (Control: 68±5% vs Progenos: 77±4%; p≤.05). Placental development was affected in color measurement (a: 4.1±.2 vs 5.3±.3 and b:8.1±.2 and 8.8±.1)and vascularisation score (2.6±.1 and 2.9±.1) for Control and Progenos gilts respectively (p≤.05), indicating increased vascularisation of the placenta after Progenos treatment. Fetal and placental weight and length were not affected. At Day 70 no significant effect of Progenos was found on average placental weight, length, color or fetal weight and length or fetal survival, although 1 fetus extra was found in the Progenos group (p≥.05). This experiment confirms the suggested effect of Progenos on placental vascularisation and fetal survival, leading to increased reproductive performance in pigs.

Key Words: L-Arginine, pig, placenta development

177 Effect of prepartum feeding of 1,3-butanediol on subsequent pig and sow productivity. T. S. Stahly*, C. H. Stahl, and J. B. Zamzow, *Iowa State University*, *Ames*.

Prepartum feeding of 1,3-butanediol (BD) to sows has been shown to improve the metabolic status of neonatal pigs. The objective of the current study was to evaluate the effects of short-term, prepartum feeding of 1,3-butanediol on pig and sow productivity in modern production systems. Sows (PIC Camboroughs) in a 3,400 commercial sow unit were used. Sows were randomly allotted within each of 17 weekly farrowing groups (150 sows/group) to 1 of 2 prepartum diets (0 or 4.55% BD) on day 107 (±3) of pregnancy. Each sow (1,270 sows/trt) was allocated 8,250 kcal ME/d until parturition. The BD (6 kcal ME/g) provide 8% of the total ME and was added at the expense of corn. Postpartum, all sows received the same dietary regimen (0% BD). Each day, pigs born, stillborns and mortalities in the litters that had farrowed the previous 24 hr were recorded and then the live pigs of those litters were equalized by transferring pigs among sows receiving the same prepartum diet. Prepartum feeding of BD did not alter number of pigs born or stillborns/litter but lowered (P<. 01) preweaning pig mortalities (1.44 vs 1.24/litter) and the proportion of pigs allowed to nurse the sows that died prior to weaning (12.7 vs 11.0%). This resulted in .29 more pigs/litter weaned in the BD group. The magnitude of reduction in pig mortality was independent of days (4 to 11 d) BD was fed. In a subsample of litters (all litters farrowing on 2 d in each of 17 farrow groups; 375 litters/trt; 4.5 mean d prepartum), 4 small pigs in each litter were tagged and monitored to determine the effect of BD on preweaning weight gain of pigs with the highest mortality risk. BD reduced (P<.01) preweaning mortality of these 4 small pigs by 5.2 percentage units but individual pig weights at birth (1.24 vs 1.25 kg) and weaning (4.07 vs 4.10 kg; d 14) were not altered even though the BD sows were nursing larger litters. Prepartum feeding of BD did not affect the sow′s body weight change (prepartum thru lactation), wean to estrus interval or conception rate. Based on these data, short-term prepartum feeding of BD effectively improves preweaning pig productivity in modern pork production systems.

Key Words: 1,3-butanediol, sow, preweaning pig mortality

178 Effect of n-3 fatty acids and high protein supplementation on gestation and lactation performance of first parity sows. R. D. Mateo*[1], Y. Hyun[2], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock*, [2]*Dodram B&F*, *Seoul, Korea*.

A study was to determine the effect of n-3 fatty acid supplementation with or without high protein on both gestation and lactation performance of first parity sows. Four dietary treatments were evaluated during both gestation and lactation which consisted of: 1). A corn-soy basal diet (CON); 2). A high protein diet (HP); 3). CON+1% Fertilium™ (United Feeds, Sheridan, IN) (O3); and 4). HP+O3 (HPO3). Sixty-four pregnant gilts (BW 195.0±2.1 kg BW, 12.9±0.16 mm BF) at 60 d of gestation were assigned to 4 dietary treatments which were maintained to lactation. Protein contents for CON and O3 were 12.3% for gestation and 17.9% for lactation whereas HP and HPO3 had 18.4% for gestation and 19.5% for lactation. BW and BF was measured on d 60 and 110 of gestation. The numbers of piglets born and born live were recorded within 24 h post farrowing. BW and BF of sows and BW of individual piglet were measured within 24 h post farrowing and at d 10 and 21 of lactation. All piglets were weaned at 21 d. Days return to estrus of sows was recorded. No differences in BW and BF at d 110 of gestation (P>0.05) were observed among treatments. Total piglets born, born dead, and born alive (P>0.05) were same among treatment groups including within litter birth weight variation (P>0.05). No differences in BW, BF, and ADFI (P>0.05) during lactation were noted among treatment groups including days return to estrus (P>0.05). Litter characteristics (P>0.05) were same among treatment groups. Average piglet weight of O3 at d 10 (3.5 vs. 3.1 and 3.2 kg; P=0.044) and 21 (6.1 vs. 5.2 and 5.3 kg; P=0.007) were higher than CON and HPO3. Overall piglet weight gain of O3 was higher (4.5 vs. 3.7 and 3.9 kg; P=0.034) than CON and HPO3. Piglet performance of the HP group did not differ (P>0.05) from other treatment groups. Results show that n-3 fatty acid supplementation or a high protein diet provided either individually or in combination during late gestation had no apparent benefit on pregnancy outcome. However n-3 fatty acid supplementation during lactation may improve performance of piglets of first parity sows.

Key Words: omega-3-fatty acid, sows, reproductive performance

179 Effects of omega-3 fatty acid supplementation to gestation and lactation diets on the expression of immune related genes in white blood cells of lactating sows. R. D. Mateo*[1], S. E. Dowd[2], J. A. Carroll[2], Y. Hyun[3], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock*, [2]*USDA-ARS-LIRU*, *Lubbock, TX*, [3]*Dodram B&F*, *Seoul, Korea*.

Twenty six first parity sows (BW of 197.7±2.5 kg and BF of 14.87±0.21 mm) were used in this study. On d 60 of gestation, pregnant gilts were assigned to one two dietary treatments which consisted of either a corn-soy meal basal diet (CON) or the basal diet supplemented with 1% Fertilium™ (United Feeds, Inc. Sheridan, IN) (O3) which were maintained throughout the study. Gestation diets contained 3.1 ME (Mcal/kg) and 12.3% CP and were fed daily at 2 kg. Lactation diets contained 3.2 ME (Mcal/kg) and 17.9% CP and were provided ad libitum throughout lactation. Blood samples (3 mL) were collected into Tempus RNA blood tubes, via jugular venepuncture, at 21 d of lactation and further processed for microarray analysis. Using an immune system targeted microarray 8 hybridizations and dye swaps were performed and results validated with quantitative RT-PCR. Expression analysis showed that long term feeding of n-3 fatty acids to sows resulted in marked upregulation (P<0.05) of immune related genes including the components of immunoglobulin including Ig kappa (+579%) and heavy chain region (436%), SLA-6 (+145%), myelin and lymphocyte protein (+265%), activin receptor IIA (+290%), CD1a (+144%), Noxa (+102%), arginase I (+546%), and glutathione peroxidase (+144%). Repressed genes included resistin (-141%), protein kinase C alpha (-231%), toll-like receptor 2 (-190%), angiopoietin-2 (-117%), and vasoactive intestinal polypeptide receptor 1 (-113%). Functional analysis of the results showed enrichment of epidermal growth factor related genes, iron binding genes, and genes associated with transferase activity. Results from the study indicate that n-3 fatty acid supplementation during late gestation, up to lactation, increases expression of leukocyte immune related genes and decreases expression of inflammatory genes which may enhance immune response of first parity lactating sows.

Key Words: sows, omega-3-fatty acid, microarray

180 Lysine requirement of lactating primiparous sows. P. Srichana*[1], J. L. Usry[2], C. D. Knight[3], L. Greiner[4], and G. L. Allee[1], [1]*University of Missouri*, *Columbia*, [2]*Ajinomoto Heartland LLC*, *Chicago, IL*, [3]*Novus International, Inc.*, *St. Charles, MO*, [4]*Innovative Sopw Solutions LLC*, *Carthage, IL*.

An experiment was conducted with 264 primiparous sows (PIC, Camborough 22, 191 ± 19 kg) to evaluate the effect of lysine intake on sow and litter performance during a 19 d lactation period and on subsequent reproductive performance. Sows were randomly allotted to one of five corn soybean meal lactation diets formulated to contain different levels of total lysine (0.95, 1.05, 1.15, 1.25, and 1.35%, respectively). All diets were formulated to be isocaloric 3.46 Mcal ME/kg and contained vitamins and minerals that exceeded recommendations (NRC, 1998). Experimental diets were given to sows from 112 d of pregnancy throughout the 19 d lactation period. Litters were standardized to average 10 pigs within 48 h after farrowing, and sows had free access to feed throughout the lactation period (19.4 ± 0.23 d). Sows were fed with a computerized feeding system that insured true ad libitum feed intake, and allowed the determination of daily sow feed intake during lactation. Sow ADFI exceeded expectation, averaging 5.6 kg/d with no differences (P ≥ 0.05) between dietary lysine levels. As expected, total lysine intake increased 53.5, 58.9, 64.3, 65.2, and 70.0 g/d as dietary lysine content of the diet increased. Increasing dietary lysine intake resulted in a linear increase (P ≤ 0.01) in litter growth rate, weaning weight, and average daily gain of the piglet. Litter growth rate was highest when 1.35% total lysine was fed. Dietary lysine level did not affect sow body weight change, wean to estrus interval, or subsequent reproductive performance (P ≥ 0.05). A total lysine intake of 70 g/d derived from a corn soybean meal diet, resulted in the highest sow lactation performance. However, since the response to lysine was linear the lysine requirement cannot be determined from this study, but appears to be 1.35% or greater for primiparous sows.

Key Words: sow, lactation, lysine

181 Effects of adding spray dried plasma protein (Appetein) on sow productivity during lactation. E. D. Frugé*[1], M. L. Roux[1], R. D. Lirette[1], T. D. Bidner[1], L. L. Southern[1], and J. D. Crenshaw[2], [1]*LSU Agricultural Center*, *Baton Rouge, LA*, [2]*APC Inc.*, *Ankeny, IA*.

Seventy two (36 per treatment) primiparous and multiparous sows over 4 farrowing groups were used to evaluate the effects of Appetein (animal plasma, serum globulin, animal serum, and lactose) on sow and litter performance during lactation. The dietary treatments consisted of corn-soybean meal (C-SBM) control and a C-SBM plus 0.5% Appetein. The diets contained 1.0% total Lys and were fed from the group average d 110 of gestation to weaning. Sows were allotted based on breed, parity, and the date of d 110 of gestation. Litters were standardized within diet and pigs were weaned at an average age of 19 d. Sows were fed 3 times daily during lactation. After weaning, sows were fed a common gestation diet and checked twice daily for estrus. Sows were grouped by parity for statistical analysis, and groups consisted of all parities, young parities (0 to 2), and old parities (3 to 7). When grouped by all parities, sows fed Appetein had increased litter ADG (1.58 vs. 1.77 kg, $P < 0.05$) with one less day of lactation ($P < 0.04$). Young parity sows fed Appetein had decreased ADFI during lactation (6.06 vs. 5.40 kg, $P < 0.07$) and no effects ($P > 0.10$) of diet on litter performance. Old parity sows fed Appetein had an increased ($P < 0.10$) average pig birth weight (1.48 vs. 1.64 kg), litter (1.39 vs 1.90 kg) and pig ADG (0.20 vs. 0.22 kg), and litter weaning weight (43.4 vs. 50.72 kg). In addition, sows fed Appetein had increased pig survival rate (77.6 vs. 88.0%, $P < 0.04$) and number of pigs weaned greater than 3.6 kg (7.01 vs. 8.52, $P < 0.01$). Otherwise, sow response variables (parity, sow weight on d 110 of gestation, d 1 postfarrowing, and weaning weight, lactation and overall weight change, days to estrus, pigs born alive or dead, total pigs born, litter live weight, back fat were not affected by treatment ($P > 0.10$). Subsequent farrowing data were collected but no treatment effects ($P > 0.10$) were observed. Appetein increased productivity of sows in parity 3 or greater.

Key Words: spray-dried plasma, feed intake, sow

182 The use of crystalline amino acids in lactating primiparous sow diets. P. Srichana*[1], J. L. Usry[2], C.D. Knight[3], L. Greiner[4], and G.L. Allee[1], [1]*University of Missouri*, *Columbia*, [2]*Ajinomoto Heartland LLC*, *Chicago, IL*, [3]*Novus International, Inc.*, *St. Charles, MO*, [4]*Innovative Sow Solutions LLC*, *Carthage, IL*.

Two experiments using 283 primiparous sows were conducted to evaluate the effect of crystalline amino acids inclusion on N balance and lactation performance. Exp. 1 compared a corn soybean meal diet with 0.075% L-lysine.HCl to a similar diet with 0.30% L-lysine.HCl and threonine, or a diet supplemented with 0.30% L-lysine.HCl, threonine, methionine, tryptophan, isoleucine and valine on N balance and lactation performance. In Exp. 2, 259 primiparous sows (PIC, Camborough 22, 191 ± 21 kg) were randomly allotted to one of five experimental diets containing different levels of L-lysine.HCl inclusion (0.00, 0.075, 0.150, 0.225, and 0.300%, respectively). Both L-threonine and a methionine source were supplemented to the same amino acid ratios relative to lysine as in the corn soybean meal control diet. All diets were formulated to have the same total lysine (1.20%) and were isocaloric (3.45 Mcal ME/kg). In Exp. 1 the 0.30% L-lysine.HCl supplemented diet with threonine and other essential amino acids resulted in similar N balance and litter performance as the control diet. In Exp. 2, increasing L-lysine.HCl resulted in similar litter and reproductive performance. The average litter gain was 2.27, 2.29, 2.38, 2.23, and 2.41 kg/d when sows were fed 0.00, 0.075, 0.150, 0.225, and 0.30% L-lysine.HCl, respectively. Increasing L-lysine.HCl inclusion did not affect average daily feed intake (ADFI) which averaged 6.00 kg/d. Collectively, these studies demonstrate that lactation diets for parity 1 females can contain up to 0.30% L-lysine.HCl with supplemental threonine and a methionine source, and have no detrimental effect on litter growth rate, sow weight change and subsequent reproductive performance while decreasing nitrogen excretion by over 30%.

Key Words: sow, lactation, lysine

183 Lactation feed intake and postweaning estrus of sows fed spray-dried plasma. J. Crenshaw*[1], D. Boyd[2], J. Campbell[1], L. Russell[1], R. Moser[3], and M. Wilson[3], [1]*APC Incorporated*, *Ankeny, IA*, [2]*The Hanor Company Incorporated*, *Franklin, KY*, [3]*JBS United Incorporated*, *Sheridan, IN*.

Four experiments involving 272, 410, 894 or 582 sows per respective experiment (Exp 1 to 4) were conducted to determine the effect of dietary spray-dried plasma (SDP) at 0% or 0.25% SDP (Exp 1 and 2) and 0% or 0.50% SDP (Exp 3 and 4) in lactation diets on lactation feed intake (LFI), sow weight loss from day 110 gestation to weaning (SWL), litter weight (LW), and average postweaning days to first estrus (DES). Data within experiment was analyzed for dietary treatment and parity (P) grouping (P1, P2 or P > 2) effects. For Exp 1 (only P1 and P2 sows were used), LFI was increased (P < 0.01), SWL was less (P < 0.07), DES was reduced (P < 0.06), and LW tended to increase (P = 0.18) for sows fed SDP. For Exp 2, SWL was reduced (P = 0.09) by feeding of SDP, while other variables were not affected by treatment. For Exp 3, LFI was increased (P < 0.01) for P1 and P2 sows, but reduced (P < 0.01) for P > 2 sows. Days to first estrus was reduced (P < 0.01) for P1 sows fed SDP in Exp 3, but not affected by treatment for P2 or P > 2 sows. In Exp 4 (only P > 2 sows were used), LFI was again reduced (P < 0.03) for older sows fed SDP, however LW and average pig weight at weaning was increased (P < 0.01) for P > 2 sows fed SDP. For Exp 1, 2 and 3, days to first estrus were subjected to categorical analysis for percentage of sows in estrus by days 4 to 6 or days 10 to 22 postweaning. Combined data from Exp 1, 2 and 3 of P1 and P2 sows (n = 818) indicated that a higher (P < 0.01) percentage of sows fed SDP expressed first estrus by days 4 to 6 postweaning and a lower (P < 0.01) percentage of sows fed SDP expressed first estrus by days 10 to 22 postweaning. Relatively low levels of SDP (0.25% to 0.50%) in lactation feed increased feed intake of P1 and P2 sows and reduced DES. Older sows fed SDP had heavier pigs at weaning even though they consumed less lactation feed per day.

Key Words: spray dried plasma, sows, lactation

184 Effects of dietary dried distillers grains with solubles on energy and nitrogen balance, and milk composition of lactating sows. M. Song*, S. K. Baidoo, M. H. Whitney, G. C. Shurson, and L. J. Johnston, *University of Minnesota*, *St. Paul*.

An experiment was conducted to evaluate effects of dried distillers grains with solubles (**DDGS**) in corn-soybean meal based lactation diets on energy and nitrogen balance and milk composition in lactating sows. Randomly selected sows (n = 30; 215 ± 15 kg BW; parity 3 to 5) were assigned randomly to one of five dietary treatments. The treatments were: 1) a corn-soybean meal based diet (**CON**), 2) **CON** + 10% **DDGS** (**DG10**), 3) **CON** + 20% **DDGS** (**DG20**), 4) **CON** + 30% **DDGS** (**DG30**), or 5) **CON** + 30% **DDGS** high protein (**DGHP30**). The **DGHP30** diet was formulated without use of synthetic amino acids. Sows were introduced gradually to their lactation diets beginning on d 109 of gestation. Feed offered was gradually increased through d 5 then sows were allowed *ad libitum* intake until weaning at d 19. Chromic oxide (0.3%) was added to feed as an indigestible marker. Fecal grab samples and urine (using Foley catheters) were collected on d 8, 9, and 10 of lactation for energy and **N** balance. Blood for urea nitrogen (**BUN**) and milk for fat and protein concentration were collected on d 0 and at weaning. Dietary energy content, **N** retention and digestibility, and milk protein and fat levels at weaning did not differ between sows fed **CON** and sows fed **DG** treatments. Sows fed **DG20** and **DG30** had lower (P<0.05) **BUN** at weaning than sows fed **CON** and **DGHP30**. These results indicate that up to **DG30** can be used for lactating sows without affecting energy and **N** balance and milk fat and protein levels.

Table 1. Dietary effect of DDGS on nutrient balance in lactating sows

	CON	DG10	DG20	DG30	DGHP30	PSE
DE, %	85.99	84.98	86.32	86.49	86.12	0.67
ME, %	84.81	83.73	85.74	85.49	85.17	0.65
N retention, g/d	114.58	107.48	125.08	131.33	139.26	13.00
N digestibility, %	33.41	45.46	34.75	33.42	29.89	5.38
Milk protein (d 19), %	4.56	4.81	4.81	4.63	5.13	0.03
Milk fat (d 19)%	7.41	7.55	7.79	7.89	7.97	0.29
BUN (d 19), mg/dL	22.84[a]	21.85[ab]	18.44[b]	18.40[b]	22.39[a]	1.19

[a b] Means with different superscripts differ (P<0.05)

Key Words: DDGS, sow lactation, nutrient balance

185 Effect of dietary fish oil supplementation on the reproductive performance of gilts and sows. C. M. Murphy*[1], M. Ellis[1], P. J. Bechtel[2], R. Knox[1], and A. Rojo[1], [1]*University of Illinois*, *Urbana*, [2]*USDA/ARS/SARU*, *Fairbanks, AK*.

Two studies were conducted to determine the effects of fish oil supplementation on reproduction. Study 1 used 60 gilts in a RCBD with 3 treatments: Negative control (no added fat); Positive control (4% animal fat); Fish oil (4% fish oil). The negative control diet had 13.2% CP, 3.3 Mcal ME/kg, 0.63% lysine and the two added fat diets contained 13.0% CP, 3.4 Mcal ME/kg, 0.63% lysine. Diets were fed (2.75 kg/d) from d 10 after first estrus until the day after breeding on the 3rd estrus after which gilts were fed a gestation diet (2 kg/d; 12.5% CP, 3.3 Mcal ME/kg, 0.60% lysine). Gilts were slaughtered at d 25 to 30 post-breeding and the numbers of corpora lutea (CL) and fetuses and fetal weights were recorded. Study 2 was conducted on a commercial farm with 206 sows (parities 2 to 5; average of 3) in a RCBD with 2 treatments: Standard lactation diet (20.5% CP, 3.4 Mcal ME/kg); Fish oil (added to provide 80g/pig/d; 19.7% CP, 3.4 Mcal ME/kg). Diets were fed from entrance to the farrowing house (3-5 d prefarrowing) until rebreeding (average feeding period of 25 d). Number of piglets born alive, dead, and weaned, along with litter birth and weaning weights were recorded during the treatment phase. In the subsequent parity, the same measurements were taken as well as a subjective piglet viability score at birth. In Study 1, gilts fed fish oil had more CL (15.28, 16.01, and 17.16 ± 0.66; P<0.05, negative and positive control and fish oil, respectively) and fetuses (13.41, 14.32, and 15.64 ± 0.74; P<0.05, respectively) than those fed the negative control diet, with gilts fed the animal fat supplemented diets being intermediate but not different from the others. In Study 2, during the treatment phase sows fed the control diet weaned more pigs (8.78 vs 8.27 ± 0.17 kg; P<0.05) and had a higher total litter weight gain (32.57 vs 27.14 ± 1.77 kg; P<0.05) than those fed the fish oil. However, there was no effect of dietary treatment on any measure during the subsequent parity. These studies show that feeding fish oil prior to breeding increased fetal numbers in gilts but had no effect on the litter performance of sows. Further research is required to determine the reasons for these conflicting results.

Key Words: fish oil, reproduction, sows

186 Predicting growth rates of adult working boars in a commercial A. I. boar stud. R. C. Sulabo*[1], J. Quackenbush[2], R. D. Goodband[1], M. D. Tokach[1], S. S. Dritz[1], J. M. DeRouchey[1], and J. L. Nelssen[1], [1]*Kansas State University*, *Manhattan*, [2]*Zoltenko Farms, Inc.*, *Hardy, NE*.

There is almost no information on ideal growth rates for adult working boars; however, estimates can be made if the relationship between boar weight and age is known. Therefore, this study was aimed to predict growth rates in adult working boars in a commercial boar stud. A total of 214 adult working boars from two genetic lines (180 TR4 and 34 L-380 PIC) in a commercial boar stud were individually weighed using a platform scale. Age of the boar was recorded at the time of weighing. A regression equation to predict boar weight as a function of age was developed using PROC REG of SAS. Using the model, BW was predicted on a daily basis and ADG was derived as the difference between two predicted BW values. Factorial estimates of daily ME requirement and feeding levels were determined. The energy requirement for weight gain was computed by using the predicted ADG as a guide in setting target weight gains. The modeled live weight curve in boars as a function of age exhibited a positive curvilinear response (R^2=0.90, P<0.01). The model was: BW, kg = [(3.7 x 10^{-7} x Age, d^3) - (0.001048 x Age, d^2) + (1.02336 x Age, d)] – 28.62. Using the developed equation, ADG was derived from the predicted BW and showed a negative curvilinear response as the boars aged. Predicted ADG decreased from 0.62 kg/d at 150 kg to 0.04 kg/d at 315 kg. Estimated daily energy needs of boars under thermoneutral conditions increased from 7.94 Mcal ME/d at 135 kg to 9.27 Mcal ME/d at 320 kg. In conclusion, relating age and body weights of boars in a given farm population can be an efficient method to model on-farm growth and predict growth rates. These data can then be used to develop farm-specific feeding programs or to set different growth curves for experimental purposes.

Key Words: boars, growth rate, prediction equations

187 Effect of yeast culture on performance, gut integrity and immune function in nursery pigs. C. M. C. van der Peet-Schwering[1], A. J. M. Jansman[1], and I. Yoon*[2], [1]*Animal Sciences Group, Wageningen University and Research Centre*, *Lelystad, The Netherlands*, [2]*Diamond V Mills Inc.*, *Cedar Rapids, IA*.

Weanling pigs (n = 480; 27 d of age; BW = 7.8 ± 0.1 kg) were used to determine effects of yeast culture (YC, Diamond V XPC_{LS}™ yeast culture) and modified yeast culture (YC + mannan oligosaccharide (MOS)) on performance, gut integrity, and immune cell composition of nursery pigs and to determine whether these dietary supplements can replace antimicrobial growth promoters (AGP) in pig diets. Pigs were blocked by weight and allotted to pens based upon sex. There were 10 pigs per pen and 12 pens per treatment. Experimental treatments included 1) diets without AGP or YC (control); 2) diets with AGP (40 mg/kg Avilamycine) but without YC; 3) diets without AGP but with 0.125% YC; 4) diets without AGP but with 0.125% YC + 0.2% MOS. Pigs were fed for five weeks post-weaning. On the day of weaning and on d 14 and 35 post-weaning, blood samples were collected for blood cell composition (n = 8/treatment). Intestinal samples were obtained from the same pigs. Villus height and crypt depth were measured in the jejunal mucosa and microbial profiling was performed on the intestinal digesta. Average daily feed intake was unaffected by dietary treatment. Average daily gain (427, 448, 443, and 450 g/d; $P = 0.06$, for treatment 1, 2, 3, and 4, respectively) and feed efficiency (1.51, 1.47, 1.47, and 1.47; $P = 0.01$) were improved for pigs fed the supplemented diets compared to pigs fed the control diets. Performance parameters were similar for AGP, YC, and YC + MOS. Blood cell composition was unaffected by dietary treatment except the number of platelets (x 10^9/L) were higher (395, 512, 511, and 440; $P = 0.04$) in pigs fed all supplements. Villus height, crypt depth, and microbial composition in the gut were unaffected by dietary treatment. Blood cell composition, villus height, crypt depth, and microbial composition, however, were affected by time after weaning. Results of the study suggest that 1) yeast culture could be an alternative to AGP in diets for nursery pigs and 2) addition of MOS to diets containing yeast culture would not improve performance and immunity of nursery pigs above that of yeast culture alone.

Key Words: yeast culture, performance, nursery pigs

188 Development of a *Bacillus subtilis* product for a large commercial swine farm to reduce *Clostridium perfringens* and *Clostridium difficile* in neonatal pigs. A. Baker*[1], E. Davis[1], D. Rosener[1], K. Novak[1], R. White[2], A. Veldkamp[1], and T. Rehberger[1], [1]*Agtech Products, Inc.*, *Waukesha, WI*, [2]*Iowa Select Farms*, *Iowa Falls, IA*.

Disease caused by *Clostridium perfringens* Type A and *Clostridium difficile* is common in neonatal pigs and can lead to scouring, low weaning weights, and pre-weaning mortality. This study evaluated the diversity of *C. perfringens* Type A and *C. difficile* in neonatal pigs in a large commercial swine farm to develop a *Bacillus*-based direct-fed microbial to control the incidence of disease. Neonatal pigs with clinical signs of scours and a small number of healthy pigs were swabbed rectally during nine months at 11 sites throughout the commercial swine farm. Samples were plated on selective media for *C. perfringens* and *C. difficile*, isolated colonies were picked, and DNA was extracted. Multiplex PCR confirmed the identification of 794 isolates as *C. perfringens* Type A and 476 isolates as *C. difficile* from the 333 pigs swabbed. *C. perfringens* Type A was isolated from 89.8% of the pigs and *C. difficile* from 57.6% of the pigs. Dendrograms were constructed using RAPD PCR to cluster the toxigenic isolates according to banding patterns. The *C. perfringens* Type A dendrogram consisted of 138 clusters representative of 794 isolates at a similarity coefficient of 80%. The largest cluster in the *C. perfringens* Type A dendrogram contained 131 isolates, 47 of which had identical RAPD types. The *C. difficile* dendrogram was comprised of 476 isolates grouped into 126 clusters. The largest cluster contained 30 isolates — 13 with identical RAPD types. At least one isolate per cluster was tested against six unique strains of *Bacillus subtilis* and inhibition of clostridial growth was measured by light absorbance. Of the six *Bacillus* strains tested, four provided 90% or greater inhibition of *C. perfringens* and *C. difficile*, whereas inhibition by two strains varied depending upon type of clostridia (type × strain interaction, $P \leq 0.001$). The results of this evaluation indicate the presence of a high degree of diversity in *C. perfringens* and *C. difficile* populations within this commercial swine farm and suggest that these populations can be controlled by the specific selection of *Bacillus* strains.

Key Words: swine, clostridia, microbial flora

189 Effects of water-soluble and in-feed organic acids on the growth performance of weanling pigs. R. O. Gottlob, J. M. Benz*, S. S. Dritz, M. D. Tokach, R. D. Goodband, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University*, *Manhattan*.

A total of 360 weanling pigs (initially 5.2 kg and 18 ± 3 d of age, PIC) were used in a 42-d growth assay to determine the effects of water-soluble antimicrobials and organic acids in feed or water on nursery pig growth performance. Pigs were blocked by BW and allotted to one of nine experimental treatments. There were five pigs per pen and eight pens per treatment. The nine treatments included: 1) control (no feed or water antimicrobials or acids); 2) water containing 38 mg/L neomycin sulfate; 3) water containing 0.06% Activate WD; 4) water containing 0.12% Activate WD; 5) feed containing neomycin and oxytetracycline (154 ppm neomycin sulfate, 154 ppm oxytetracycline HCl; neooxy); 6) feed containing 0.50% Activate DA; 7) feed containing 0.45% Starter L; 8) feed containing 0.45% Multimax L; and 9) feed containing 0.50% Activate DA and 0.10 % Mintrex P. Activate™ WD (water dispersible), DA (dry acid), Starter L (liquid), and Multimax L (liquid) organic acid blends are combinations of Methionine hydroxyl analog (MHA) and butyric, propionic, and/or lactic acids with methionine activity ranging from 29% to 31%. Mintrex P is a mixture of organic trace minerals including zinc, copper, and manganese with some residual methionine activity as a result of having MHA as the carrier. From d 0 to 14, pigs provided antimicrobials, Multimax L, or the combination of Activate DA and Mintrex had greater ($P < 0.05$) ADG than pigs fed the control. Overall (d 0 to 42), pigs provided neo/oxy in the feed had greater ($P<0.05$) ADG, compared with pigs in all other treatments, except pigs provided the combination of Activate DA and Mintrex P which were intermediate. Pigs provided neo/oxy in the feed had greater ADFI ($P<0.02$) than did pigs provided the control treatment. There were no differences in feed efficiency between any of the treatments. These data demonstrate that pigs provided in-feed antimicrobials had improved growth, whereas those provided organic acids in feed and water did not.

Key Words: nursery pig, antimicrobials, organic acids

190 Effect of probiotics supplementation on growth performance and immune response in weaning pigs. Y. D. Jang*, H. K. Oh, H. B. Choi, and Y. Y. Kim, *Seoul National University*, *Seoul, Korea*.

Probiotics are defined as a live microbial feed supplement which beneficially affects the host animals by improving its intestinal microbial balance. It is known that probiotic effects were mediated through immune regulation, particularly through balance control of cytokines. There have been several efforts to search for alternatives to antibiotics. The objective of this study was to investigate the effect of probiotics supplementation on the growth performance and immune response of weaning pigs. Treatments were 1) NCON (basal diet), 2) PCON(basal + 0.12% avilamycin) and 3) A(basal + 0.2% Aspergillus oryzae), 4) B(basal + 0.2% Lactobacillus casei), 5) C(basal + 0.2% Bacillus subtilis), 6) D(basal + 0.2% Lactobacillus cripticus). A total of 120 pigs ([L x Y] x D, 7.16 ± 0.01 kg average body weight, weaned at 23 ± 3 days of age) were assigned to 6 treatments of 5 replicates of 4 pigs per pen in a randomized complete block design. During the whole experimental period, ADG (217, 294, 223, 236, 226, 225 g, $P<0.01$) and ADFI (474, 548, 451, 489, 476, 467 g, $P<0.05$ for NCON, PCON, A, B, C, D, respectively) of group PCON were greater than other treatments but G:F ratio in treatment A(Aspergillus oryzae) was similar to group PCON (0.538, 0.495, $P<0.05$ for PCON, A, respectively). Lipopolysaccharide was injected to induce immune response in weaning pigs. At 3h post-injection, blood was collected and analyzed for CD4+ and CD8+ T-cells. The CD4+/CD8+ ratio was determined using the fluorescence cytometry method. The number of CD4+ T cells was significantly lower in group C than in other treatments ($P<0.10$). Pigs in the NCON and PCON group had more CD4+ T cells than the pigs in the probiotics treatments (1026.7, 1075.7, 906, 758, 421, 758, $P<0.10$ for NCON, PCON, A, B, C, D, respectively). The number of CD8+ T cells was not significantly different among treatments. There were no differences in the ratios of CD4+/CD8+ among treatments. These results demonstrated that supplementation of 4 different probiotics had potential effects on growth performance and immune response in weaning pigs.

Key Words: probiotics, weaning pigs, CD4

191 Effect of EU authorized feed additives as antibiotic alternatives on growth performance, diarrhea occurrence, nutrient digestibility and immune response in weaning pigs. H. B. Lee*, Y. D. Jang, H. F. Long, and Y. Y. Kim, *Seoul National University*, *Seoul, Korea*.

This experiment was conducted to evaluate the effects of four feed additives authorized by the EU as a potential practical alternative to antibiotics in weaning pigs. Treatments were: 1) Negative Control (basal diet), 2) Positive Control (basal + 0.12 % avilamycin), 3) A (basal + 1.20 % potassium diformate), 4) B (basal + 0.50 % benzoic acid), 5) C (basal + 0.25 % *Saccharomyces cerevisiae*) and 6) D (basal + 0.04 % *Bacillus* spp.). For the feeding trial a total of 144 crossbred piglets weaned at 21 ± 3 days of age with an average initial body weight of 6.65 ± 0.66 kg were allotted to 6 treatments and 6 replicates with 4 pigs per pen in a randomized complete block (RCB) design. The Positive Control group showed a higher (P<0.05) ADG (281 g vs. 246 g) and a lower (P<0.01) diarrhea occurrence score (1.29 vs. 1.61) compared to the Negative Control group. Treatments A, B, D and the Positive Control had similar ADG that were greater (P<0.05) than that of the Negative Control. Treatments A, D and the Positive Control had similar diarrhea occurrence score that were less frequent (P<0.01) than that of the Negative Control. No differences were observed in ADFI and G:F ratio. For the metabolism trial, 18 crossbred piglets were individually caged in metabolism crates by 3 replicates in a completely random design. No statistical differences were observed for nutrient digestibility and nitrogen retention. Immune responses followed by injection of LPS had no statistical differences among all treatments. However treatment C showed the fastest and highest Ig G concentration climb. These results suggest that potassium diformate and *Bacillus* spp. have antibiotic alternative potentials in growth performance improvement and diarrhea occurrence reduction.

Key Words: antibiotic alternative, weaning pig

192 Effects of single or complex antibiotics on growth performance, nutrient digestibility, morphological changes of the small intestine, and antibiotic resistance in weaning pigs. J. H. Yun*, W. G. Park, H. B. Lee, L. G. Piao, and Y. Y. Kim, *Seoul National University*, *Seoul, Korea*.

This experiment was conducted to investigate the effects of single or complex antibiotics on growth performance, nutrient digestibility, morphological changes of the small intestine and antibiotic resistance in young pigs. A total of 120 weaning pigs ([L×Y]×D, weaned at 25 days of age) were allotted to 5 treatments in a randomized complete block design in 6 replicates with 4 pigs per pen. Treatments were: 1) CON(basal diet), 2) P1(CON + Colistin Sulfate(CS) 40ppm), 3) P2(CON + CS 40ppm + Avilamycin(AV) 40ppm), 4) P3(CON + CS 40ppm + Neomycin sulfate(NS) 100ppm) and 5) P4(CON + CS 40ppm + AV 40ppm + NS 100ppm). Fifteen pigs with a body weight of 9.26 kg, were used to measure nutrient digestibility. An additional 15 pigs were anatomized to measure morphological changes and antibiotic tolerance. During the experimental period group P2 showed a significant increase in body weight(15.4, 16.5, 17.8, 16.8, 17.4 kg, P<0.01), ADG (241, 273, 307, 281, 296g, P<0.05), ADFI (480, 561, 569, 515, 570g, P<0.05) and G:F ratio(0.514, 0.503, 0.555, 0.553, 0.546 P<0.05 for CON, P1, P2, P3, P4, respectively) compared with the non-antibiotic treatment. However there were no significant differences in blood urea nitrogen and nutrient digestibility. Single or complex antibiotic supplementation had no effect on villi height and crypt depth. However, the ratio of villi heights and crypt depth improved by the supplementation with antibiotics(3.07, 3.95, 4.17, 3.52, 3.68 P<0.01), regardless of antibiotic sources. Antibiotic resistance of E. coli isolated from treatment P2, P3 and P4 was significantly higher than non-antibiotic treatments(0/5, 4/5, 3/5, 3/6 3/6 Chloramphenicol, P<0.05). Antibiotic resistance of Enterococcus spp. isolated from Avilamycin treatments was significantly higher when compared with other treatments(0/1, 0/4, 1/1, 0/2, 3/3 Avilamycin, P<0.01). Addition of single or complex antibiotics to weaning pig's diet was found to be beneficial for the growth performance, but there were no additional benefits although complex antibiotics were provided.

Key Words: antibiotics, growth performance, antibiotic resistance

193 Evaluating the inclusion of an egg antibody powder to swine nursery diets on pig performance. B. Corrigan*[1], G. Grinstead[1], D. Koehler[1], B. Renk[2], and M. Yank[2], [1]*Vita Plus Corporation*, *Madison, WI*, [2]*aOvaTechnologies, Inc.*, *Madison, WI.*

The objective of this trial was to evaluate the effect of increasing levels of an egg antibody produced from laying hens hyper-immunized with phospholipase A_2 on nursery pig performance. A total of 390 weaned (17 to 22 days of age; initial BW 5.74 kg) pigs were used in a 48-day nursery trial. Pigs were randomly blocked by body weight to one of five treatments in a 30-pen nursery facility (13 pigs per pen). Treatments were: 1)Four-phase nursery diet sequence(Control), 2)As 1 with .2% Egg; 3)As 1 with .4% Egg; 4)As 1 with .6% Egg; 5)As 1 with .8% Egg. Diet phases I and II (pellet) and diet phases III and IV (meal) were fed from d 0 to 7, 7 to 14, 14 to 28 and 28 to 48, respectively. Pig and feeder weights were taken on d 0, 7, 14, 21, 28 and 48. A quadratic (P<0.001) response was shown for pig BW on d 48 where all levels of Egg increased BW (+1.92, +2.22, +1.72, and +1.69 kg for Egg .2, .4, .6, and .8, respectively) over the Control (25.62 kg). ADG from 28 to 48 (.654, .684, .650, and .665 kg for Egg .2, .4, .6, and .8 vs .603 kg for the Control; P<0.01), 0 to 48 (.454, .460, .450, and .449 kg for Egg .2, .4, .6, and .8 vs .414 kg for the Control; P<.001), and 14 to 48 (.565, .565, .551, and .554 kg for Egg .2, .4, .6, and .8 vs .509 kg for the Control; P<.002) was quadratically increased by the Egg diets vs the Control. F/G from 0 to 48 (.693, .697, .691, and .694 kg for Egg .2, .4, .6, and .8 vs .734 kg for the Control;P<.01) and 14 to 48 (.715, .725, .719,and .717 kg for Egg .2, .4, .6, and .8 vs .764 kg for the Control;P<.02) was quadratically improved by the Egg diets compared to the Control. These results suggest that the inclusion of the egg antibody improves nursery pig performance, in particular during the later nursery diet phases. Moreover, the the .2% level of the egg antibody was as effective as the higher levels. Further research is in progress to further evaluate the effect of the phospholipase A_2 antibody on pig performance.

Key Words: pigs, antibodies, phospholipase A_2

194 Effects of electron beam and gamma ray irradiation levels in spray-dried animal plasma on nursery pig growth performance. C. N. Groesbeck*[1], J. M. DeRouchey[1], M. D. Tokach[1], R. D. Goodband[1], S. S. Dritz[1], J. L. Nelssen[1], and H. E. Clemmons[2], [1]*Kansas State University*, *Manhattan*, [2]*Sadex*, *Sioux City, IA*.

A total of 385 pigs (PIC, initial BW 6.1 kg) were used in a 28-d trial to determine the effects of electron beam and gamma ray irradiation dosage level to spray-dried animal plasma (plasma) on nursery pig performance. Pigs were allotted to pen and blocked by weight using an incomplete block design with either 7 or 8 replications per treatment. Dietary treatments were randomly allotted to pen within block. There were 7 replications for the negative control, the positive control and the gamma ray irradiation at 2 kGy. All other treatments had 8 replications. Ten dietary treatments were fed from d 0 to 14 including a negative control diet with no added plasma, a positive control diet with added regular plasma, or one of 8 irradiated plasma diets. The eight irradiated treatments included either electron beam or gamma ray irradiated plasma at increasing dosage levels of 2, 4, 6, or 10 kGy. All pigs where fed a common diet from d 14 to 28. Irradiation of the plasma reduced the total bacterial and coliform counts at each dosage level regardless of irradiation source. There were no interactions ($P > 0.05$) between irradiation source and dosage level for the entire trial. From d 0 to 14, pigs fed the diets containing plasma had an increased ($P < 0.01$) ADG (252 vs 204 g) and ADFI (274 vs 222 g) compared to the pigs fed the negative control diet. Pigs fed diets with irradiated plasma had similar growth performance to pigs fed the positive control diet ($P > 0.05$). There were no differences ($P > 0.12$) in growth performance between pigs fed the electron beam or gamma ray irradiated plasma diets. In conclusion, these data indicate that irradiation of plasma by electron beam or gamma ray at various dosage levels reduced total bacteria and coliforms. Irradiation of spray-dried animal plasma did not improve growth performance in this study.

Key Words: nursery pig, spray-dried animal plasma, irradiation

195 Effect of irradiated protein source fed in meal or pelleted diets on nursery pig performance. C. N. Groesbeck*, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, S. S. Dritz, and J. L. Nelssen, *Kansas State University*, *Manhattan*.

A total of 350 pigs (PIC, initial BW 4.9 kg and 21 ± 3 d of age) were used in a 22-d trial to determine the effects of feeding irradiated protein sources (spray-dried animal plasma, soybean meal, fish meal or all three) in meal and pelleted diets on the growth performance in nursery pigs. Pigs were blocked by weight with 5 pigs/pen and 7 pens/treatment. Pigs were fed one of ten experimental treatments which consisted of a single diet formulation that was fed in either meal or pelleted form containing either no irradiated protein sources or irradiated spray-dried animal plasma, soybean meal, fish meal, or all three irradiated protein sources for phase one (d 0 to 11). All pigs were then fed a common diet for phase two (d 11 to 22). Irradiation of the protein sources, as well as pelleting reduced total bacterial and coliform counts. There were no irradiation × diet form interactions ($P > 0.16$) observed for growth performance. From d 0 to 11, there was no effect of protein source irradiation ($P > 0.14$) on ADG, ADFI, or G/F. However, pigs fed pelleted diets had improved G/F (0.95 vs 0.90; $P < 0.02$) compared with pigs fed meal diets with no difference in ADG and ADFI. From d 11 to 22, pigs fed meal diets had a tendency for improved ADFI (738 vs 711 g; $P < 0.10$) compared to the pigs fed pelleted diets. Overall (d 0 to 22), pigs fed diets containing irradiated protein sources had a tendency for improved G/F (0.85 vs 0.83; $P < 0.11$) compared with pigs fed control diets. Pigs fed meal diets had a tendency for improved ADFI (435 vs 418 g; $P < 0.12$) compared with the pigs fed pelleted diets. Pigs fed pelleted diets had improved G/F (0.86 vs 0.83; $P < 0.01$) compared with pigs fed meal diets. These data confirm that technologies of irradiation and pelleting will reduce total bacteria and coliform counts within individual feed ingredients or a complete diet. Pelleting of diets improved feed efficiency but irradiation of proteins source did not improve performance.

Key Words: nursery pig, pellet, irradiation

196 Effect of low protein amino acid-supplemented diets on growth performance, plasma urea N, and diarrhea incidence in weaned pigs. F Opapeju*[1], C Nyachoti[1], and M Rademacher[2], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Degussa AG*, *Rodenbacher Chaussee 4, 63457 Hanau-Wolfgang, Germany*.

The objectives of this study were to determine the growth performance of piglets fed low CP AA-supplemented diets and to determine whether Ile might be the next limiting AA to Lys, Thr, Trp, and Met in low-CP diets fed to weaned pigs. Ninety-six pigs (average initial BW = 6.44 ± 0.14 kg) were assigned to 4 phase 1 diets in a completely randomized design resulting in 6 replicate pens (4 pigs/pen) per diet. Dietary treatments were: 1) 21% CP diet, 2) 19% CP, Ile deficient diet, 3) 19% CP diet supplemented with crystalline Ile up to the level in diet 1, and 4) 17% CP diet supplemented with Ile and Val based on the ideal protein ratio. All diets contained the same amount of standardized ileal digestible Lys, Met + Cys, Thr, and Trp based on the ideal protein ratio. Pigs were weighed weekly to determine ADG, ADFI, and G:F. Baseline and final blood samples were collected on d 0 and 21 for determination of plasma urea N (PUN). On d 4, 5 and 11, fecal consistency (FC) scoring (0, normal; 1, soft feces; 2, mild diarrhea; 3, severe diarrhea) was performed by 2 trained individuals with no previous knowledge of treatment allotment to pigs. Compared to diet 1, pigs fed diet 2 had lower ($P < 0.05$) ADG during wk 1 and 2, and G:F during wk 2. Similarly, pigs fed diet 3 had lower ($P < 0.05$) G:F than those fed diet 1 during wk 1 and 2; and pigs fed diet 4 had lower ($P < 0.05$) G:F compared to other dietary treatments during wk 2. Overall, pigs fed diet 1 had higher ($P < 0.05$) ADG and G:F, and pigs fed diet 4 had higher ($P < 0.05$) ADFI than those fed other diets. Pigs fed diet 1 had higher ($P < 0.05$) final BW than those fed diet 2 but similar final BW compared with those fed diets 3 and 4. Baseline and final PUN concentration were similar across diets. The FC score of pigs fed diet 1 was higher ($P < 0.05$) than those fed diets 3 and 4 on d 4, 11 and overall. The results indicate that low CP diet supplemented with adequate amount of AA supported growth performance of piglets as those fed high CP diet and reduced diarrhea incidence, and that Ile might be limiting in low CP diet fed to weaned pigs.

Key Words: dietary protein, growth performance, weaned pig

197 Amino acid digestibility of protein sources fed to weanling pigs. S. C. Pahm* and H. H. Stein, *University of Illinois*, *Urbana*.

he standardized ileal digestibility (SID) of AA by weanling pigs was determined in 4 soybean products, fishmeal (FM), and casein. The 4

soybean products were soybean meal (SBM), soy protein concentrate (SPC), soy protein isolate (SPI), and fermented soybean meal (FSBM). Seven weanling barrows (initial BW: 10.9 kg) were fitted with a T-cannula in the distal ileum and allotted to a 7 × 7 Latin square design. Each of the protein sources was included in one diet and a N-Free diet was used to determine endogenous losses. Each period lasted 7 d and digesta were collected from the cannulas on d 6 and 7 of each period. Casein had the greatest ($P \leq 0.05$) SID for most AA, but the SID for Arg, Lys, Thr, and Trp in SPC and SPI were similar to casein. The SID of Arg, Lys, Thr, and Trp in FM were also similar to casein, but the SID for all other indispensable AA and for the mean of the indispensable AA in FM were lower than in casein ($P \leq 0.05$). There were no differences in SID for any AA among FM, SPC, and SPI. Except for Lys, the SID for all indispensable AA in FSBM were not different from FM, SPC, and SPI, and there were no differences in SID between FSBM and SBM. However, the SID for all indispensable AA except His, Lys, Thr, and Trp in SBM were lower ($P \leq 0.05$) than in SPC. The SID for CP and all indispensable AA in SBM except Thr and Trp were also lower ($P \leq 0.05$) than in SPI, but except for Leu and Thr, no differences between SBM and FM were observed. Results from this experiment showed that the SID for most AA in SPC and SPI are comparable to casein and greater than in FSBM and SBM. The SID for most AA in FSBM are also comparable to the SID for AA in FM.

Table 1. Standardized ileal digestibility (%) of AA by weanling pigs

Item	Soybean meal	Soy protein concentrate	Soy protein isolate	Pep Soygen	Fish meal	Casein
Ile	82.9 x	89.8 y	89.6 y	85.8 xy	87.5 xy	95.7 z
Lys	79.2 xy	88.3 yz	90.8 z	77.2 x	87.7 yz	97.3 z
Met	97.3 z	92.2 y	91.7 y	88.3 xy	89.5 xy	98.5 z
Cys	73.4	85.2	82.0	69.7	76.0	84.6
Phe	84.1 x	91.9 y	91.7 y	87.2 xy	87.7 xy	97.4 z
Thr	77.4 x	85.8 xyz	85.0 xyz	78.5 xy	86.9 yz	90.9 z
Trp	84.8 x	87.5 xy	87.9 xy	83.5 xy	88.7 xy	92.0 y
Val	81.9 x	89.5 y	89.3 y	84.3 xy	89.0 y	96.8 z

[xyz]Means within a row without a common superscript differ (P<0.05).

Key Words: amino acids, digestibility, fermented soybeans

198 Nutritional value of processed fish byproducts for young pigs. A. Rojo*[1], M. Ellis[1], P. J. Bechtel[2], Y. Bin[1], and E. Castaneda[1], [1]*University of Illinois*, *Urbana*, [2]*USDA/ARS/SARU*, *Fairbanks, AK*.

Two studies were conducted to evaluate the nutritional value of three fishmeals as protein sources in weanling pig diets. Study 1 was conducted as a Latin square design with four treatments: hydrolyzed pollock fish meal (HPF), hydrolyzed salmon fishmeal (HSF), hydrolyzed commercial fishmeal (HCF), and spray dried animal plasma (SDPP). Sixteen 3-wk old pigs were surgically fitted with ileal cannulas and used to measure the apparent digestibility of the four diets, which were switched among the pigs weekly. Compared to SDPP, Lys (86 vs. 86, 82 and 88%, SEM = 4.87) Trp (84 vs. 82, 78, and 80%, SEM=3.70), and Thr (74 vs. 78, 75 and 80%, SEM=3.54) digestibilities were the same (P > 0.05) for all fish meals tested (HCF, HPF and HSF, respectively). HPF and HSF had the lowest and highest digestibilities respectively (P < 0.05), for Iso (67 and 92%), Leu (73 and 93%) and Arg (71 and 93%). Study 2 was conducted for 28 d as a RCBD with eight replicates. A total of 96 weaned pigs (7.1 kg BW, 3 wk old) housed in groups of four animals, were used to investigate the effects on growth performance of diets based on 2 of the fishmeals (HCF, HPF) plus a control diet (SDPP). The feeding period was divided into two phases; Phase I, d 0-7, and Phase II, d 8-28. The diets in each phase were corn-soybean meal based, had the same nutrient content (NRC, 1998) and used the digestibility coefficients obtained from Study 1 (3.47 and 3.44 Mcal/kg, 19.0 and 17.0% crude protein, 1.21 and 1.01% apparent digestible lysine, Phase I and II respectively). ADFI during the first week was higher (P < 0.05) in pigs fed the SDPP compared to HCF and HPF (0.17, 0.07 and 0.10 kg/d, respectively, SEM=0.009), however, at the end of the experiment, overall ADFI was not different (P > 0.05) among the treatments (0.63, 0.56 and 0.58 kg/d, respectively, SEM=0.019). Overall, pigs fed the diet containing SDPP compared to pigs fed HCF and HPF grew faster (0.42 vs. 0.32 and 0.35 kg/d, respectively, SEM=0.012, P < 0.05) and had higher G:F ratio (0.66 vs. 0.57 and 0.59 kg/kg, respectively, SEM=0.018, P < 0.05). The results of these studies suggest that the fishmeals evaluated were inferior to SDPP in terms of their effect on early post-weaning performance of piglets.

Key Words: fishmeal, growth, weaned pigs

199 The effect of isoleucine in segregated early weaning and transition diets. S. K. Linneen*, S. S. Dritz, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, and J. L. Nelssen, *Kansas State University*, *Manhattan*.

Two experiments were conducted to evaluate the effects of isoleucine (Ile) level and source on nursery pig performance. Experiment 1 was arranged as a 2 × 2 factorial with low or high TID lysine **(Lys; 1.30 or 1.56%)** and low or high TID isoleucine **(Ile; 49 or 60% of Lys)**. A total of 194 pigs (5.8 kg) were used in a 10-d trial. From d 0 to 10, there were no Lys × Ile interactions (P>0.23). Pigs fed diets containing high Lys had greater (P<0.01) ADG and G:F compared to pigs fed diets containing low Lys. Increasing the Ile:Lys ratio tended (P=0.16) to increase ADG and ADFI from d 0 to 5 with entire response due to increasing Ile for pigs fed the low Lys diets. In Exp. 2, a total of 1,540 pigs (5.6 kg) were used to test the effects of increased dietary Ile using different Ile sources. Treatments included: control (SEW and transition diets with 49 and 52% TID Ile:Lys ratios, respectively), the control with increased Ile from added L-isoleucine, or the control diet with 1.25% blood meal replaced on a lysine basis with poultry meal, soybean meal, or wheat gluten to increase the Ile:Lys ratio to at least 54%. During the SEW period (d 0 to 5), pigs fed the control diets or diets containing added L-isoleucine had improved (P<0.05) ADG and G:F compared with pigs fed the control or diet containing added soybean meal with pigs fed other diets being intermediate. During the transition period (d 5 to 10), pigs fed diets containing added soybean meal had improved ADG (201 vs 179 g/d; P<0.05) compared to pigs fed diets containing poultry meal. From d 0 to 10, there were no differences (P>0.05) in ADG or ADFI; however, pigs fed the diet with added soybean meal had improved (P<0.05) G:F compared to pigs fed the control diet. In conclusion, maintaining an adequate isoleucine level is critical in diets immediately after weaning. L-isoleucine and wheat gluten are possible ingredient alternatives to increase Ile in the SEW diet; however, these ingredients made no difference on growth performance after the SEW period.

Key Words: nursery pig, amino acid, isoleucine

200 An evaluation of liquid feeding immediately post-weaning to improve performance of the lightest pigs within a nursery group. J. R. Bergstrom*[1] and D. McKilligan[2], [1]*Kerber Milling Company*, *Emmetsburg, IA*, [2]*TechMix Inc.*, *Stewart, MN*.

Two experiments were conducted to evaluate liquid feeding the lightest pigs weaned for the first 3 d post-weaning. In Exp. 1, the lightest 180 pigs (avg. 4.2 kg) of 650 weaned were individually ear-tagged, weighed, and allotted to 1 of 3 treatments. There were 30 pigs per pen and 2 pens per treatment. Individual pig served as the experimental unit in a CRD for the evaluation of ADG, culls, and mortality. The treatments were: dry-fed (control, C), liquid milk replacer (MR), and experimental liquid feed (LF). Treatments were offered *ad libitum* as the sole diet from d 0 to 3. Afterwards, MR and LF pigs were offered the same budget of diets as C. Pig weights were recorded on d 0, 3, 6, and 51. In Exp. 2, the lightest 150 pigs (avg. 4.0 kg) of 650 weaned were individually ear-tagged, weighed, and allotted to 1 of 5 treatments. There were 30 pigs per pen per treatment. Experimental design and variables were similar to Exp. 1. The treatments were: dry-fed (C) and 4 MRs (MR1, MR2, MR3, and MR4). Treatments were offered as in Exp. 1. Pig weights were recorded on d 0, 3, 7, and 58. In both experiments, d 0 to 3 ADG of pigs offered MR (240g in Exp. 1, 285g in Exp. 2) was higher (P<0.05) than C (108g in Exp. 1, 122g in Exp. 2), and LF (132g) in Exp. 1. In Exp. 1, overall (d 0 to 51) ADG was greatest (P<0.01) for C pigs (376g vs. 354g and 349g for MR and LF, respectively), which resulted in the C pigs being heavier (P<0.05) on d 51 (23.5kg vs. 22.3kg and 22.0kg for MR and LF, respectively). In Exp. 2, overall (d 0 to 58) ADG and d 58 weight was greatest (P<0.05) for MR4 pigs (372g and 25.5kg), followed by C (363g and 25.1kg), MR3 (349g and 24.3kg), MR1 (331g and 23.3kg), and MR2 pigs (308g and 21.8kg). Feeding MR, or LF in Exp. 1 numerically reduced mortality and culls in both experiments. Feeding a MR to the lightest pigs weaned improved their initial performance; however, the growth benefits were sustained only when pigs were fed MR4. The composition of a MR appears to influence subsequent performance and feeding a MR or LF to the lightest pigs may improve survivability.

Key Words: weaned pigs, liquid diet, milk replacer

201 Effects of zinc, manganese and copper amino acid chelates (AAC) on feeding performance and meat quality of growing-finishing pigs. R. A. Samford*, H. D. Ashmead, A. Bourdonnais, and S. D. Ashmead, *Albion Advanced Nutrition*, *Clearfield, UT*.

108 pigs with in. wt. of 20 kg were fed for 105 days to a final wt of appx. 105 kg. Group A was fed a starter ration containing 100 ppm Zn, 40 ppm Mn and 30 ppm Cu and grower and finisher rations containng 100 ppm Zn, 40 ppm Mn and 20 ppm Cu as SO_4. Group B received equal supplemental metals as Group A (50% SO_4:50% AAC). Group C received a starter ration containing 70 ppm Zn, 20 ppm Mn and 20 ppm Cu and grower and finisher rations containing 70 ppm Zn, 20 ppm Mn and 10 ppm Cu (50% SO_4:50% AAC). Statistical analysis was conducted using Analysis of Variance according to the GLM procedure of Systat.

Mineral source had no effect on feeding performance or dressing percent. Pigs fed 50% SO_4:50% AAC had improved meat color, increased muscle firmness, increased ham and loin pH and tended to decrease intramuscular fat compared to pigs fed 100% SO_4.

Pigs fed lower amounts of Zn, Mn and Cu sourced from 50% SO_4:50% AAC had equal feeding performance and equal or greater carcass quality than pigs fed larger amounts of minerals sourced entirely from SO_4. With equal or greater feeding performance and carcass quality, environmental effects of feeding lower amounts of supplemental minerals as a blend of SO_4 and AAC should be evaluated.

Table 1. Performance of Pigs fed Different Sources of Mineral

Group	A	B	C
ADG, gm/day	677	661	645
Dressing %	81.60	81.76	81.76
IM Fat, %	1.14	1.02	1.19
Loin pH	6.06[a]	6.10[b]	6.05[a]
Ham pH	6.14[a]	6.16[b]	6.23[b]
Muscle Firmness			
Elect Cond (µS	9.85[a]	9.07[b]	9.77[a]
Elect Cond (Ham) (µS	11.15[a]	10.72[b]	10.77[b]
Color			
Minolta CIE L	57.66[a]	54.78[b]	56.22[a,b]
Minolta CIE B	15.60[1]	14.82[2]	15.33[1,2]

a,b=(P>.05);1,2=(P>.01)

Key Words: swine, amino acid chelate, environment

202 Effects of thermal stress and dietary chromium tripicolinate on growth performance and plasma cortisol in weanling pigs. B. G. Kim*, M. D. Lindemann, and G. L. Cromwell, *University of Kentucky*, *Lexington*.

Two experiments were conducted to investigate the effects of thermal stress and dietary chromium tripicolinate (CrPic) on growth performance and plasma cortisol in weanling pigs. In Exp. 1, a total of 54 pigs (BW of 5.94 ± 1.29 kg) were allotted to a 2 × 3 factorial arrangement using two ambient temperatures (26.5 or 16.0°C during d 14 to 26) and three dietary levels of CrPic (0, 1,000, or 2,000 ppb). In Exp. 2, a total of 54 pigs (BW of 5.95 ± 0.84 kg) were allotted in the same treatment arrangement but with different ambient temperatures (23.7 or 40.5°C during d 14 to 28). During d 0 to 14 of both experiments, a neutral ambient temperature (NT) was maintained. In Exp. 1, pigs in low ambient temperature (LT) had higher feed:gain (1.59 vs. 1.45; P < 0.001) than pigs in NT during d 14 to 21. Pigs in LT consumed more feed (1,064 vs. 842 g/d; P < 0.01) and gained more weight (712 vs. 542 g/d; P < 0.001) than pigs in NT during d 21 to 26. During d 14 to 26, pigs in LT tended to have higher ADFI (975 vs. 885 g/d; P = 0.08) and feed:gain (1.54 vs. 1.49; P = 0.07). Dietary CrPic did not affect growth performance, and plasma cortisol was not influenced by CrPic or temperature. In Exp. 2, pigs in high ambient temperature (HT) consumed less feed (926 vs. 1,074 g/d; P < 0.01), and gained less weight (575 vs. 663 g/d; P < 0.001) than pigs in NT during d 14 to 28. However, feed:gain was unaffected by ambient temperature (1.61 vs. 1.62; P = 0.79). Dietary CrPic had no effect on growth performance. Pigs in HT had lower plasma cortisol on d 18 (44.3 vs. 56.9 ng/ml; P = 0.05), and on d 27 (37.4 vs. 52.5 ng/ml; P < 0.01). Respiratory rate of pigs in HT was higher compared to the pigs in NT (114.6 vs. 65.0 breath/min; P < 0.001) on d 27. These results indicate that growth performance and plasma cortisol are affected by thermal stress but these effects are not moderated by dietary CrPic.

Key Words: thermal stress, chromium, pigs

203 Effects of meal transition diets on growth performance of nursery pigs reared in a commercial environment. C. N. Groesbeck*, S. S. Dritz, M. D. Tokach, R. D. Goodband, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University*, *Manhattan*.

A total of 2,016 pigs (PIC; initial BW 5.7 kg) were used in a 28-d trial evaluating feed budget and diet form (meal or pellet) in a commercial nursery. Pigs were randomly sorted into one of 72 pens (36 pens of barrows and 36 pens of gilts) with 28 pigs per pen. All pens were weighed and allotted so all pigs within a block were the same weight. One pen of barrows and one pen of gilts consumed feed from a single fenceline feeder. The experimental unit was the combined data from the two pens. Pigs were allotted to one of six feed budget treatments: 1) pelleted diets with 0.45 kg/pig of SEW (6.7% plasma) and 1.36 kg/pig of Transition (2.5% plasma); 2) pelleted diets with 0.23 kg/pig of SEW (6.7% plasma) and 0.45 kg/pig of Transition (2.5% plasma); 3 and 4) meal diet with either 0.91 or 1.81 kg/pig of Transition (2.5% plasma); or 5 and 6) meal diet with either 0.91 or 1.81 kg/pig of Transition (4% plasma). All pigs were then fed 5.4 kg of a phase 2 meal diet, and a phase 3 meal diet for the duration of the trial. From d 0 to 10 and overall, pigs fed pelleted SEW and Transition diets had improved (P<0.05) ADG, and feed efficiency (G/F), lower removal rates, and higher margin over feed (pig value - feed cost) compared to the pigs fed meal-based Transition diets. Pigs fed the greater budget of pelleted diets also had improved (P<0.01) ADG and G/F from d 0 to 10, and G/F and margin over feed from d 0 to 28 compared to pigs fed the lower budget of pelleted diets. In this experiment, starting pigs on pelleted SEW and Transition diets with the 0.45 and 1.36 kg budget provided the greatest growth performance.

Table 1.

Diet Form	Pellet	Pellet	Meal	Meal	Meal	Meal
Plasma, %	6.7/2.5	6.7/2.5	2.5	2.5	4	4
SEW, kg/pig	0.45	0.23	---	---	---	---
Transition, kg/pig	1.36	0.45	0.91	1.81	0.91	1.81
d 0 to 10						
ADG, g	150	113	95	109	91	100
ADFI, g	150	150	145	140	136	145
Gain:Feed	1.00	0.75	0.66	0.78	0.67	0.69
d 0 to 28						
ADG, g	299	290	277	281	277	281
ADFI, g	404	404	399	399	395	404
Gain:Feed	0.74	0.72	0.69	0.70	0.70	0.70
Removal, %	3.0	2.1	4.8	5.1	3.9	4.5

Key Words: nursery pig, feed budget, plasma

204 Production responses of weanling pigs fed diets containing REAP® Starter enzymes or added fat. H. H. Stein*[1], D. Y. Kil[1], D. N. Peters[2], D Spangler[3], P. Brown[3], D. P. Casper[3], and K. Haydon[4], [1]*University of Illinois*, *Urbana*, [2]*South Dakota State University*, *Brookings*, [3]*Agri-King Inc.*, *Fulton, IL*, [4]*Prince Agri-Products*, *Quincy, IL*.

One hundred ninety-two pigs were weaned at approximately 20d of age and fed a common starter diet for 2 wk. Pigs were then weighed and allotted to 1 of 4 treatments in a 2 x 2 factorial design. Treatments included 2 levels (0 or 0.1%) of a proprietary enzyme mixture, REAP® Starter (RS), and 2 levels (0.5 or 3.0%) of added fat (AF). There were 4 pigs per pen and 12 replicate pens per treatment. The experimental period was 28d and ADG, ADFI, and G:F ratio were measured for d 0 to 14, d 14 to 28, and d 0 to 28. All diets were based on corn and soybean meal and the source of added fat was choice white grease. No interactions between RS and AF were detected. Pigs fed RS had greater ($P \leq 0.05$) BW at the end of the experiment than pigs fed diets without RS (27.97 vs. 26.97 kg). Pigs fed diets containing 3% AF also had greater ($P \leq 0.06$) BW at the end of the experiment than pigs fed diets containing 0.5% AF (27.94 vs. 27.00 kg). From d 0 to 14, ADG was not influenced by RS or AF. However, from d 0 to 28, ADG increased ($P \leq 0.05$) if RS was included in the diet (0.647 vs. 0.614 kg/d) or when AF was 3% rather than 0.5% (0.651 vs. 0.610 kg/d). The ADFI tended ($P \leq 0.07$) to be greater for pigs fed RS from d 14 to 28 and from d 0 to 28 than for pigs fed diets without RS, but there was no effect of the level of AF on ADFI. Values for G:F were not influenced by RS, but pigs fed diets containing 3% AF had a greater ($P \leq 0.05$) G:F from d 14 to 28 and from d 0 to 28 than pigs fed diets containing 0.5% AF. In conclusion, the addition of RS to a corn soybean meal based diet fed to weanling pigs increased BW, ADG, and tended to increase ADFI, while 3% AF increased BW, ADG, and G:F compared with 0.5% AF. The lack of a significant interaction between main effects indicates that RS enhances nutrient digestibility of a corn soybean meal diet, which results in growth rates of weanling pigs that are similar to pigs fed a diet containing 3% AF.

Key Words: enzymes, fat, pigs

205 Responses to increasing doses of saccharin in piglet feeds on preference values and performance. E. Roura*[1], C. Risley[2], D. Solà-Oriol[3], and D. Torrallardona[3], [1]*Lucta S.S.*, *Barcelona, Spain*, [2]*Lucta USA Inc.*, *Northbrook, IL*, [3]*IRTA*, *Centre Mas de Biver, Reus, Spain*.

A two-phase trial was conducted to study the effects of a dose response addition of saccharin on the feed preference and performance of weanling pigs. One hundred and twenty newly weaned 26-d old Landrace pigs (7.8 kg; SD 1.34) were distributed in six blocks of 6 pens each according to the initial body weight of the animals with 3 or 4 animals per pen. During the pre-starter period (12 days), the animals from each pen were offered free access to two diets, one on each side of a double hopper. One of the diets was the Control diet without saccharin and the other diet was one of the six experimental diets with increasing doses of saccharin (0, 150, 500, 1000, 1500 and 2000 ppm, respectively). During the starter period each pen had free access to only one diet that contained the same dose of saccharin used in the experimental diet of the previous period. During the 12-day preference test period, all treatments that were offered access to a diet with saccharin (T-2 to T-6) showed numerically lower values of total feed intake, growth and feed efficiency than the double control treatment (T-1). Preferences of saccharin during the pre-starter phase were not significantly different than 50% (neutral value) and ranged from 35.1 (150 ppm) to 62.8 (500 ppm). None of the treatments with saccharin significantly affected feed preference, feed intake or performance in relation to the control treatment. Only treatment T-3 (500 ppm) numerically improved feed preference relative to the control

diet. During the starter phase (12-28 days of trial) and over the whole experimental period, all treatments that were offered access to a diet with saccharin (T-2 to T-6) showed numerically lower values for total feed intake and growth than the double control treatment (T-1). It is concluded that the addition of saccharin at doses up to 2000 ppm did not improve feed preference or weanling pig performance.

Key Words: piglet, feed intake, saccharin

206 Interaction between the palatabilities of cereal and protein source in diets for pigs. D Solà-Oriol[1], E Roura*[2], and D Torrallardona[1], [1]*IRTA, Mas de Bover*, *Constantí, Spain*, [2]*Lucta SA*, *Barcelona, Spain*.

Differences in feed palatability due to individual ingredients have been reported for pigs. However, little is known about the interactions between ingredients. To study the interaction between cereal (C) and protein source (P) on feed preference, a series of double choice preference trials were conducted with a common reference diet (REF). A total of 24 diets was tested: 4 cereals (barley or oats at 30 or 60%), 4 proteins (lupine or rapeseed at 10 or 20%) and 16 diets consisting of all possible cereal-protein combinations. A double control (REF vs. REF) was used. Preference was calculated as the percentage contribution of the tested diet to total feed intake. Additionally, hardness, fragility, chewing effort and stickiness of the diets were also measured with a texture analyzer. For each of the 16 combinations, the interaction between C and P was studied, using the values of the four corresponding diets (REF, cereal, protein and cereal-protein). A 2x2 factorial arrangement of treatments was used, taking C and P as main factors. Pearson's correlation coefficients between the preference of each diet and its texture parameters were obtained. The GLM and CORR procedures of the statistical package SAS were used. C and P affected ($P<0.05$) preference for most combinations. Interactions were observed ($P<0.05$) between cereals and protein sources, indicating that lupine, combined with either barley or oats, reduces palatability to a larger extend than when tested by itself (11.8, 5.0 vs. 58.4% preference; SEM=3.06) and that the independent effects of oats and rapeseed (6.9, 13.1 %; SEM=1.61) are not additive when presented in combination (5.2%; SEM= 3.06). Similarly significant ($P<0.05$) effects of C, P and C×P were observed on the texture parameters for most combinations. Significant ($P<0.05$) Pearson's correlation coefficients between preference and hardness, fragility and chewing effort were observed ($r = -0.51$, -0.52 and -0.62, respectively). In conclusion, the effects of cereal and protein source on the palatability and texture of a diet for pigs are not independent. The texture characteristics of the diets partially explain their palatability.

Key Words: piglet, palatability, texture

207 The effects of frequent out-of-feed events on growth performance of nursery, grower, and finisher pigs. S. K. Linneen*, S. S. Dritz, R. D. Goodband, M. D. Tokach, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University*, *Manhatta.*

Two experiments were conducted to determine the effects of out-of-feed events on nursery and finishing pig performance. In Exp. 1, 190 pigs (initially 6.35 kg) were used in a 35-d trial (8 replications with 6 pigs/pen). Treatments included a 20-h (12:00 noon to 8:00 am) feed withdrawal for 1, 2, or 3 randomly selected days or a control treatment in which feeders were never withdrawn. Feeders were withdrawn on d 11, d 8 and 23, or d 9, 14, and 20 for pigs with 1, 2, or 3 out-of-feed events, respectively. During each week in which pigs experienced an out-of-feed event, ADG decreased ($P < 0.06$) compared to control pigs. From d 7 to 14 and d 14 to 21, ADFI decreased ($P < 0.07$) for pigs with out-of feed events, compared with control pigs. If the out-of-feed event occurred early in the week, pig growth performance was usually intermediate to that of control pigs and the pigs with an out-of-feed event later in the week. In the following week, however, pigs that had an out-of-feed event in the previous week had improved ADG and G/F compared with pigs that did not have an out of feed event. Overall, there were no differences in ADG (492, 487, 495, 488 g/d; $P < 0.94$) or G:F (0.733, 0.727, 0.736, 0.735; $P < 0.86$) among pigs with none, 1, 2, or 3 out-of-feed events. In Exp. 2, 479 pigs (initially 41.6 kg) were used in an 85-d trial in a commercial finishing barn (8 replications with 19 or 20 pigs/pen). Treatments included a control treatment in which pigs had access to feed for the entire trial, feed withdrawal (20 h; 12:00 noon to 8:00 am) one day per week for the entire trial, or one day per week from d 45 to 85 (market wt). Feed withdrawal occurred on a randomly selected day, with the exception of Saturday, Sunday, or a day before weighing. There were no differences ($P > 0.12$) in growth performance throughout the trial. In conclusion, results suggest that out-of-feed events (20 h or less per week) will have no long term effects on growth performance in nursery or growing-finishing pigs.

Key Words: pigs, feed management, feed availability

208 The effect of two versus six meals per day on performance of developing pigs being restricted in feed intake. J. D. Schneider*, M. D. Tokach, S. S. Dritz, R. D. Goodband, J. L. Nelssen, and J. M. DeRouchey, *Kansas State University*, *Manhattan*.

Three trials (Exp 1 and 2 = 42 d; Exp 3 = 28 d) were conducted to evaluate the effects of feeding frequency on the performance of restrict-fed growing pigs (initially 67 kg in Exp. 1, and 71 kg in Exp. 2 and 3). In all experiments, pigs were housed in 1.8 × 3.1 m pens with half-solid cement and half-slatted flooring that contained one nipple waterer. Pigs were fed a corn-soybean meal based diet formulated to 1.15% TID lysine and 3,294 kcal of ME/kg. Energy and lysine were supplied to pigs to target an average growth rate of 794 g/day based on NRC (1998) values. Pigs were fed by dropping similar daily amounts of feed, either 2 (07:00 or 14:00) or 6 times (3 meals within 2 h at AM and PM feedings) per day, by an Accu-Drop Feed Dispenser® (AP Systems, Assumption, IL) on the solid cement flooring. Data from all experiments were analyzed as a complete randomized design using the MIXED procedure of SAS. In Exp. 1, there was an increase ($p < 0.01$) in ADG (683 vs. 606 g/d) and G/F (0.41 vs. 0.36) for pigs fed similar amounts of feed 6 times per day compared with pigs fed 2 times per day. In Exp. 2, increasing the feeding frequency of pigs fed a restricted diet from 2 to 6 times per day improved ($P < 0.02$) ADG (623 vs. 504 g/d) and G/F (0.36 vs. 0.29). In Exp. 3, the additional treatment was designed to minimize feed wastage by dropping feed closer to the floor in pigs fed 2 times per day. The goal was to determine whether the improvements in performance were due to improved efficiency or decreased feed wastage. Pigs fed 6 times per day had improved ($P < 0.05$) ADG (608, 518, 509 g/d for 6 times, 2 times, and 2 times modified, respectively) and G/F (0.37, 0.31, and 0.31) compared to

either 2 times per day treatment. There was no difference (P > 0.10) in performance for pigs fed 2 times per day when feed was dropped from the feed drop or by the modified method. Feeding a restricted diet 6 times per day appears to improve pig performance compared with feeding 2 times per day.

Key Words: feeding frequency, restricted intake, pigs

209 Energy digestibility and DE content of co-extruded flax and pea for grower pigs. J. K. Htoo*[1], X. Meng[2], J. F. Patience[3], and R. T. Zijlstra[1], [1]*University of Alberta*, *Edmonton, AB*, [2]*Alberta Agriculture, Food and Rural Development*, *Brooks, AB*, [3]*Prairie Swine Centre Inc. Saskatoon*, *SK, Canada*.

Flax can increase pork omega-3 fatty acid content; however, energy digestibility and DE content of flax products, including a 50:50 combination of flax and pea, has not been well described. Five barrows (32 kg initial BW) fitted with a T-cannula at the distal ileum were fed five diets according to a 5x5 Latin square design: a wheat and soybean meal control diet and four diets containing 30% raw or co-extruded flax and pea plus 70% control diet and chromic oxide as an indigestible marker. The four extrusion treatments included: 1) E0, ground, non-extruded; 2) E1, single screw extruded; 3) E2, twin screw extruded with low intensity [screw speed 120 rpm; die temperature 110 °C; water input 4 kg/h]; and 4) E3, twin screw extruded with high intensity [300 rpm; 125 °C; 10 kg/h). The ADF content was 14.9, 12.0, 12.8 and 15.8% DM in E0, E1, E2 and E4, respectively. After a 7-d acclimation at 3 times maintenance, feces were collected for 2 d and ileal digesta for 2 d. Energy digestibility in the test ingredients was calculated using the difference method. The apparent total tract digestibility (ATTD) of DM did not differ among the four ingredients and ranged from 89.0 to 94.9%. The ATTD of OM was higher in E2 than in E1 and E3 (P<0.05). Energy ATTD was higher in E2 than E0 (P<0.05) and did not differ among the three extruded samples, and ranged from 70.8 to 79.9%. The DE content of E2 was higher than E0 and E3 (P<0.05). Ileal digested energy contents of E0, E1, E2 and E3 were 3.62, 3.67, 4.24, and 3.96 Mcal/kg DM, respectively. The DE content (Mcal/kg DM) of E0, E1, E2 and E3 were 3.76, 4.18, 4.39 and 4.06, respectively. Overall, energy digestibility was improved by extrusion but not maximized at the highest intensity, suggesting that co-extrusion of flax and pea should be carefully controlled. In conclusion, co-extrusion increased energy digestibility of flax and peas and should be considered optimize feeding programs for omega-3 enriched pork.

Key Words: extrusion, flax, pea

210 Inclusion of yellow, field peas in nursery pig diets to improve growth performance. K. R. Blubaugh*[1], A. L. Meteer[1], B. R. Wiegand[1], G. I. Peterson[2], J. D. Spencer[2], and J. R. Winter[1], [1]*Illinois State University*, *Normal*, [2]*JBS United, Inc.*, *Sheridan, IN*.

The main objective of this study was to determine if yellow, short-season field peas could partially replace corn and soybean meal in the mid- and late- nursery pig diets (6.5 to 6.6 kg BW and 9.9 to 11.2 kg BW, respectively), and to evaluate the efficacy of a mixed enzyme (alpha-galactosidase, galactomannanase, xylanase, beta-glucanase) in diets with and without field peas to improve nursery pig growth performance. All pigs were fed a two phase program (P1 and P2) provided for two wk each. The combination enzyme was supplemented at the rate of 0.1% and 0.05% for P1 and P2, respectively. This 2 x 2 factorial arrangement resulted in four treatments, consisting of 1) Control (Corn-Soy); 2) Control + enzyme; 3) 20% Field Peas; and 4) , 20% Field Peas + enzyme. Diets were balanced on SID lysine and met or exceeded NRC requirements. Nursery pigs (n=240), 25 d of age and 6.5-6.6 kg bodyweight, were randomly assigned within sire group to pen (six pigs per pen) with equal weights across replications (n = 10). Pigs were provided 0.21 m^2 pen space per pig. Pen was the experimental unit. A one wk acclimation period initiated the trial in which all pigs received the control diet (corn-soybean meal). Feed and water were provided ad libitum for the entire trial period. Pigs and feed were weighed weekly for calculation of ADG, ADFI, and G:F. Significant increases in ADG (P = 0.02), 847 vs 918 g/d for control and peas, respectively; ADFI (P = 0.01), 1233 vs 1390 g/d for control and peas, respectively; but decreases in G:F (P = 0.01), 685 g/kg vs 658 g/kg for control and peas, respectively were observed with field pea inclusion from 0-28 d. Pigs fed diets containing field peas combined with enzyme supplementation tended to increase ADG (Pea x enzyme; P = 0.10) from 0-28 d and feed intake (P = 0.09) from 21-28 d. The inclusion of yellow field peas (20%) in the mid- and late- nursery periods provided significant improvements in nursery pig growth performance compared to corn-soybean meal based diets. Additionally, the supplementation of exogenous cellulase enzymes tended to improve nursery pig performance when diets contained 20% field peas

Key Words: field peas, enzyme, pigs

211 Response of pigs in the weight rage 34 to 61 kg to Threonine:Lysine ratio in the diet. M. K. O'Connell*[1], P. B. Lynch[1], and M. Overend[2], [1]*Pig Production Development Unit*, *Teagasc Moorepark, Fermoy, Co. Cork, Ireland*, [2]*Forum Products Ltd.*, *Redhill Surrey, England*.

The objective of this study was to determine the optimum threonine:lysine ratio (THR:LYS) for pigs in the weight range 34 to 61 kg. Seventy-two pairs of pigs (36 pairs entire male, 36 pairs female) were assigned to one of five THR:LYS ratios: A-0.55, B-0.60, C-0.65, D-0.70 and E-0.75 in a randomised block design. Diets were composed of barley, wheat and soybean, with added oil, amino acids, and vitamins and minerals. Crude protein concentration was 155 g/kg for entire males and 140 g/kg for female pigs. Amino acids (except threonine) were kept at constant ratios of 0.35:0.66:0.20:1 for methionine:methionine+cysteine:tryptophan:lysine. THR:LYS ratio was increased by addition of L-threonine in 0.5 kg and 0.45 kg increments for males and female, respectively, at the expense of wheat. Digestible energy was 13.5 MJ/kg for all diets. Trial period was 38±3.3 days. Entire male pigs had higher ADG (751 v 659 g/d; P<0.001; sem 16.5) and better FCR (2.38 v 2.72 kg/kg; P<0.001; sem 0.054) than female pigs, resulting in higher finishing weights (62.9 v 60.0 kg; P<0.01; sem 0.73). Quadratic regression equations were applied to the data which predicted the THR:LYS ratio that would result in the maximum ADG and DFI or the minimum FCR for entire male and female pigs. Those values are presented in Table 1. The optimum THR:LYS ratio for entire males was between 0.66 and 0.72, and was lower for females at between 0.60 to 0.65, depending of criteria of interest.

Table 1. THR:LYS ratios at which maximum ADG and DFI or minimum FCR are predicted for entire male and female pigs

	Entire males				Females			
	THR:LYS	Max/Min	R^2	sig	THR:LYS	Max/Min	R^2	sig
ADG, g	0.70	787	0.99	***	0.65	676	0.99	**
DFI, g	0.66	1760	0.27	0.73	0.65	1862	0.99	**
FCR	0.72	2.26	0.98	*	0.60	2.65	0.78	0.22

*P<0.05, **P<0.01, ***P<0.001

Key Words: threonine, lysine, growing pigs

212 Response of pigs in the weight range 80 to 100 kg to threonine:lysine ratio in the diet. M. K. O'Connell*[1], P. B. Lynch[1], and M. Overend[2], [1]*Pig Production Development Unit*, *Teagasc Moorepark, Fermoy, Co. Cork, Ireland*, [2]*Forum Products Ltd.*, *Redhill Surrey, England*.

The objective of this study was to determine the optimum total threonine:lysine ratio (THR:LYS) for pigs in the weight range 80 to 100 kg. Sixty-six pairs of pigs (31 pairs entire male, 35 pairs female) were assigned to one of five THR:LYS ratios: A-0.55, B-0.60, C-0.65, D-0.70 and E-0.75 in a randomised block design. Pairs were allocated to blocks based on gender and weight. Diets were composed of barley, wheat and soybean, with added oil, amino acids, and vitamins and minerals. Crude protein and total lysine concentrations were 155 and 10.0 g/kg for entire males and 127 and 8.0 g/kg for female pigs. Amino acids (except threonine) were kept at constant ratios of 0.35:0.66:0.20:1 for methionine:methionine+cysteine:tryptophan:lysine. THR:LYS ratio was increased by addition of L-threonine in 0.5 kg and 0.4 kg increments for males and female, respectively, at the expense of wheat. Digestible energy was 13.5 MJ/kg for all diets. Trial period was 28±7.9 days. Pigs were slaughtered at 100 kg. Entire male pigs had higher ADG (865 v 712 g/d; P<0.01; sem 30.9) and better FCR (2.63 v 3.67 kg/kg; P<0.001; sem 0.144) than female pigs, resulting in higher finishing weights (102.7 v 98.0 kg; P<0.05; sem 1.23). Male pigs had higher carcass ADG (661 v 584 g/d; P<0.05; sem 21.2) and better carcass FCR (3.59 v 4.25 kg/kg; P<0.01; sem 0.159) than female pigs. Using PROC REG in SAS 9.1 (SAS Institute Inc., Cary, NC), quadratic regression equations were applied to the data. Derivation from first principles was used to predict the THR:LYS ratio that would result in the maximum live and carcass ADG or the minimum live FCR for entire male and female pigs. Those values are presented in Table 1. The optimum THR:LYS ratio for entire males was between 0.61 and 0.68, and was higher for females at between 0.72 to 0.78, depending on the criteria of interest.

Table 1. THR:LYS ratios at which maximum live and carcass ADG or minimum FCR are predicted for entire male and female pigs[1]

	Entire males				Females			
	THR:LYS	Max/Min	R^2	sig	THR:LYS	Max/Min	R^2	sig
ADG, g	0.63	835	0.92	0.08	0.72	772	0.98	*
FCR	0.68	2.51	0.98	*	0.73	3.39	0.97	*
CADG, g	0.61	639	0.98	*	0.78	646	0.91	0.09

[1]All models were non-significant for carcass FCR, *P<0.05

Key Words: threonine, lysine, finisher pigs

213 Effects of increasing amounts of true ileal digestible lysine on the growth performance of growing-finishing pigs reared in a commercial facility. R. O. Gottlob, J. M. Benz*, S. S. Dritz, M. D. Tokach, R. D. Goodband, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University*, *Manhattan*.

Two 28-d experiments using 2,259 gilts (PIC 1050 x 337) were conducted to determine the growth and economic effects of increasing dietary true ileal digestible (TID) lysine in commercially-reared growing-finishing pigs. Both experiments included six dietary treatments of incrementally increasing TID lysine in diets containing 6% added fat. The dietary TID lysine ranged from below to above current requirement estimates from previous trials to determine if there were any changes in lysine requirements during the past five years. In Exp. 1, pigs were initially 60 kg and averaged 87.3 kg at the end of the trial. The TID lysine levels were 0.65, 0.75, 0.85, 0.95, 1.05, and 1.15%, which corresponded to lysine:calorie ratios of 1.80, 2.08, 2.35, 2.63, 2.91, and 3.19 g/Mcal, respectively. Increasing TID lysine increased ADG (linear, P<0.01) and improved F/G (quadratic, P<0.06), with optimal performance at 1.05% TID lysine (TID lysine:ME ratio of 2.91 g/Mcal). Pigs fed this diet consumed approximately 22 g of TID lysine per day, and used 21.6 g of TID lysine/kg of gain. In Exp. 2, pigs were initially 80.5 kg and averaged 109.5 kg at the end of the trial. The TID lysine levels were 0.52, 0.62, 0.72, 0.82, 0.92, and 1.02% (TID lysine:calorie ratios of 1.44, 1.71, 1.99, 2.27, 2.55, and 2.83 g/Mcal, respectively). The optimal TID lysine level changed over the course of the experiment. From d 0 to 14, pigs fed 0.92% TID lysine had the greatest ADG and G/F, whereas pigs fed 0.72% TID lysine had the highest ADG and G/F from d 14 to 28. Pigs fed these diets required approximately 19.5 g of TID lysine/kg gain. In summary, results of the experiment suggest an increase in dietary TID lysine recommendations compared to our earlier studies. Even though the optimal lysine level may be changing over time for pigs in this production system, it appears that 20 g TID lysine per kg of gain provides a good estimate of the pig's lysine requirement.

Key Words: finishing pigs, energy, lysine

214 Effects of dietary supplementation of an enzyme blend on apparent and standardized ileal digestibility of nutrients for growing pigs. F. Ji*[1], D. Casper[2], P. Brown[2], D. Spangler[2], K. D. Haydon[3], and J. E. Pettigrew[1], [1]*University of Illinois*, *Urbana*, [2]*Agri-King, Inc.*, *Fulton, IL*, [3]*Prince Agri Products*, *Quincy, IL*.

The objective of this experiment was to measure the impact of a beta glucanase/protease enzyme blend product (EBP) on apparent ileal (AID) and standardized ileal digestibility (SID) of nutrients. Twelve ileal-cannulated growing barrows (38.2 ± 0.5 kg) were blocked on previous feed intake and randomly assigned to 1 of 4 treatments using a 4 x 4 Latin square design replicated 3 times. Treatments were hydrolyzed casein for measurement of endogenous amino acids, Basal (B), B + 0.05% EBP, and B + 0.10% EBP. The diets contained 3.36 Mcal ME/kg and 1.2% total lysine. Pigs were housed in individual metabolism crates and the experimental periods were 11 d for dietary adaptation and fecal digestibility (reported elsewhere) followed by 2 d of ileal collection when ileal effluent was collected continuously for 12 hr each d. The EBP increased ($P < 0.05$) the AID of neutral detergent fiber, hemicellulose, and acid-hydrolyzed oil, but not of energy or dry matter (Table 1). The AID of 3 nonessential amino acids, methionine and ash were reduced by EBP. The SID of amino acids were unchanged except for a reduction in the case of methionine ($P < 0.05$). In summary,

EBP increased the ileal digestibility of several nutrients that provide energy but reduced digestibility of certain amino acids.

Table 1. Apparent ileal digestibility (%) of diet components

Component	Basal (B)	B + .05% EBP	B + .10% EBP	SEM
Neutral detergent fiber	1.21[a]	9.52[b]	10.05[b]	2.48
Hemicellulose	-1.19[a]	13.11[b]	13.42[b]	2.47
Acid hydrolyzed oil	52.06[a]	53.84[ab]	57.73[b]	1.39
DM	70.86	69.13	70.50	0.81
Energy	70.93	69.48	70.71	0.82
Methionine	82.76[b]	80.35[ab]	79.07[a]	0.81

[a,b] Means within a row lacking a common superscript differ, $P < 0.05$.

Key Words: enzyme, apparent and standardized ileal digestibility, growing pigs

215 Can be found in Nonruminant Nutrition, after 142.

216 Effects of feeding an evolved E.coli-derived phytase to weanling and growing pigs. L. M. McGinnis*[1], M. R. Widmer[1], C. L. Wright[1], T. M. Parr[2], and H. H. Stein[3], [1]*South Dakota State University*, *Brookings*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*, [3]*University of Illinois*, *Urbana*.

Two experiments were conducted to determine the effects of an evolved E.coli-derived phytase (Quantum™) in diets fed to weanling and growing pigs. In Exp 1, 120 newly weaned pigs were allotted to 1 of 5 treatments with 6 replicates per treatment and 4 pigs per pen. The positive control (PC) diet contained 0.32% digestible P while the negative control (NC) diet contained 0.18% digestible P. Three additional diets were similar to NC but contained 500, 1000, or 1500 FTU of Quantum phytase (QP). Pig performance was recorded for 4 weeks. Results showed no differences in ADG, ADFI, G:F, or BW between pigs fed PC and QP diets. There was a linear effect ($P \leq 0.10$) for ADG (0.27, 0.31, 0.32, and 0.32 kg/d) and G:F (0.66, 0.69, 0.71, and 0.73 kg/kg) as the concentration of phytase was increased. In Exp. 2, 192 growing pigs, initial BW 18.32 ± 0.19 kg, were allotted to 1 of 8 treatments with 4 pigs/pen and 6 replicates per treatment. Diets were fed for 8 wk. A PC and a NC were formulated to contain 0.23% and 0.11% digestible P, respectively. The remaining 6 diets were formulated by adding 250, 450, or 650 FTU of QP or a fungal phytase (Natuphos; FP) to the NC diet. At the conclusion of the experiment, 1 barrow and 1 gilt were selected from each pen and the 3rd and 4th metacarpals were harvested. Pigs fed PC were heavier (60.9 vs. 57.9 kg) and had greater ADG (0.76 vs. 0.70 kg) than pigs fed NC ($P \leq 0.10$). Final BW (62.5, 63.5, and 59.5 kg for QP and 62.0, 62.0, and 60.6 for FP) and ADG (0.77, 0.78, and 0.74 kg for QP and 0.78, 0.78, and 0.75 kg for FP) were greater (linear, $P \leq 0.05$) for pigs fed diets containing phytase compared with the NC group. Pigs fed QP had greater ($P \leq 0.05$) bone weight (8.1, 8.6, and 8.0 vs. 7.5, 7.8, and 8.0 g), more bone ash (2.88, 3.12, and 2.96 vs. 2.71, 3.82, and 3.07 g), and a greater quantity of bone P (0.48, 0.53, and 0.50 vs. 0.46, 0.48, and 0.52 g) than pigs fed FP. It is concluded that QP is a highly effective phytase source that can be fed to weanling and growing pigs as an alternative to inorganic P.

Key Words: pigs, phytase, phosphorus

217 Effectiveness of ractopamine hydrochloride on growth performance, carcass composition and sensory characteristics in heavy weight finishing swine. C. T. Herr, B. A. Autrey, S. N. Carr*, D. H. Mowrey, and K. D. Miller, *Elanco Animal Health, Eli Lilly & Co.*, *Greenfield, IN*.

Nine-hundred pigs, 450 barrows and 450 gilts, housed at five different geographical locations were allotted by gender and weight to determine the effectiveness of ractopamine hydrochloride (RAC) on growth performance, carcass composition, and sensory characteristics in heavy weight finishing swine. Pigs were fed treatments of 0, 5, or 10 ppm RAC within three different weight gain groups which consisted of: the last 20.4 kg of gain, final weight 111.1 ± 3.2 kg (WG1); last 20.4 kg of gain, final weight 131.5 ± 3.2 kg (WG2); and the last 40.8 kg of gain, final weight 131.5 ± 3.2 kg (WG3). A 16.0% CP diet, 0.82% lys, was fed. Average Daily Gain increased ($P<0.05$) for all pigs fed 10 ppm RAC in all weight gain groups compared to controls. ADG was increased for pigs fed 5 ppm RAC compared to controls in WG2 (1.10 vs 0.91 kg/d; $P<0.05$) and WG3 (1.05 vs 0.96 kg/d; $P<0.05$). G:F was improved ($P<0.05$) for all pigs fed RAC compared to controls. Pigs in WG1 and WG2 and fed 10 ppm RAC had improved ($P<0.05$) G:F compared to pigs fed 5 ppm RAC. Chemical lean as a percentage was improved ($P<0.05$) for all pigs fed RAC compared to controls. Pigs fed 10 ppm RAC had higher ($P<0.05$) carcass yields compared to controls in those pens assigned to WG1 and WG2. Pigs in WG3 fed RAC had higher carcass yields than controls (78.07 vs 77.23%; $P<0.05$). Tenth rib fat depth was decreased (1.88 vs 2.08cm; $P<0.05$) in pigs fed RAC compared to controls in WG3. All pigs fed RAC had increased ($P<0.05$) loin eye area (LEA) compared to controls with the exception of the 5 ppm treatment in WG2 ($P=0.093$). Further, pigs fed 10 ppm RAC had increased ($P<0.05$) LEA compared to pigs fed 5 ppm RAC in all three weight gain groups. RAC showed no negative effects ($P>0.05$) during sensory panel evaluation which included measures of tenderness, juiciness, pork flavor, or off-flavor. Improvements in growth and carcass characteristics were observed in pigs of different weights fed RAC, with no negative effects on pork quality.

Key Words: ractopamine, swine, performance

218 A spreadsheet method for experimental animal allotment. B. G. Kim* and M. D. Lindemann, *University of Kentucky*, *Lexington*.

Animal allotment is an important step in animal experimentation. Random animal allocation after blocking for known sources of variation is critical to get clear and accurate treatment responses. The use of spreadsheet packages has facilitated the sorting and ranking aspects of allotment. However, animal allotment is still time-consuming, especially when an experiment requires a large number of animals and/or more than one animal in each experimental unit (pen). Therefore, we have developed an Excel spreadsheet-based Experimental Animal Allotment Program (EAAP) that automatically allots animals based on a completely randomized or a randomized complete block design. The EAAP source codes for all the modules have been written in Visual Basic for Application as an Excel XP add-in. A user can run the program file EAAP.xls with no special installation. The EAAP allows a user to select the experimental design, the number of treatments, the number of replications, and the number of animals for each pen. A user

may also assign a CV allowance for the mean BW among the pens within each block and the number of loops for randomization until the variation within blocks meets the CV allowance. The user then inputs the animal information, including BW, identification number and gender. The program will automatically block by BW and/or gender, randomize animals within each block, calculate the pen average of BW, and the CV of pen BW within each block. The randomization loop runs until the pens become homogeneous enough to meet the CV allowance. The program displays a summary table including the allotment, the pen average of BW, the treatment average of BW, and the CV of each block. A user does have the ability to manually change the treatment allotment of individual pigs, if a biased ancestry of a pen exists. The EAAP allows animal scientists to quickly and efficiently allot experimental animals. The program is available at: http://www.uky.edu/Ag/AnimalSciences/swine/EAAP.html.

Key Words: animal allotment, animal experiment, Excel macro

219 Effects of feeding corn-soybean meal diets containing 10% corn dried distillers grains with solubles (DDGS) on pork fat quality of growing-finishing pigs under commercial production conditions. G. Xu*[1], G. C. Shurson[1], E. Hubly[2], B. Miller[2], and B. de Rodas[2], [1]*University of Minnesota*, *St. Paul*, [2]*Land O'lakes/Purina Feed*.

Two cooperating pork producers with similar swine confinement finishing barns and the same genetic line were selected to assess the effects of feeding corn-soybean meal diets containing 10% DDGS on carcass and pork fat quality of growing-finishing pigs. One producer fed corn-soybean meal based diets (CON, n=1,021) while the other producer fed similar diets that contained 10% DDGS (DDGS, n=991). An 8-phase feeding program was used on both farms (initial BW of 22.2 kg to 123.4 kg BW). Choice white grease was added as a supplemental fat source in all diet phases (3.75% to 2%). Diets contained similar ME and lysine levels within phase across dietary treatments, and the final finisher diet contained 4.5g/ton of Paylean®. At 24 h postmortem, 24 pigs (gilts = 12, barrows = 12) from each group were randomly selected for collection of belly fat samples. There were no significant differences (P> 0.05) in hot carcass weight, last or tenth rib backfat thickness, ham, loin, belly, and lean percentage, and loin depth between pigs fed CON and DDGS. For belly fat quality, feeding DDGS increased iodine value (66.7 vs. 68.3; $P < 0.05$), linoleic acid (11.9 vs. 14.0%; $P < 0.01$), total poly-unsaturated fatty acids (14.1 vs. 16.1%; $P < 0.01$), and the ratio of ω–6 to ω–3 fatty acids (13.3 vs. 15.8; $P< 0.01$). Belly fat from pigs fed DDGS was lower in oleic acid (47.4 vs. 45.1%; $P < 0.01$), eicosenoic acid (0.86 vs. 0.80%; $P < 0.05$) and total mono-unsaturated fatty acids (51.8 vs. 49.5%; $P < 0.01$) than from pigs fed CON. Melting point, and Japanese color scores of belly fat were not affected by dietary treatment. These results suggest that feeding diets containing 10% DDGS to grow-finish pigs will increase the iodine value and linoleic acid content of pork fat, but pork fat quality would be acceptable based upon an iodine value standard of 70 set by the Danish Meat Research Institute.

Key Words: DDGS, pork quality, fatty acids

220 Determination of P bioavailability in corn and sorghum distillers dried grains with solubles for growing pigs. S. Jenkin*[1], S. Carter[1], J. Bundy[1], M. Lachmann[1], J. Hancock[2], and N. Cole[3], [1]*Oklahoma State University*, *Stillwater*, [2]*Kansas State University*, *Manhattan*, [3]*USDA/ARS*.

A total of 35 barrows (29.6 kg BW) were used in a 34-d study to determine the effects of corn or sorghum distillers dried grains with solubles (DDGS) on growth performance, bone traits, and P bioavailability. One corn and three sorghum DDGS were each collected from different processing plants. Pigs were blocked by weight, ancestry, and randomly allotted to one of seven dietary treatments with five pigs/treatment. The basal diet was a fortified corn starch-dextrose-soybean meal diet which was adequate in all nutrients except P. This diet contained 0.3% total P, which was provided by soybean meal and monosodium phosphate (MSP). Treatments were the basal, the basal plus MSP to provide 0.075 and 0.15% added P, and the basal plus corn DDGS or the three sorghum DDGS to provide 0.15% P. The corn DDGS contained 0.79% P and the three sorghum DDGS contained 0.80, 0.66, 0.69% P, respectively. All diets were formulated to 1.05% lysine and 0.70% Ca. Pigs were housed individually with ad libitum access to water and fed at 3.25 times maintenance daily. At the end of the 34-d study, all pigs were killed, the femurs excised, and the feet removed to collect the 3rd and 4th metacarpals and metatarsals. Bone breaking strength was determined and the metacarpals were dried and ashed. Increasing levels of MSP increased (linear, $P < 0.04$) ADG, ADFI, G:F, P intake. Bone breaking strength (129, 146, 175, 165, 162, 163, 160 kg) was increased (linear, $P < 0.01$) by MSP and DDGS addition. DDGS had no effect ($P > 0.10$) on performance or bone traits as compared to the high MSP diet. Also, there were few differences ($P > 0.10$) between corn and sorghum DDGS. Bone strength was regressed on added P intake, and the availability of P was determined based on slope ratio. Bioavailability of P was approximately 77% in corn DDGS and 69, 70, and 64% in the three sorghum DDGS. These results suggest that the bioavailability of P in DDGS is relatively high; however, the bioavailability of P varied among DDGS sources.

Key Words: distillers dried grains, pig, phosphorus

221 Determination of amino acid digestibility of corn, sorghum, and a corn-sorghum blend of dried distillers grains with solubles in growing pigs. P. E. Urriola*[1], D. Hoehler[2], C. Pedersen[3], H. H. Stein[4], L. J. Johnston[1], and G. C. Shurson[1], [1]*University of Minnesota*, *St. Paul*, [2]*Degussa Corporation*, *Kennesaw, GA*, [3]*Danisco Animal Nutrition*, *Marlborough, UK*, [4]*University of Illinois*, *Urbana*.

The objective of this study was to evaluate CP and AA digestibility in corn dried distillers grains with solubles DDGS (C), sorghum DDGS (S), and a corn-sorghum blend DDGS (CS). Eleven growing barrows (initial BW = 44.6 ± 6.5 kg) were fitted surgically with a T-cannula at the distal ileum. Eight of the 11 diets contained 66.7% of C, 2 diets contained 66.7% of S and CS, and 1 diet was N-free. Chromic oxide (0.3%) was used in all diets. Standardized ileal digestibility (SID) values of CP and AA in all DDGS samples were calculated using the direct procedure. Crude protein, NDF, and ADF concentrations were higher in CS and S than in C. Sorghum DDGS had a higher concentration of CP and ADF, but lower NDF than CS. Lysine SID

values ranged from 47 to 67% (SEM = 1.94). Tryptophan was the second most variable AA with SID values ranging from 56.2 to 72.0% (SEM = 1.91). The SID of Thr varied from 63.6 to 75.9%. The SID of Leu and Met were among the least variable AA and ranged from 82.9 to 89.4% and 78.9 to 87.1%, respectively. Mean SID of Arg and Lys, in C (81.5 and 61.6%), S (79.2 and 64.0%), and CS (81.8 and 60.9%) were similar ($P > 0.05$). The SID of His, Leu, Met, and Phe were lower in S (71.9, 77.3, 76.5 and 76.9%, respectively) than any sample of C (79.3, 86.0, 82.8, and 82.4%, respectively) or CS (75.1, 81.0, 80.1, 78.5%, respectively; $P < 0.01$). The SID of Trp was higher in S (72.0%) than in C (64.9%; $P < 0.01$), and there was no difference between C and CS (62.4%; $P = 0.20$). There was a correlation between total AA content and digestible AA content for Met, Thr, and Trp (r^2 = 0.97, 0.84, and 0.78, respectively), but a poorer correlation for CP and lys (r^2 = 0.73 and 0.55, respectively). Poor correlations between nutrient content and digestibility indicate that rapid and accurate in vitro procedures need to be developed in order to predict digestible AA content in DDGS. Differences in nutrient content between C and S were similar to differences among the corn and sorghum grain.

Key Words: DDGS, amino acids, digestibility

222 Prediction of in vivo amino acid digestibility of dried distillers grains with solubles (DDGS) from selected physical and chemical characteristics. P. E. Urriola*[1], D. Hoehler[2], C. Pedersen[3], L. J. Johnston[1], and G. C. Shurson[1], [1]*University of Minnesota*, *St. Paul*, [2]*Degussa Corporation*, *Kennesaw, GA*, [3]*Danisco Animal Nutrition*, *Marlborough, UK*, [4]*University of Illinois*, *Urbana*.

Standardized ileal digestible CP and AA content from 36 samples of distillers dried grain with solubles (DDGS) and 1 sample of distillers dried grain (DDG) were obtained from 5 in vivo experiments. Thirty four of the samples of DDGS were produced from corn (C), 1 sample was produced from sorghum, and 1 sample was produced from a corn-sorghum blend. Minolta (M) and Hunter (H) color were expressed as (L*, a*, and b*). NDF and ADF were analyzed using the Ankom procedure. Hemicellulose (Hem) was calculated subtracting ADF from NDF. Acid detergent insoluble nitrogen (ADIN) was determined by analyzing nitrogen in ADF. Soluble protein (SolCP) was determined by soaking the DDGS sample in borate-phosphate buffer. Starch in DDGS was analyzed in three fractions: total (TOT), insoluble (INS), and soluble (SOL). The INS was separated after washing the DDGS with 80% ethanol and 20% water. The SOL was calculated by subtracting INS from TOT. Particle size (PS) of DDGS was analyzed by sieving 100 g for 10 min. Correlation coefficients (r) were calculated and predictions of digestible AA were performed by principal components regression. Digestible CP (DCP) was correlated ($P < 0.05$) with L* (r = 0.48 [M]; 0.38 [H]) and b* (r = 0.43 [M]; 0.22 [H]). Digestible Lys (Dlys) was correlated ($P < 0.05$) with L* (r = 0.33 [M]; 0.44 [H]) and tended ($P < 0.10$) to be correlated with b* (r = 0.31 [M]; 0.44 [H]). There was low correlation between NDF, ADF, Hem, ADIN, PS, ash, TOT, INS, SOL and DCP (r = -0.04, 0.09, -0.13, -0.04, 0.06, -0.06, -0.05, -0.16, 0.14, respectively). Soluble CP was correlated with DCP (r = 0.27; $P < 0.05$). The prediction of DCP (R^2 = 0.80 [M]; 0.78 [H]) and digestible Trp (R^2 = 0.79 [M]; 0.74 [H]) from a multiple linear model including all in vitro measures was satisfactory ($P <$ 0.05). However, the prediction of Dlys (R^2 = 0.44 [M]; 0.57 [H]) and digestible Thr (R^2 = 0.65 [M]; 0.54 [H] was poor. In conclusion, prediction of DCP and DTrp were possible from physical and chemical characteristics evaluated but they were of limited value for predicting Dlys.

Key Words: DDGS, digestibility, color

Odor and Nutrient Management

223 Influence of dietary manipulation on DM, N, and P excretion of lactating sows. J. Bundy*, S. Carter, M. Lachmann, S. Jenkins, and Z. Marable, *Oklahoma State University*, *Stillwater*.

A total of 58 sows (Yorkshire and Yorkshire x Landrace; 180 kg BW; parity = 1.3) was used during three different lactation periods to determine the effects of reducing dietary CP and P on sow performance and DM, N, and P excretion. Sows were blocked by parity, BW, and breed, and placed into one of two identical, environmentally-controlled, barns with each having a shallow pit, pull-plug drainage system. Each barn was randomly allotted to one of two dietary treatments. The control diet consisted of a fortified corn and soybean meal based diet formulated to 18.5% CP and 0.60% P. The experimental diet (LPP) was similar to the control diet with the exceptions of a 0.50% unit reduction in CP with 0.05% lysine HCL added, and a 0.10% unit reduction in P with the inclusion of 350 phytase units. Both diets were formulated on a true digestible Lysine basis (0.88%). Sows were weighed upon entry into the farrowing house and at weaning. Also, litter weights and weaning weights were recorded to evaluate sow performance. All feed and water intake was recorded weekly. Pit volume, pH, and electrical conductivity were measured weekly prior to pit sampling and draining. The pits were refilled with water at the beginning of each week and the beginning volume was measured. Feed and pit samples were collected for DM, N, and P analysis. There were no differences ($P > 0.10$) in pH and electrical conductivity of the slurry for sows fed the two diets. Also, no differences ($P > 0.10$) in sow weight change, number born alive, number weaned, litter weight, ADFI, or DM, N, and P intake were noted between treatments. Daily DM excreted (g/sow) was similar ($P > 0.10$) between treatments, but daily N excretion was reduced ($P < 0.05$) for sows fed the LPP diet. Likewise, daily P excretion tended to be reduced ($P < 0.10$) with the LPP diet. Based on these results, the LPP diet did not affect sow performance, intake, or daily DM excretion. However, the results of this study suggest that feeding an LPP diet to lactating sows can reduce daily N and P excretion.

Key Words: diet, lactating sow, nutrient excretion

224 Bacterial protein synthesis in the pig's large intestine varies according to the fermented non-starch polysaccharides. J. Bindelle[1], P. Leterme*[2], J. P. Destain[3], R. Agneesens[4], and A. Buldgen[1], [1]*Faculté Universitaire des Sciences agronomiques*, *Gembloux, Belgium*, [2]*Prairie Swine Centre Inc.*, *Saskatoon, SK, Canada*, [3]*Centre Wallon de Recherches Agronomiques*, *Gembloux, Belgium*, [4]*Centre Wallon de Recherches agronomiques*, *Libramont, Belgium*.

Diet manipulation may alleviate environmental impact of swine production. For example, high-fiber diets shift nitrogen excretion from urea in urine to bacterial protein in feces. However, little information is available on the capacity of non-starch polysaccharides (NSP) to enhance bacteria growth. An in vitro study, based on the gas technique, was carried out in order to measure the rate of bacterial protein synthesis of colonic bacteria populations incubated with starch (S, as a reference) or 4 NSP: inulin (I) from chicory roots, cellulose (C), xylan (X) from oat spelt and citrus pectin (P). The carbohydrates were incubated for 72h at 39°C in an inoculum solution, prepared from fresh feces of adult sows and a buffer solution supplemented with mineral salts, including ^{15}N-labelled NH_4 Cl. Bacterial protein synthesis was estimated by measuring the rate of incorporation of ^{15}N in the isolated bacteria at mid-fermentation by IRMS. Gas production was monitored and the remaining substrate was analyzed for sugar content by HPLC, short-chain fatty acids (SCFA) by GC and N (combustion method). The kinetics of carbohydrate fermentation differed between the substrates with P, S and I presenting faster rates of degradation, compared to the other substrates ($P < 0.001$) and X and C presenting longer lag and mid-fermentation times. The proportion of fermented carbohydrates reached 81, 90, 56, 46 and 87%, respectively for S, I, C, X and P. Starch and I fixed more N per g substrate ($P < 0.001$) than C, X and P (22.4 and 22.1 mg fixed N/ g fermented substrate vs 10.5, 12.0 and 10.0 mg, respectively). Production of SCFA was the highest for the substrates with low N fixation: 588 and 570 mg/g fermented substrate for C and X vs 460, 409 and 339 mg for S, I and P ($P < 0.001$). Thus, despite a high and fast fermentation rate, P had a low N fixation rate and low SCFA production. In conclusion, the capacity of NSP to enhance bacterial protein synthesis in the large intestine varies from one NSP source to another.

Key Words: pig, NSP fermentation, nitrogen excretion

225 Soybean meal inclusion rate effects on odor, hydrogen sulfide and ammonia in commercial swine production units. D. R. Stender*, W. Powers, C. Johnson, J. Harmon, and K. Kohl, *Iowa State University*, *Ames*.

Nutrients in the swine diet impacts the nutrient composition of excreted manure. Differences in composition during storage in the pit may change decomposition patterns which may indirectly change the odor intensity. The objective of this study was to evaluate the impact of soybean meal inclusion on air quality emission parameters.

Three commercial farms with side-by-side 1100-head swine finishers with under-slat manure pits were sampled seasonally for odor, H2S and NH3 concentration. One farm had an additional 1100-head barn with split pits resulting in four field replications. The barns were sampled over a 3-yr period, resulting in a total of 36 duplicate odor samples collected in late March, late July and early October each year. All treatment diets were initiated in late winter and fed from 22 to 123 kg BW.

Forty-five kg of SBM from the control diet (HP) was replaced with a combination of 45 kg of corn and synthetic amino acids per ton of feed (LP). The SBM to corn/amino acid substitution between the two treatments remained consistent throughout the trial based on pig requirements.

Air samples (10 L tedlar bags) were collected at the manure pit fans of each barn and analyzed at the ISU olfactometry lab for odor threshold, H2S concentration (Jerome meter) and NH3 concentration (Draeger tubes).

The HP treatment averaged 1420 odor units compared to 1035 odor units for the LP treatment, reducing odor by 27% ($P= 0.02$). Reduction in H2S concentration was not significant, averaging 0.92 ppm and 0.59 ppm for HP and LP treatments, respectively; $P = 0.09$. Least squares means of NH3 concentrations were 12.3 ppm and 9.1 ppm for the HP and LP treatments, respectively ($P =0.10$).

More field research is needed to evaluate seasonal influences of dietary modification impacts.

Key Words: manure, odor

227 Water Quality Concerns in EPA Region 7 Streams Lakes and Streams. B. Horchem*, *Region 7 Environmental Protection Agency*, *Kansas City, Kansas*.

The Region 7 Environmental Protection Agency (EPA) includes four states. The states are Iowa, Kansas, Missouri and Nebraska. In EPA Region 7, according to NRCS NRI data there are approximately 85 million acres that are used primarily for cropland and 57.4 million acres that are used for grazing. There are approximately 21.5 million cattle and calves in the four states, according to NASS.

In three of our four states nutrients are in the top five causes for developing TMDLs to address water quality concerns. In the other state, Kansas TMDLs nutrients arenâ€™t in the top five because they have not determined the criteria for nutrient.

Nutrients are essential to life in small amounts, but excessive nutrients in water bodies cause excessive growth of algae and eutrophication of the waters. Nitrogen and phosphorus are the two primary nutrients found in livestock waste. When livestock have free access to streams and lakes you can expect higher nutrient and fecal coliform levels in the waters.

Tile drains are used in many cropland fields in Region 7. The tile drains carry high levels of nutrients, especially nitrogen, to water bodies. The tile drains also carry pesticides to the water bodies.

Pastures and areas where manure is stored can be sources of bacteria and fecal coliform. Through implementing proper best management practices the amount of bacteria and fecal coliform that reach the streams and lakes.

Pesticides and pesticide degradates can be found most of the year in streams draining watersheds with substantial areas of agriculture. The pesticide most commonly found in Region 7 water bodies is atrazine

Key Words: water, nutrient

228 Assessing risk of phosphorus transport to midwestern surface waters. A. P. Mallarino*, *Iowa State University*, *Ames*.

Phosphorus (P) transport from fields to surface water bodies is affected P source factors (such as the soil P level, P application rate, and time of application among others); soil, crop, and water conservation practices; and the transport mechanism involved. Therefore, information of soil-test P and P application practices is inadequate to assess the risk of P delivery. A comprehensive, yet practical, P assessment tool - the P index - was proposed to better assess risk of P transport to water resources. This tool integrates source and transport factors into a decision making process that ranks fields (or field zones) and helps identify causes of high P delivery. Indices developed across the U.S.A. vary to reflect concepts and conditions in each region. Most P indices developed in the Midwest consider source factors in a multiplicative manner within three transport mechanisms: erosion, surface runoff, and subsurface drainage. The Iowa P Index adapts existing USDA-NRCS tools [RUSLE2, sediment delivery ratios (SDR), and runoff curve numbers (RCN)] to estimate sediment and water loss. It requires few measurements from producers. An erosional component considers gully, sheet and rill erosion; sediment delivery and P enrichment; total soil P (estimated from soil-test P); vegetative filter strips; and long-term availability of particulate P in lake ecosystems. A runoff component considers water runoff based on modified RCN; soil-test P; and rate, time, and method of P application. A third component considers water flow through subsurface drainage (mainly through tiles) and soil-test P. The sum of partial index numbers from each component is classified into five risk classes. The index emphasizes long-term processes comparatively more than short-term processes. In summary, the P index identifies causes of high P delivery and suggests alternative P and soil management practices that can reduce the risk of total P delivery from fields to water resources. Detailed information about the Iowa P Index is available at http://www.ia.nrcs.usda.gov/technical/Phosphorus/phosphorusstandard.html.

Key Words: phosphorus index

229 Grazing and nutritional management of beef cows to limit non-point source pollution of streams in Midwestern pastures. J. Russell* and M. Haan, *Iowa State University*, *Ames*.

Sediment, phosphorus, and pathogen loading of surface water resources are amongst the major water quality problems in the Midwest. Stream bank erosion and manure deposition from pastureland have been implicated as major contributors to non-point source pollution of Midwestern streams and lakes. These problems are likely related to poor grazing management and/or pasture conditions that promote congregation of cattle near pasture streams. Grazing management practices that control the timing, frequency, duration and intensity of grazing in riparian zones of western rangelands enhance stream water quality by maintaining vegetation and minimizing hoof traffic on stream banks and reducing manure deposition near the streams, but are untested in the Midwest. Restricting access of streams to stabilized crossings in continuously stocked pastures in Iowa reduced ($P < 0.05$) the proportion of bare and fecal-covered ground and increased ($P < 0.05$) forage sward height and mass within 33.8 m of the streams compared to full stream access. Limiting access of riparian paddocks in rotationally stocked pastures to a minimum residual sward height of 10 cm or a maximum length of 4 d per rotation also decreased ($P < 0.05$) the proportion of bare ground and increased ($P < 0.05$) forage sward height and mass within 33.8 m of the stream compared to full stream access in continuously stocked pastures. Differences in ground and manure cover between grazing management treatments were related to the temporal/spatial distribution of cattle within pastures. The presence of constructed off-stream water sites also reduced ($P < 0.05$) the proportions of observations within 33.8 m of streams during periods when no natural off-stream water sources were available. The P concentration of smooth bromegrass forage from continuously and rotationally stocked pastures ranged from 0.24 to 0.30%, implying that reduced P supplementation of cattle could be used to decrease the environmental P load. Non-point source pollution of surface water resources in Midwestern pastures may be decreased by grazing and nutritional management.

Key Words: water quality, grazing, beef cattle

Physiology

230 Effects of nutrition on oocyte quality and early embryonic development in sheep. A. T. Grazul-Bilska*, J. S. Caton, E. Borowczyk, D. A. Redmer, and L. P. Reynolds, *North Dakota State University*, *Fargo*.

Nutrition has been shown to influence several reproductive functions including hormone production, oocyte competence and fertilization, early embryonic development, and pregnancy rates. Nutritional factors affecting oocyte and embryo quality include energy balance and specific nutrients such as vitamins, minerals and amino acids. In addition, nutrition may affect expression of genes that are important for oocytes and early embryonic development. Data concerning the effects of nutrition on oocyte and embryo quality are limited and frequently contradictory. Nevertheless, some existing data suggest that manipulation of the diet may help to improve embryo production systems. Therefore, we hypothesized that level of dietary nutrient supply would affect oocyte quality determined by the rates of in vitro fertilization (IVF) and early embryonic development. Oocyte quality was measured by the rates of IVF, and morula and blastocyst formation for control (C), overfed (OF) and underfed (UF) ewes that received 100%, 200% and 60% of a maintenance diet, respectively, for 8 weeks before oocyte collection. The rates of IVF, morula and blastocyst formation were lower ($P < 0.001$) in OF and UF than C ewes (C, 85, 63 and 40%; OF, 51, 18 and 5%; UF, 48, 28 and 4%, respectively). The proportion of ewes providing oocytes that developed to blastocyst stage tended ($P < 0.1$) to be greater in UF (29%) than OF (17%) ewes. However, plasma estradiol-17β concentration, number of visible follicles (large and small), total number of oocytes, number of healthy oocytes and percentage of healthy oocytes were similar for C, OF and UF ewes. These data indicate that dietary intake in donor ewes has a substantial effect on oocyte quality, which results in lower rates of cleavage, and morula and blastocyst formation after IVF in sheep. Supported by ND SBARE grant to ATGB.

Key Words: nutrition, oocyte quality, sheep

231 Elucidating the mechanisms involved in oocyte quality by examining gene expression. R. L. Krisher*, *Purdue University*, *West Lafayette, IN*.

Oocyte quality, or competence, has a direct effect on embryo quality, the establishment and maintenance of pregnancy, and production of healthy offspring. In vitro maturation, as it is currently undertaken, does not support the correct development of oocyte competence, and negatively affects the potential of the oocyte to develop to the blastocyst stage and beyond. Until the mechanisms involved in oocyte quality are elucidated, any effort to utilize assisted reproductive technologies for the improvement of animal production will be inefficient at best. Unfortunately, there are currently no reliable cellular markers that can be used to assess oocyte competence. The correct program of RNA synthesis and storage during oocyte growth, as well as final accumulation of maternal factors during oocyte maturation, is essential to establish competency for meiosis and embryogenesis. It is conceivable that transcriptional anomalies in oocyte-specific genes account for some of the inefficiencies commonly experienced when applying assisted reproductive technologies. We are investigating how maternal age and in vitro oocyte maturation affect expression of genes associated with developmental competence. Oocytes derived from postnatal, juvenile mice are a useful model for determination of mechanisms involved in oocyte competence, as competence is progressively acquired as the female nears puberty. Our work will establish the gene expression profile of developmentally competent oocytes, and identify changes in this profile that are associated with reduced developmental potential. A comparative analysis of gene expression in oocytes of differing qualities will establish which genes might be targets for manipulation to improve developmental competence. This information will allow us to develop strategies to enhance oocyte maturation, assays to test for oocyte quality and improved media formulations for in vitro oocyte maturation. Finally, the production of competent oocytes will positively impact the application of nuclear transfer and transgenic technologies to animals for agricultural and biomedical purposes.

Key Words: oocyte quality, gene expression

232 Effect of embryo biotechnologies on genetic imprinting. X. C. Tian*, *University of Connecticut*, *Storrs*.

Assisted reproductive technologies (ART) such as in vitro fertilization and somatic cell nuclear transfer (SCNT) have enormous potential applications in agriculture and human medicine. These technologies, however, are hindered by reduced efficiency and abnormal fetal development such as the large offspring syndrome (LOS). To understand the underlying mechanisms of these developmental problems, we studied imprinted genes that regulate fetal growth in fetuses and newborns of cloned cattle and pigs. We found aberrant expression patterns and levels of several imprinted genes in these animals, suggesting imprinting deregulation by embryo in vitro manipulations and incomplete nuclear reprogramming. When the DNA microarray technology was used to examine the expression profiles of cloned blastocysts, however, we found close resemblance of imprinted gene expression in cloned bovine blastocysts to those of the naturally fertilized embryos. Our findings suggest that cloned embryos have undergone significant nuclear reprogramming by the blastocyst stage; however, it is possible that problems occur during re-differentiation for tissue- and organogenesis and that small reprogramming errors may be magnified downstream in development.
This work was supported by funds from NIH and USDA to XCT.

Key Words: nuclear transfer, genetic imprinting, epigenetics

233 Somatic cell nuclear transfer in cattle. P. J. Ross*, Z. Beyhan, and J. Cibelli, *Cellular Reprogramming Laboratory, Michigan State University*, *East Lansing*.

Since first described, the efficiency of SCNT remains low and attempts to increase it have been severely hampered, mainly by the lack of a defined endpoint that measures the level of reprogramming achieved in the cloned embryos. The only reliable marker for complete nuclear reprogramming after SCNT is the generation of a healthy offspring. Cell number and allocation (CN&A) in cloned embryos has been suggested as a potential marker for reprogramming. The number of trophectoderm (TE) cells is lower in cloned embryos; this in turn may be responsible for the insufficient formation of the placenta observed in SCNT pregnancies. This hypothesis has not been tested for technical reasons. Determination of CN&A involves the destruction of the embryo. We developed a non-invasive technique to determine CN&A in SCNT blastocysts expressing a nuclear localized red fluorescent protein (HcRed). We validated this technique using differential staining and found it to be highly accurate to determine total, ICM, and TE cell number, and for ICM:TE ratio ($r>0.96$;$P<0.01$). Using a spinning-disk confocal microscope we are able to image bovine and mouse embryos without affecting their developmental potential. Moreover, we were able to establish a pregnancy from a bovine transgenic SCNT embryo which had been processed to determine CN&A.
In a different approach to find markers that correlate with reprogramming we compared gene expression profiles of embryos derived from 2 different cell lines with different developmental potential. Using Affymetrix GeneChip array we observed that the expression profile of the cells was very different to that of the resulting SCNT embryos, with 5,665 probe sets detected as differentially expressed. Embryos derived from these two cell lines showed similar expression profile to IVF derived embryos. Only 212 probe sets were differentially expressed between embryos derived from the high efficiency and low efficiency cell lines. A set of genes maintained their relative levels of expression in both the cell lines and the SCNT blastocyst, probably representing genes that failed to be reprogrammed by the oocyte. Further analysis of these genes will help us elucidate their potential utility as markers of proper reprogramming.

235 Characterization of mRNA expression for the endothelial differentiation G-protein-coupled (EDG) receptors in porcine endometrial tissue during the pre-implantation period of pregnancy. J. Miles* and J. Vallet, *USDA, ARS, US Meat Animal Research Center*, *Clay Center, NE*.

Establishment of pregnancy in the pig requires proper preparation of the uterine environment. Although the mechanisms by which the

endometrium undergoes preparation for embryo implantation are not clear, recent evidence has suggested that lysophospholipids, such as sphingosine 1-phosphate (S1P) and lysophosphatidic acid (LPA) which function through the endothelial differentiation G-protein-coupled (EDG) receptors may play a role in coordinating uterine preparation for embryo implantation. The objective of the current study was to characterize mRNA expression for the EDG receptors in porcine endometrial tissue during the pre-implantation period of pregnancy. Total RNA was isolated from endometrial tissue at d 10, 12, 14 and 16 of gestation (n = 4 gilts per day of gestation) and mRNA expression for the EDG receptors was measured via real-time PCR. Data were analyzed for analysis of variance using GLM procedures. At all days of gestation examined, mRNA for four of the five high-affinity EDG receptors for S1P (*EDG1, EDG3, EDG5* and *EDG8*) were detected by RT-PCR, while *EDG6* expression was not detected. Expression of *EDG1* mRNA was increased ($P < 0.01$) in endometrial tissue at d 14 and 16 of gestation compared with d 10 and 12. In contrast, the expression of *EDG5* mRNA was increased ($P < 0.01$) in endometrial tissue at d 10 and 12 compared with d 14 and 16. Expression of mRNA for all three high-affinity EDG receptors for LPA *(EDG2, EDG4* and *EDG7)* were detected by RT-PCR at all days of gestation examined. Expression of mRNA for *EDG7* was increased ($P < 0.01$) in endometrial tissue at d 12 of gestation compared with endometrial tissue at d 10, 14 and 16 of gestation. These results demonstrate altered gene expression for the EDG receptors in porcine endometrial tissue throughout the pre-implantation period of pregnancy, suggesting that S1P and LPA may play a role in the preparation of the uterine environment for embryo implantation in the pig.

Key Words: endometrium, EDG receptors, gene expression

236 Seasonal, litter size, and birth order effects on farrowing intervals and stillbirth rate in swine. J. L. Vallet*, J. A. Nienaber, T. M. Brown-Brandl, and J. R. Miles, *USDA, ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*.

The number of piglets weaned is affected by the farrowing process through its impact primarily on stillbirth rate (SR). The effects of season and birth order on the farrowing process and SR are not well characterized. To examine these relationships, farrowing was recorded in first parity gilts of our USMARC BX population in May (Ave 17.1 °C, 68 gilts) and July (Ave 24.4 °C, 59 gilts), 2006, using video cameras. The time of birth of each piglet and whether the piglet was born alive, stillborn, or a mummy was assessed. For each piglet, the time interval from the birth of the previous piglet was calculated. Assisted births and mummies were excluded. There was no significant effect of birth order in the litter on farrowing interval (FI). However, when birth order was converted to a proportion of the litter farrowed, FI and SR were significantly greater ($P < 0.01$) for the last tenth of the litter. Finally, FI and SR for the last, next-to-last and second-to-last piglets in each litter were examined. The last piglet in the litter had a significantly greater ($P < 0.01$) FI and SR (52 ± 4 min and 15 ± 4%, respectively) than the next-to-last (21 ± 4 min and 2 ± 1%) and second-to-last (19 ± 5 min and 6 ± 2%) piglet. Seasonal and(or) litter size effects on FI and SR were analyzed by heterogeneity of regression analysis on within gilt averages. No seasonal or litter size effects on average SR were detected. The relationship between litter size and average FI was third order and differed ($P < 0.05$) between May and July. The prediction equations for each season indicated that average FI were greater in July for litter sizes less than 5. These results indicate that FI and SR are greatest for the last piglet born in the litter compared to piglets born earlier in the order and suggest that season affects the farrowing process, especially for small litter sizes. Taken together, results suggest that conceptuses remaining in the uterus affect farrowing intervals.

Key Words: parturition, conceptus, birth order

237 Estrus induction and maintenance of cycles in gilts with PG600 and boar exposure. K. Moore*, C. Spinka, and T. Safranski, *University of Missouri*, *Columbia*.

Ability to induce puberty in gilts at an earlier and predictable age can facilitate introduction into the breeding herd. One method to initiate puberty (PG600; 400 IU of PMSG and 200 IU of hCG, Intervet), elicits estrus in a majority of gilts. However, a proportion of those gilts do not recycle normally. This study looked at efficacy of PG600 and boar exposure alone and in combination to induce and maintain regular cycles. Two replicates of 160 gilts each (182 days old) were conducted on a commercial farm in June and July, 2006. Replicates were combined for analysis. Gilts were presumed prepubertal on arrival from the multiplier and randomly assigned to one of four treatments in a 2x2 factorial arrangement: PG600, weekday 10 min full physical contact boar exposure (BE), PG600 + BE, and neither PG600 nor BE. Detection of estrus was performed during BE or during 2 min fenceline BE. Gilts were considered in estrus when they stood to be mounted. A total of six gilts were removed from the experiment for health reasons. PG600 and PG600 + BE gilts had a higher ($P<0.0001$) percentage in estrus within seven days than the BE and control treatments (54% ± 5.44, 63% ± 5.44 versus 19% ± 5.44, 10% ± 5.44, respectively). Eighty-five of 146 gilts in estrus within 7d returned to estrus 18-23 d later. Although the BE and control groups had fewer gilts respond within 7d, a larger proportion recycled within 18-23d; (100% ± 0.097 of BE versus 78% ± 0.097 control and, 55.8% ± 0.911 and 50 ± 0.911 for PG600 and PG600 + BE respectively). Half of control gilts showed heat within 30d regardless of initial weight. PG600 and BE gilts with heavier initial weights had a higher probability of coming into heat. Heavier gilts in the PG.600 + BE group had a lower probability of cycling; no explanation for this can be found. The greatest response was to PG600. Response to BE is dependent on many factors, and in this study was lower than expected. Addition of daily boar exposure to PG600 did not result in dramatic increase in proportion maintaining cycles and may not be warranted.

Key Words: gilt, puberty, PG600

238 Influence of standing estrus and estradiol on time of uterine pH decline during a fixed-time AI protocol. J. R. Nelson*, B. L. Perry, and G. A. Perry, *South Dakota State University*, *Brookings*.

Research has shown cows in estrus within 24 h of fixed-time AI had greater pregnancy rates, elevated concentrations of estradiol, and

lower uterine pH at time of AI compared to cows not in estrus. Our objective was to determine when during a fixed-time AI protocol estradiol and(or) estrus influenced uterine pH. Lactating beef cows (n = 35) were treated with the CO-Synch protocol (100 µg GnRH on d -9; 25 mg PG on d -2; and 100 µg GnRH on d 0). Half (n = 18) of the cows received an injection of estradiol cypionate (ECP; 1 mg) 12 h following PG. Exact onset of estrus was detected using a computerized estrous detection aid (HeatWatch®). All cows administered ECP exhibited estrus. Cows exhibiting estrus, regardless of treatment, had similar ($P > 0.16$) estradiol concentrations from the time of PG through the second GnRH injection. Cows treated with ECP and control cows detected in estrus had elevated ($P < 0.01$) estradiol concentrations prior to the second GnRH injection compared to control cows not detected in estrus. Following the second GnRH injection, estradiol concentrations remained elevated in ECP-treated cows ($P < 0.05$). A time by estrus interaction ($P < 0.03$) influenced uterine pH. At the time insemination would have occurred (second GnRH injection), ECP-treated and control cows that exhibited estrus had a lower ($P = 0.01$) uterine pH compared to control cows that did not exhibit estrus (6.85 ± 0.04, 6.85 ± 0.06, 7.09 ± 0.07, respectively). When onset of estrus was standardized to the time of the second GnRH injection, ECP-treated and control cows that exhibited estrus had lower ($P = 0.01$) uterine pH compared to control cows not in estrus (6.78 ± 0.1, 6.72 ± 0.13, 7.09 ± 0.07, respectively). However, 12 h prior to and 6 h following the onset of estrus, uterine pH was similar ($P > 0.05$) among all treatments. In summary, ECP treatment elevated concentrations of estradiol and lowered uterine pH to levels similar to control cows that exhibited estrus, and the change in uterine pH was specific to a short period of time around the onset of estrus.

Key Words: estradiol, estrus, uterine pH

240 Effects of dam winter grazing system and protein supplementation on progeny performance. J. L. Martin*, D. C. Adams, and R. N. Funston, *University of Nebraska West Central Research and Extension Center*, *North Platte, NE*.

A 2x2 factorial study evaluated effects of cow winter system and last trimester protein supplementation on progeny. Composite cows (n = 108) grazed either range (WR) or corn residue (CR) during winter and within grazing treatment received 0.45 kg/d (DM) 28% CP cubes (PS) or no supplement (NS). Steer calves (n =51) entered the feedlot 10 d post-weaning and were harvested 218 d later. Heifer calves (n = 55) were wintered in drylots and grazed summer range. Pre-calving BW and BCS were greater (P = 0.003, P < 0.001) for PS than NS cows that grazed WR but similar (P > 0.10) for CR cows. Calf birth weight was unaffected (P = 0.21) by PS but was greater (P = 0.07) for CR than WR cows. Pre-breeding BW and BCS were greater (P < 0.001, P = 0.003) for CR than WR cows and PS than NS (P = 0.04, P = 0.004) cows. At weaning, CR cows were heavier (P = 0.006) than WR cows but similar BCS (P = 0.67). Weight and BCS were not affected (P > 0.23) by PS. Calf weaning BW was greater (P = 0.0005) for PS cows that grazed WR but similar (P = 0.44) for CR cows. Pregnancy rate was greater (P = 0.003) for CR than WR cows but similar (P = 0.36) for PS and NS cows. Final BW and 12th rib fat were greater (P = 0.05, P = 0.04), and HCW tended to be greater (P = 0.12) for steers from CR cows than WR cows. Quality and yield grades, ADG, and LM area (P > 0.10) were similar. Feedlot and carcass traits were not affected by PS (P > 0.10). Heifer ADG, DMI, G:F, and residual DMI were not affected by treatment (P >0.10). Heifers born to PS cows that grazed WR were heavier (P = 0.08) at beginning of breeding than heifers from NS cows on WR. Dam treatment did not affect (P > 0.10) heifer cyclicity or pregnancy rate. Heifers born to CR cows were younger (P = 0.04) at puberty and tended to be heavier (P = 0.12) at pregnancy diagnosis than progeny of WR cows. Grazing CR increased cow pregnancy rate and steer final BW, and reduced heifer age at puberty versus grazing WR. Calf weaning BW and heifer pre-breeding BW increased with PS of WR cows.

Key Words: fetal programming, heifer development, protein

241 Effect of wintering system and level of nutrition around the time of breeding on gain and reproduction in beef heifers. D. M. Larson* and R. N. Funston, *University of Nebraska, West Central Research and Extension Center*, *North Platte, NE*.

Two experiments evaluated heifer development system and level of nutrition around the time of breeding on ADG and pregnancy rate. In Exp. 1, 96 heifers (222 ± 3 kg BW) grazed winter range (WR) or corn residue (CR) with supplement (28% CP, 0.45 kg/d) and were subsequently treated similarly until 4 d before bull exposure (45 d), when half of each winter treatment group received supplement (28% CP, 1.4 kg/d) for 21 d while grazing. In Exp. 2, 99 heifers (259 ± 3 kg BW) grazed CR with supplement (28% CP, 0.45 kg/d) or were developed in dry lot (DL). After winter treatment, CR heifers were managed in DL. Seven d before and 12 d after AI, half the heifers from each winter treatment were placed on a high (H) or low (L) energy diet. Heifers were inseminated by timed AI and 12 d after AI exposed to bulls (62 d). In Exp. 1 and 2 blood samples were collected before breeding to determine cyclicity and ultrasound was used to diagnose pregnancy. In Exp. 1, ADG before bull exposure was greater (P < 0.001) for WR (0.23 ± 0.02 kg/d) than CR (0.12 ± 0.02 kg/d) heifers. After bull exposure, ADG was greater (P < 0.001) for CR (0.81 ± 0.02 kg/d) than WR (0.71 ± 0.02 kg/d) heifers. Heifers pubertal before bull exposure was greater (P < 0.001) for WR (73%) than CR (33%) heifers. Heifers pregnant after bull exposure (86%) was not affected (P > 0.10) by winter or supplement treatments. In Exp. 2, ADG before AI was greater (P < 0.001) for DL (0.70 ± 0.04 kg/d) than CR (0.37 ± 0.04 kg/d) heifers. After AI, ADG was greater (P < 0.001) for CR (0.74 ± 0.02 kg/d) than DL (0.57 ± 0.02 kg/d) heifers. Heifers pubertal 43 d before AI was greater (P < 0.001) for DL (94%) than CR (47%) heifers. Development system did not affect AI conception (50%) nor overall pregnancy rates (85%) (P > 0.10); however, H heifers tended (P = 0.09) to have higher AI pregnancy rates (58 vs. 41%). Grazing WR or CR with modest ADG until breeding does not decrease conception rates and may lower heifer development costs.

Key Words: gain, heifer development, pregnancy rate

242 Reproductive performance, blood urea nitrogen, and blood glucose concentration in beef heifers grazing annual ryegrass in the spring and supplemented at different intervals prior to timed AI. D. Kreider*[1], K. Coffey[1], J. Caldwell[1], W. Coblentz[2], T. Montgomery[3], W. Whitworth[3], R. McNew[1], and R. Ogden[2], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA-ARS*, *Marshfield, WI*, [3]*University of Arkansas SE Research and Extension Center*, *Monticello*.

In successive years (n=36 and n=40), 76 Gelbvieh x Angus heifers at 12 to 14 months of age were sorted by weight and randomly allocated to one of eight bermudagrass pastures overseeded with annual ryegrass in order to determine the impact of supplemented rumen degradable carbohydrates at different intervals prior to breeding on conception rate (CR) to artificial insemination (AI), overall pregnancy rate (PR), serum urea nitrogen (SUN) and serum glucose (GLU) concentrations. Heifers grazed pastures during March, April, and May. Two replicates were provided no supplement (C); three replicates each were provided 1.4 kg/hd of supplement (32.5% ground corn, 32.5% cracked corn, 30% wheat middlings, and 5% liquid molasses) at approximately 0930 h daily, beginning either 60 (60S) or 30 (30S) d before timed AI. Heifers in each of the two treatment groups received supplement for 30 days, regardless of treatment. Supplement for 60S was discontinued at the time 30S was initiated. Heifers were weighed without prior removal from pasture and water at the initiation of the study and at approximately 28-d intervals. Serum samples were gathered at 1230 h and 1530 h on d 7 following the start of supplement and on the d before timed AI. CR to timed AI was 42, 62, and 48% for C, 30S, and 60S, respectively, but did not differ between treatments (P=0.31). PR was 92, 86, and 78% for C, 30S, and 60S and did not differ between treatments (P=0.42). SUN was not altered by treatment (P=0.95), or time of day (P=0.68), but was affected by month (P<0.001). SUN decreased, averaging 24.1±2.5, 15.5±2.4, and 10.5±2.4 mg/dl (mean±SE) for March, April, and May respectively. GLU differed between months, averaging 90.8±3.8, 90.5±3.2 and 101.6±3.3 mg/dl (mean±SE) for March, April, and May respectively. There was also a time of day by month interaction (P<0.001) for GLU. Timing of supplementation in this study did not affect conception to AI or overall pregnancy rates.

Key Words: ryegrass, glucose, serum urea nitrogen

244 Impacts of placentome type on angiogenic factor expression and vascularity in the ewe. W. J. Arndt*, P. P. Borowicz, M. L. Johnson, L. P. Reynolds, and K. A. Vonnahme, *North Dakota State University*, *Fargo*.

In sheep, placentomes vary in shape, with Type A placentomes being the smallest overall, Type D being the largest, and Types B and C being intermediate in size. It has been hypothesized that as placentomes progress from Type A to D placentomes, they become more vascular. In a previous study, we found no effect of placentome type on maternal placental (caruncular) vascularity measured as: area per capillary (APC), capillary area density (CAD), capillary surface density (CSD), or capillary number density (CND). Our current objective was to determine APC, CAD, CSD, and CND in the fetal placenta (cotyledon). Further, gene expression of 11 angiogenic factors in caruncular and cotyledonary tissue was determined. Pregnant ewes (n = 20) were slaughtered on d 130 of gestation, and placentomes of each type were fixed by vascular perfusion for determination of cotyledonary vascularity as described by Borowicz et al. (2006: 10.1095/biolreprod.106.054684). Further, caruncular and cotyledonary tissues from each placentome type were snap frozen for quantitative RT-PCR analyses of angiogenic factors, including the vascular endothelial growth factor (VEGF), NO, angiopoietin (ANGPT), and fibroblastic growth factor (FGF) systems. Cotyledonary APC, CSD, and CND did not differ among placentome types. In contrast, CAD was increased (P < 0.01) in Type B and D placentomes compared to Type A and C (33.0 and 33.6 vs. 28.8 and 30.9 ± 0.5). Although placentome type did not affect angiogenic factor gene expression, cotyledon had an increased (P < 0.01) expression of VEGF, VEGF receptor- 1 and -2, placental growth factor, ANGPT-1 and -2, ANGPT receptor, and FGF receptor compared with caruncle. Soluble guanylate cyclase gene expression was increased (P < 0.01) in caruncle compared to cotyledon. It appears that placentome types do not differ in vascularity or caruncular or cotyledonary angiogenic factor expression. Supported by USDA NRI CSREES No. 2004-35203-14949 to KAV.

Key Words: sheep, pregnancy, placentome

245 Effects of maternal selenium and dietary restriction on placentome development and proliferation. L. Lekatz*, J. S. Caton, P. B. Borowicz, D. A. Redmer, L. P. Reynolds, and K. A. Vonnahme, *North Dakota State University*, *Fargo*.

Pregnant Targhee ewe lambs (n = 64; 50.7 ± 2.8 kg BW) were randomly allotted to one of eight treatments in a 2 x 2 x 2 factorial design. Factors were Se level, mid-gestational nutrition (d 50 to 90), and late gestational nutrition (d 90 to 130). At breeding, ewes were assigned to receive an adequate-Se (ASe; 0.3 ppm Se; 8.5 µg/kg BW) or a high-Se (HSe; 3.0 ppm Se; 85 µg/kg BW) diet. Diets were iso-CP and iso-ME. Mid- (d 50 to 90) and late (d 90 to 130) gestational nutritional treatments were control (C; fed to NRC recommendations) and restricted (R; fed 60% of controls). At slaughter (d 130) the gravid uterus and its components were removed, weighed, frozen and/or fixed. The gravid uterus was heavier in the late-C group compared to the late-R ewes (8.1 vs. 6.6 ± 0.16 kg). There was no effect of maternal diet on total placentome, caruncle (CAR), or cotyledon (COT) wt, but there was a mid x late nutrition interaction (P = 0.03) on placentome number. Mid-R-late-C, mid-R-late-R, and mid-C-late-R ewes had a similar number of placentomes (91.1, 85.6, 90.3 ± 1.98), but mid-R-late-C and mid-C-late-R ewes had more placentomes than mid-C-late-C ewes (76.2 ± 1.98). There was no effect of diet on cellular proliferation, DNA concentration, RNA:DNA, or protein:DNA in the CAR or COT, and no effects on RNA concentration in the CAR. There was a mid x late nutrition interaction (P = 0.01) on COT RNA concentration, with mid-R-late-C ewes having higher RNA concentrations than all other treatments (7.5 vs. 4.5, 4.7, 4.3 ± 0.32 mg/g). A Se x mid-nutrition interaction on protein concentration in CAR (P = 0.01) and COT (P = 0.01) was observed, with HSe-mid-R ewes having reduced CAR protein concentration compared to ASe-mid-R ewes (90.0 vs. 120.1 ± 4.88 mg/g) and reduced COT protein concentration compared with HSe-mid-C ewes (87.4 vs. 120.6 ± 4.71 mg/g). It appears that nutritional restriction any time during mid- to late pregnancy impacts placentome number, and that cellularity of the placentome can be

altered by Se or mid-gestational diet regardless of nutritional levels during late pregnancy.

Key Words: sheep, pregnancy, placentome

246 Effects of maternal nutrition on fetal liver glycogen content in sheep. T Tedrow*, R. Weigl, J. S. Caton, D. A. Redmer, L. P. Reynolds, and K. A. Vonnahme, *North Dakota State University*, *Fargo*.

During normal pregnancy, fetal glucose requirements are met by placental transport. However, pregnancies with inadequate nutrition or placental insufficiencies result in the late term fetuses initiating gluconeogenesis. Our hypothesis was that in a nutrient restriction model, where fetal wt is reduced, fetal glycogen content of the liver and muscle would be increased. Objectives were to determine how maternal nutrition during pregnancy impacts fetal liver and muscle glycogen concentrations near term. Pregnant Targhee ewe lambs (n = 64; 50.7 ± 2.8 kg BW) were randomly allotted to one of eight treatments in a 2 x 2 x 2 factorial design. Factors were Se level, mid-gestational nutrition (d 50 to 90), and late gestational nutrition (d 90 to 130). At breeding, ewes were assigned to receive an adequate-Se (ASe; 0.3 ppm Se; 8.5 µg/kg BW) or a high-Se (HSe; 3.0 ppm Se; 85 µg/kg BW) diet. Mid- and late gestational nutritional treatments were control (C; fed to NRC recommendations) and restricted (R; fed 60% of controls). At slaughter (d 130), fetuses were weighed, livers removed, weighed, and frozen and a portion of the longissimus dorsi located at the 12th rib was sampled. Fetal liver and muscle glycogen was determined by a colorimetric assay using glucose as standards. There was a Se x Mid- x Late- nutrition interaction on fetal BW. Ewes fed the ASe-Mid-C-Late-C had heavier fetuses (P = 0.06) than ASe-Mid-C-Late-R, ASe-Mid-R-Late-R, HSe-Mid-C-Late-C, HSe-Mid-C-Late-R, and HSe-Mid-R-Late-R fed ewes (4.5 vs. 3.8, 3.9, 3.9, 3.8, 3.5 ± 0.3 kg, respectively). Further, HSe-Mid-R-Late-C ewes had heavier (P = 0.06) fetuses compared to HSe-Mid-R-Late-R ewes (4.1 vs. 3.5 ± 0.03 kg). There was no effect of any dietary treatment on liver wt or liver glycogen concentration. There was a main effect of mid-gestation nutritional treatment on muscle glycogen concentration with Mid-R ewes having fetuses with reduced (P < 0.04) glycogen concentration compared with fetuses from Mid-C ewes (55.5 vs. 65.9 ± 3.8 mg/dl). While liver glycogen was not affected by maternal diet, fetal muscle glycogen content measured near term is impacted by maternal nutrition experienced during mid-gestation.

Key Words: sheep, glycogen, pregnancy

247 Glucose tolerance of offspring born from ewes receiving differing nutritional levels during pregnancy. C. M. Effertz*, J. S. Caton, C. J. Hammer, J. S. Luther, T. L. Neville, J. J. Reed, D. A. Redmer, L. P. Reynolds, and K. A. Vonnahme, *North Dakota State University*, *Fargo*.

Maternal nutrition during sensitive periods of fetal development can affect the development of the pancreas and thus insulin sensitivity to glucose. Preliminary data from our laboratory indicates that the number of insulin producing cells is reduced in fetal pancreas from undernourished ewes. Our hypothesis is that when challenged postnatally to glucose, there will be less insulin released in offspring from undernourished ewes. Pregnant Targhee-cross ewe lambs were randomly allotted to one of six treatments in a 3 x 2 factorial arrangement to examine the effects of nutrient restriction and overnutrition and dietary Se on insulin sensitivity to glucose. Treatments were: nutrition (maintenance [M] vs. 60% maintenance [R] vs. 140% maintenance [O]) and dietary Se (no added Se, 7.4 µg/kg BW [NSe] vs. Se-enriched yeast, 81.5µg/kg BW [HSe]). Selenium treatments were initiated at breeding and nutritional treatments on d 140 of gestation. All diets were similar in CP (14.65%) and ME (2.64 Mcal/kg). Lambs were born and ewe lambs were used exclusively for the glucose challenge (n = 30; d = 107 ± 0.71; 33.5 ± 0.76 kg). Catheters were placed in the jugular vein of each ewe lamb and blood samples were drawn at ~30 min after catheter placement. Blood samples were drawn (t = -5, -2, 2, 5, 10, 15, 30, 45, 60, 90, 120, 150, 180 and 240 min). An injection (0.5 g glucose / kg) was given at t = 0. Glucose and insulin levels were determined by colormetric and Immulite assays, respectively. Area under the curve for each animal was determined using Sigma Plot software. There was no effect of Se or nutrition on the amount of glucose that was in the circulation. There was, however, a Se x Nutrition interaction with ewe lambs from NSe-R ewes having a reduced insulin release compared to ewe lambs from HSe-R, HSe-O, HSe-M, NSe-O, and NSe-M ewes (4344 ± 597 vs. 2444 ± 513). It appears that HSe in the face of nutrient restriction during mid to late pregnancy may spare insulin secretion in postnatal life. Supported by USDA CSREES NRI Competitive Grant no. 2005-35206-15281.

Key Words: insulin, sheep, fetal programming

248 Determination of insulin concentrations in sheep isocalorically supplemented with two different volatile fatty acids. C. O. Lemley*, J. M. Koch, and M. E. Wilson, *West Virginia University*, *Morgantown, West Virginia*.

Dairy cow pregnancy rates have declined 30% in the last 50 years, and approximately 80% of total pregnancy loss occurs during the embryonic stage (before day 42). Low concentrations of progesterone have been associated with embryonic loss. Several authors have suggested that decreasing progesterone catabolism could ameliorate the high rate of observed embryonic loss. The primary organ involved in the catabolism of progesterone is the liver, and cytochrome P450 3A and 2C subfamilies account for a large proportion of this catabolism. Previously, we have shown that ewes orally gavaged with propionate had elevated insulin secretion and reduced catabolism of progesterone. Recently, we have demonstrated a dose dependent decrease in progesterone catabolism by hepatocytes challenged with increasing concentrations of insulin, as well as a dose dependent decrease in the activity of the two major cytochrome P450s involved in progesterone catabolism. Currently, we are investigating methods for nutritionally stimulating insulin secretion in sheep without altering metabolic energy or dry matter intake. Ewes were fed 1 kg three times daily for eight days consisting of 54.5% corn silage, 27.3% tritacale haylage, 18.2% soy bean meal, and 200 mL of 3.5 M sodium acetate (energy control n = 4) or 2.0 M sodium propionate (gluconeogencic volatile fatty acid predicted to stimulate insulin secretion; n = 4). To test whether propionate feeding stimulated insulin secretion blood samples were collected four hours after ewes had consumed the morning feed. Plasma was isolated and RIA was utilized to determine insulin concentrations.

At four hours after feeding a treatment difference was observed ($p < 0.05$), indicating a 25% increase in insulin concentrations in the propionate group. The establishment of two different diets that are isocaloric with equal dry matter, but with one that stimulates insulin secretion, will allow us to investigate the influence of nutritionally modified insulin secretion on progesterone clearance, as well as the activity of enzymes involved in progesterone catabolism, in vivo.

Key Words: insulin, progesterone, catabolism

249 Use of indigenous South African plants to alleviate heat stress-induced subfertility in male mice. M. S. Santiago[1], K Cammack[2], E. Maricle[1], D. Fisher[3], and W Lamberson*[1], [1]*University of Missouri*, *Columbia*, [2]*University of Wyoming*, *Laramie*, [3]*University of the Western Cape*, *Cape Town, South Africa*.

Heat stress causes subfertility in males, causing significant economic losses in the U.S. dairy, beef, and swine industries. We have previously demonstrated that heat-stress reduces fertility of male mice. Four South African herbs were identified as candidates to mitigate the effects of heat stress: *Sutherlandia frutescens* (SF), *Tulbaghia violacea* (TV), *Helichrysum* (H) and *Artemesia afra* (AA). Our objective was to determine if feeding these herbs to male mice reduces the phenotypic effects of heat stress on fertility. Mature ICR male mice (n=36) were randomly assigned to one of six treatment groups: 1) thermoneutral (21°C) control; 2) heat stress (35°C for 24 hr = d 0) control; and 3-6) heat stress following five days of administering SF, TV, or H (dried plants mixed 1:4 with rodent chow), or AA (1% w/v decoction with water). Males were hemicastrated (d 1) and testes were collected for future gene expression analyses. Males proven fertile were each mated to 8 ICR females from d 18 to 26 post heat stress, a period during which subfertility was expected. Pregnant females were sacrificed on d 16 of gestation and numbers of ovulations, implantations and fetuses were counted. Mice subjected to heat stress without other treatment had reduced fertility compared to non-heat stressed controls (37 vs. 75 fetuses and 3.6 vs. 6.4 matings; $P<0.05$). Males given AA averaged 5.6 matings and 63.2 progeny, not significantly less than the number produced by non-heat stressed controls and significantly more than non-treated heat-stressed males. Treatment with *Artemesia afra* alleviated more than 70% of the reduction in fertility due to heat stress. These results suggest that treatment with *Artemesia afra* may have potential to reduce or prevent reductions in fertility resulting from heat stress in male mammals.

Key Words: heat stress, infertility, mouse

250 Hepatic gene expression in Holstein cows treated with bovine somatotropin (bST) and fed omega-3 fatty acids in early lactation. M. Carriquiry*, W. J. Weber, S. C. Fahrenkrug, and B. A. Crooker, *University of Minnesota*, *St. Paul*.

Multiparous cows were blocked by expected calving date and previous milk yield and assigned randomly to treatments to determine effects of bST and dietary fat on hepatic gene expression. Dietary fat was provided from calving and included whole, high-oil sunflower seeds (**SS**; 10% of dietary dry matter (**DM**); omega-6:omega-3 ratio of 4.7) as a source of linoleic acid or a mixture of Alifet-High Energy® and Alifet-Repro® (**AF**; 3.4 and 1.5% of dietary DM, respectively; omega-6:omega-3 ratio of 2.6) as a source of protected omega-3 fatty acids. Cows received 0 or 500 mg bST (POSILAC®) every 10 d from 12 to 70 d in milk ((**DIM**) and at 14-d intervals thereafter. Treatments from the 2 x 2 factorial combination of diet (SS or AF) with or without bST administration were designated as **SSY**, **SSN**, **AFY**, and **AFN**, respectively. Biopsies were collected (-12, 10, 24, and 140 DIM) when cows (n = 32, 8 blocks) were in positive and negative energy balance (**EB**). The amount of mRNA for growth hormone receptor (**GHR**), insulin-like growth factor-I (**IGF-I**), IGF-binding protein-3 (**IGFBP3**), peroxisome proliferator-activated receptors α (**PPARα**) and hepatic nuclear factor 4α (**HNF4α**) and an endogenous control (hypoxanthine phosphoribosyltransferase (**HPRT**) were measured by quantitative realtime RT-PCR. Relative amounts of mRNA for GHR, IGF-I, and IGFBP3 were reduced after calving and increased thereafter. Abundance of PPARα mRNA increased as lactation progressed. Administration of bST increased hepatic expression of GHR, IGF-I, and IGFBP3 mRNA by 10 d (24 DIM) of treatment and the effect was still present at 140 DIM. There was interaction of bST with diet on PPARα mRNA abundance as the amount of PPARα mRNA increased in AFN cows and decreased in AFY cows. The amount of hepatic HNF4α mRNA was not affected by stage of lactation, bST, or diet. Initiation of bST at 12 DIM increased hepatic mRNA abundance for components of the somatotropic axis even when cows were in negative EB.

Key Words: somatotropic axis, dietary fat, hepatic mRNA

251 Effects of swathed forage type; big bluestem, crested wheatgrass, or foxtail millet on intake and total tract digestion. B. W. Neville*, G. P. Lardy, T. C. Gilbery, M. L. Bauer, K. K. Sedivec, and J. S. Caton, *North Dakota State University*, *Fargo, ND, USA*.

Five ruminally and duodenally cannulated beef steers (529 ± 32 kg) were used in a 5 x 5 Latin square design (17-d periods) to determine intake and digestion of forages from a companion swath grazing study. Treatments were big bluestem (BB), big bluestem with protein supplement (BB+S), crested wheatgrass (CW), foxtail millet (FM), and native range (NR). Steers were offered ad libitum access to the treatment forages and for BB+S, a protein supplement (40% CP, cooked molasses block) was offered (0.16% BW). Intake of DM and OM followed similar patterns, NR was intermediate ($P \leq 0.01$) to BB and FM, but was not different ($P = 0.21$ DM; $P = 0.32$ OM) from CW (5.1, 6.0, 9.2, and 6.8 ± 0.4 kg DM/d; 4.6, 5.7, 8.5, and 6.2 ± 0.4 kg OM/d for BB, CW, FM, and NR, respectively). For CP intake, NR was intermediate ($P < 0.01$) to BB and FM, while CW was similar to NR ($P = 0.57$; 0.22, 0.41, 0.77, and 0.38 ± 0.03 kg CP/d for BB, CW, FM, and NR, respectively). Intake of NDF for NR was intermediate to BB ($P = 0.02$) and FM ($P < 0.01$), and similar to CW ($P = 0.39$; 3.7, 4.4, 6.4, and 4.8 ± 0.3 kg/d, respectively for BB, BB+S, CW, FM, and NR). Supplementation increased ($P < 0.01$) DM, OM, CP, and NDF intakes of BB+S compared to BB. Total tract OM digestibility was greater ($P < 0.01$) for FM vs. NR (66.5 vs. 52.4 ± 4.2%). Total tract

CP digestibilities were 26.5, 43.9, 43.1, 58.2, and 40.5 ± 6.0% for BB, BB+S, CW, FM, and NR respectively; with NR intermediate ($P \leq 0.03$) to BB and FM; however, CW was similar ($P = 0.67$) to NR, and supplementation increased ($P = 0.01$) CP digestibility. For total tract NDF and ADF digestibilities, FM was greater ($P < 0.01$) than NR (66.8 vs. 50.6 ± 5.1% NDF; 66.9 vs. 47.9 ± 5.5% ADF). Ruminal fluid dilution rate tended ($P = 0.06$) to differ; BB+S had increased dilution rate vs. BB (12.2 vs. 8.8 ± 1.2%). We conclude that FM was more digestible and resulted in greater DM intake when compared to BB, CW, and NR. Furthermore, the addition of a supplement increased DM, OM, and CP intake and total tract CP digestibility for steers fed BB, but not total tract digestibility of OM, NDF, or ADF.

Key Words: beef steers, digestibility, forages

Ruminant Nutrition

252 Prediction of optimal RDP levels in no-roughage feedlot diets. J. A. Pugh* and M. S. Kerley, *University of Missouri*, *Columbia*.

Roughage removal from corn-based diets is of interest due to the high nutrient cost of roughage. However, removing roughage requires regulation of starch fermentation to minimize digestive upsets. Our laboratory has conducted previous research demonstrating that rumen degradable protein (RDP) influenced fermentation rate and ruminal pH. The experimental goal was to evaluate the effect of increasing RDP level in a no-roughage corn-based diet on microbial efficiency. Five crossbred steers were fitted with ruminal and duodenal cannulas and used in a 5x5 Latin square design experiment. Dietary treatments were: control (98% corn; 4.4% RDP), low RDP (90.1% corn, 7.9% SBM; 6.6% RDP), mid RDP (82% corn, 16% SBM; 8.8% RDP), high RDP (73.9% corn, 24.1% SBM; 11% RDP), and NPN (96.3% corn, 1.7% biuret; 8.8% RDP). The control and NPN diets were designed to limit MOEFF. The RDP added diets were designed to demonstrate that MOEFF, once optimized by RDP level, would not be enhanced by increasing RDP. The NPN diet was used to compare non-protein to true protein nitrogen. Feed intakes, ruminal pH, VFA and peptide concentrations did not differ ($p \geq 0.10$) among treatments. True rumen OM digestibility for the control, low, mid, high, and NPN diets were 73.9, 67.3, 64.2, 71.4, and 82.4%, respectively. Ruminal ammonia (mM) increased ($p \leq 0.05$) with an increase in RDP. MOEFF values for control, low, mid, high, and NPN diets were 11.6, 18.8, 18.4, 18.1, and 13.0, respectively. These values showed that even though peptide concentrations were the same across treatments, and ammonia levels were adequate, the control and NPN diets did not reach the level of MOEFF that the SBM diets did. The ratio of predicted RDP (peptide) requirement to RDP supplied for the control, low, mid, high, and NPN diets was 0.81, 1.46, 2.25, 3.20, and 0.81, respectively. We concluded from these results that RDP-peptide requirement was predictable and that diets can be formulated to meet but not exceed this requirement.

Key Words: feedlot, RDP, no-roughage

253 Adaptation of feedlot cattle by limit-feeding a high-concentrate diet may alter nutrient absorption. J. O. Wallace*, W. F. Miller, C. D. Reinhardt, and B. J. Johnson, *Kansas State University*, *Manhattan*.

Four yearling steers (initial BW = 430 kg) were used in a 2×2 switchback design to compare the effects of a conventional step-up program to limit-feeding a finishing diet as a means of ruminal adaptation to high concentrate diets. Steers were individually fed either (1) three conventional step-up diets followed by a finishing diet (beginning with 60 and ending with 92% concentrate), starting at 1.5% of BW (STEP), or (2) limit-fed the finishing diet (92% concentrate), starting at 1.25% BW (LIMIT). Daily programmed increases of either 0.45 kg (STEP) or 0.23 kg (LIMIT) were provided when less than 0.23 kg of feed remained in the bunk. Following the 4 week period (7 d/step) steers were placed in an outdoor pen and fed prairie hay and soybean meal for 21d. After all cattle reached ad libitum intake of the finishing diet, DMI as a % of BW was unaffected by treatment. During week 1, valerate absorption was higher in the LIMIT steers (P = 0.02). However, following week 4 valerate absorption favored the STEP cattle (P = 0.05). Differences in total VFA and DMI during week 1 are a result of experimental design but the difference in valerate absorption after adaptation may suggest the conventional step-up diets are beneficial for rumen development and nutrient absorption. Limit-feeding a finishing diet to adapt cattle to a high concentrate diet is effective when comparing DMI to that of conventionally adapted cattle, but the resulting decrease in nutrient absorption may not compensate for the decrease in ration costs. In addition, application of a limit-fed diet may be difficult in large pen settings.

Weeks 1 and 4 Total VFA, valerate absorption, and DMI

Item	STEP	LIMIT	SEM	P-value
Week 1				
Total VFA (mM)	116.3	99.7	9.4	0.02
Val. abs. (%/hr)	0.27	0.46	0.06	0.02
DMI (%BW)	1.71	1.29	0.12	<0.01
Week 4				
VFA (mM)	99.9	107.8	2.8	0.03
Val. abs. (%/hr)	0.55	0.23	0.08	0.05
DMI (%BW)	2.61	2.80	0.12	0.12

Key Words: limit feeding, finishing diets, rumen development

254 Digestibility of fiber sources in high concentrate diets. J. W. Golden* and M. S. Kerley, *University of Missouri*, *Columbia*.

The removal of roughage and optimization of rumen undegradable amino acids (RUAA) in the feedlot diet has led to improved gain efficiencies that cannot be accurately described by net energy (NE) system calculations. We hypothesized that reduced fiber digestion could account for NE discrepancies. The objective of this study was to determine the fiber digestibility of concentrate diets in continuous culture. A single-flow continuous culture fermentation system operating at a fractional dilution rate of 0.04 was utilized. Four diets were formulated to meet the amino acid needs of a feedlot steer gaining 2.05 kgd^{-1}. All diets were corn and bloodmeal-based with diet one (H) containing 10% orchard grass hay, diet two (CSH) containing

cottonseed hulls equal to the undegradable fiber fraction of H, diet three (SH) containing soybean hulls equal to the degradable fiber fraction of H, and diet four (BM) containing no roughage. There was no difference ($P > 0.05$) in MOEFF (averaged 22.7), true ruminal DM, OM or fiber digestibility. Fiber digestibility was 20.1, 26.0, 15.9, and 21.8 % for BM, CSH, H, and SH diets, respectfully. The pH differed ($P < 0.05$) with the H treatment having the highest pH. Apparent DM and apparent OM digestibilities differed ($P < 0.05$) with the BM diet being greater than the other diets. Ammonia concentrations were greatest ($P < 0.05$) with the H diet. Total volatile fatty acid (VFA) concentration differed ($P < 0.05$) between BM, CSH, H, and SH treatments (118.0, 145.9, 140.8, and 144.3) with CSH and SH treatments having a higher VFA concentration when compared to BM. The fiber digestion was not different among the fiber sources, but was lower than predicted by NRC tables (i.e. 80% TDN for soybean hulls). The reduced NE value of fibrous feedstuffs, if adjusted, would account for approximately 4% of the discrepancy in NE estimates for growth and finishing in beef calves. However, a substantial percentage of efficiency gained when roughage is removed is due to factors other than reduced energy density of the diet.

Key Words: fiber digestibility

255 Response to dosing patterns of estradiol 17-beta and trenbolone acetate in finishing steers. S. L. Parr*, R. H. Prichard, and K. W. Bruns, *South Dakota State University*, *Brookings*.

Predominately Angus steers (n=192, BW = 372 kg) were used to evaluate the effect of implant dosing pattern on finishing steer performance and carcass traits. Cumulatively, all implant treatments provided 24 mg estradiol 17-beta (E_2) and 120 mg trenbolone acetate (TBA). The implant treatments (IMP) were 1) no implant; 2) 8 mg E_2 and 40 mg TBA administered on d 0, 42, and 84; 3) 12 mg E_2 and 60 mg TBA on d 0 and 63; and 4) 24 mg E_2 and 120 mg TBA on d 0. Steers were stratified by BW, then randomly assigned to IMP within two frame size (FS) categories and were on full feed at initiation of study. Blood was collected from 3 steers per pen on d -1, 41, 62, 83 and d 125 for plasma urea-N (PUN) determinations as a relative indicator of anabolism. Data were analyzed as a completely random design in a 2 x 4 factorial arrangement with factors of FS and IMP. No FS x IMP interactions occurred. Cumulatively (133 d), implanted cattle had higher ADG (1.42 vs. 1.58 kg; $P < 0.05$) and improved G:F (139 vs. 150 g/kg; $P < 0.05$) compared to control. Treatment 3 had lower DMI (10.30 vs. 10.83 kg; $P < 0.05$) and higher G:F (155 vs. 145 g/kg; $P < 0.05$) compared to IMP 4. Dosing pattern did not affect cumulative ADG but the pattern of growth differed. During 1 to 63 d, the change in ADG relative to control was 6.8, 5.0 and 11.8% for IMP 2, 3 and 4, respectively. From d 64 to 133, the response was 19.5, 16.6 and 11.3%, respectively. Implants caused heavier carcasses (350 vs. 365 kg; $P < 0.05$); HCW did not differ among implant treatments. Marbling (Modest^{30}) was not affected by IMP. Ribeye area was larger for IMP 3 and 4 (81.9 vs. 86.2, 85.8 cm^2; $P < 0.05$) compared to control. Treatment 2 and 3 caused lower PUN concentrations compared to control on d 62 (9.8 vs. 8.3, 8.4 mg/dL; $P < 0.05$). Cattle receiving multiple, low doses of E_2 and TBA had a slower decline in growth as days on feed increased vs. cattle receiving a single dose of E_2 and TBA. Pulsatile dosing shifts the growth pattern causing sustained anabolic response over the feeding period.

Key Words: anabolic implant, estradiol 17-beta, trenbolone acetate

256 Effects of are not confined to muscle tissue: Evidence for direct effects of ractopamine-HCl supplementation on fermentation by ruminal microorganisms. C. E. Walker*, M. J. Quinn, T. G. Nagaraja, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

Four experiments were conducted to evaluate the effects of ractopamine-HCl (RAC) on fermentation by ruminal microorganisms. In Exp. 1, an in vitro gas production assay was utilized to assess fermentative activity by ruminal microbes incubated with 0, 0.0339, 0.3339, 3.339, or 33.39 mg RAC/g corn DM. RAC had a quadratic effect on in vitro gas production ($P < 0.05$; 177, 181, 185, 190, and 170 ml for 0, 0.0339, 0.3339, 3.339, and 33.39 mg respectively). Exp. 2 utilized a 6-h in vitro batch culture system to measure the effects of 0, 0.0339, 0.3339, 3.339 mg RAC/g corn DM on production of VFAs. VFA profiles were not changed with RAC supplementation ($P > 0.50$). Exp.3 evaluated ruminal concentrations of VFA from 60 heifers fed high concentrate diets with or without 200 mg/d Optaflexx. Heifers were sampled on 2 occasions, 3 weeks apart, approximately 23 h after feeding. Ruminal VFA concentrations were lower 23 hr after feeding for heifers fed RAC ($P = 0.014$). In Exp. 4, an in vitro assay was used to evaluate DM disappearance when RAC was added at 0, 0.0339, 0.3339, and 3.339 mg RAC/g substrate DM, along with 4 substrate combinations: corn, corn + soybean meal, corn + urea, and corn + soybean meal + urea. Samples were incubated for 2, 4, 6, 8, or 12 h. There was an interaction between RAC concentration and nitrogen source ($P < 0.01$), with more degradable forms of N eliciting greater responses from RAC. Significant main effects also were detected for RAC concentration, substrate type, and hour of fermentation ($P < 0.001$). Interactions between protein source and RAC suggest that maintaining adequate levels of rumen degradable protein may be necessary to achieve optimal response to Optaflexx. These studies clearly indicate that RAC has a direct influence on fermentation by ruminal microflora.

Key Words: ractopamine-HCl, rumen fermentation, cattle

257 Performance changes through the finishing period. J. C. MacDonald*, T. J. Klopfenstein, G. E. Erickson, and K. J. Vander Pol, *University of Nebraska*, *Lincoln*.

Three research trials representing three years, 115 pens, and 920 steers were compiled to determine changes through the feeding period in BW, ADG, DMI, and G:F on a shrunk BW and carcass weight basis. All steers were weighed at approximately 30-d intervals. Interim carcass weights were calculated using dressing percentages determined from the equation $y = 0.97x + 54.7$ where x is days on feed expressed as a percent of total. This equation was derived from two published serial slaughter feeding trials. All data were expressed as a percentage of total days on feed. Regression analysis was conducted with the mixed procedures of SAS with repeated measures for all variables. No variables had polynomials greater than first order ($P < 0.05$). Both BW and carcass weight increased linearly through the feeding period ($P < 0.01$). However, while BW ADG decreased through the feeding period ($P < 0.01$), carcass weight ADG remained constant ($P = 0.33$) resulting in a linear increase in the percent of BW gain that is transferred to the carcass ($P < 0.01$). Dry matter intake increased linearly through the feeding period ($P < 0.01$) and feed efficiency decreased linearly when calculated on either a BW or carcass weight basis ($P < 0.01$). However, the decline in feed efficiency when calculated on a carcass weight basis was 26.5% the decline in feed efficiency when calculated on a BW basis. While performance decreases through the feeding period, the decline is more dramatic when calculated on a live BW

basis vs. a carcass basis. Transfer of BW gain to the carcass may approach 100% near the end of the feeding period.

Change in performance variables during the feeding period.

Item	Intercept	SE	Slope[1]	SE
BW, kg	345	5	2.56	0.02
Carcass weight, kg	182	3	2.01	0.01
BW ADG, kg	2.25	0.09	-0.006	0.001
Carcass ADG, kg	1.45	0.04	0.0004	0.0004
Weight transfer, %[2]	62.1	0.03	0.003	0.0001
DMI, kg/d	10.0	0.22	0.024	0.001
BW G:F[3]	0.216	0.006	-0.0008	0.0001
Carcass G:F[4]	0.143	0.003	-0.0002	0.0001

[1]Percent of time on feed. [2]Percent of BW gain transferred to carcass. [3]Calculated from BW gain. [4]Calculated from carcass weight gain.

Key Words: feedlot, performance, carcass

259 Relationship between metabolizable protein balance and feed efficiency in individually-fed steers and heifers. G. I. Crawford*, S. A. Quinn, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

Data from two experiments were analyzed to determine the relationship between metabolizable protein (MP) balance and feed efficiency (G:F; g/kg). In exp. 1, 29 crossbred steers (337 ± 14 kg) were individually fed steam flaked corn (SFC)-based diets containing either 0 (NEG) or 1.2% (POS) urea for 83 d, resulting in CP levels of 9.8 and 11.9% for NEG and POS treatments, respectively. In exp. 2, 75 crossbred heifers (407 ± 32 kg) were individually fed SFC-based diets containing either 0 (NEG) or 1.5% (POS) urea for 84 d, resulting in CP levels of 9.6 and 13.7% for NEG and POS treatments, respectively. To determine the relationship between MP balance and G:F, individual animal ADG and DMI were used as performance inputs to the 1996 NRC model. Individual animal final BW was adjusted to an equal (28%) empty body fat. The resulting MP balance from the model was plotted against corresponding G:F for that animal. In exp. 1, G:F measured 161.9 and 177.3 for NEG and POS ($P = 0.16$), respectively. A relationship ($P < 0.05$) between MP balance and G:F was observed with both the NEG ($r^2 = 0.95$) and POS ($r^2 = 0.60$) treatments. In both cases, an increase in G:F was associated with a decrease in MP balance. Regression equations were y = -0.293x + 114.2 for NEG and y = -0.181x + 197.2 for POS, where y = G:F and x = MP balance (g). In exp. 2, G:F was greater ($P < 0.05$) with POS (181.8) compared with NEG (140.5). Both NEG (y = -0.418x + 91.6; $r^2 = 0.46$) and POS (y = -0.250x + 199.8; $r^2 = 0.40$) exhibited negative correlations ($P < 0.05$) between MP and G:F. The more negative MP balance is primarily due to greater ADG for cattle with greater G:F. Variation in ruminal pH, relative feed intake, and conversion of MP to net protein are the most probable causes for the negative relationship between G:F and MP balance.

Key Words: cattle, feed efficiency, metabolizable protein

260 Influence of sanitizing feedlot pens on microbial populations and cattle performance. M. S. Lee*[1], J. K. Apple[1], J. W. S. Yancey[1], J. T. Sawyer[1], M. M. Brashears[2], and T. P. Stephens[2], [1]*Department of Animal Sciences*, *Fayetteville, AR*, [2]*Animal and Food Sciences*, *Lubbock, TX*.

Ninety crossbred steers (initial BW of 199 kg), purchased from salebarns throughout Arkansas, were used to test the effects of pen sanitation on microbial populations and cattle performance. Steers were blocked by weight into 5 blocks and assigned to pens of 6 steers within each block. Then, within blocks, pens were randomly assigned to 1 of 3 sanitation treatments: 1) untreated control pens; 2) pens treated with 1% cetylpyridinium chloride (CPC); or 3) treated with 5% lactic acid (LA). Sterile drag-swabs were collected 24 h after placement of steers in sanitized and control pens (designated as d 1), as well as 21 d after placement and the end of the trial (d 50). Two days after cattle removal, pens were re-sanitized, and drag swabs were collected 3 d later (d 55). On each collection day, swabs were plated for enumeration of total coliform, generic *E. coli*, and aerobic plate counts (APC), as well as *E. coli* O157:H7. Additionally, steers were weighed initially (d 0), as well as on d 14, 28, and 50 for calculation of ADG. There was no effect of pen sanitation treatment on APC ($P = 0.51$), generic *E. coli* ($P = 0.55$), or total coliform ($P = 0.44$) counts. Compared to the uncovered portion of the pens, the covered area had lower ($P < 0.05$) generic *E. coli* counts on d 1, 50, and 55 of the trial, whereas, APC and total coliform counts were less ($P < 0.05$) every collection day (location × day, $P < 0.01$). On d 1, there was a 2.5 log reduction ($P < 0.05$) in *E. coli* O157:H7 by treating pens with either CPC or LA; however, *E. coli* O157:H7 counts were similar on d 28, 50, and 55 of the trial (treatment × day, $P < 0.01$). Additionally, ADG was greater in steers fed in LA-treated pens after 14 ($P = 0.05$) and 28 d ($P = 0.10$) than those fed in CPC-treated pens. Results of this experiment suggest that sanitizing drylot pens prior to cattle placement may provide a cleaner environment for growing cattle, resulting in possible improvements in cattle performance as well as animal contamination reduction with pathogenic bacteria.

Key Words: *E. coli* O157:H7, pen sanitation, cattle

261 Effect of corn hybrid and processing method on finishing cattle performance and carcass characteristics. F. W. Harrelson*[1], M. K. Luebbe[1], G. E. Erickson[1], T. J. Klopfenstein[1], and W. A. Fithian[2], [1]*University of Nebraska*, *Lincoln*, [2]*Golden Harvest Seeds Inc.*, *Waterloo, NE*.

Corn hybrid as well as processing has been shown to influence cattle performance. A finishing trial was conducted to determine interactions between processing method and corn hybrid on performance and carcass characteristics. Yearling steers (379 kg BW; n=475) were used in a 2 × 5 factorial design, with factors including 2 processing methods (high-moisture, HMC, or dry-rolled corn, DRC) and 5 commercially available hybrids (H-8562, H-8803, H-9230, H-9485, and 33P67). Hybrids were grown at the University of Nebraska Agricultural Research and Development Center using identity preserved methods for growing and storage. Grain was harvested at 70% DM (HMC) or 84% DM (DRC). Steers were blocked by BW and assigned randomly to pens(10 treatments; 6 pens/treatment). Cattle were implanted with

Revalor S® on d 22 and were fed 127 d (heavy block) or 134 d (light block). Diets included 20% wet corn gluten feed, 7.5% alfalfa hay, and 5% supplement with the remainder being the corn hybrid tested. No significant hybrid × processing method interactions were observed. Processing method did influence performance, with cattle fed HMC having lower ($P < 0.01$) DMI and greater ($P < 0.01$) G:F than steers fed DRC. However, ADG was similar ($P = 0.18$) between DRC and HMC fed steers. Cattle fed HMC diets were also fatter ($P < 0.01$) than steers fed DRC, however there were no differences in HCW ($P = 0.16$) or marbling score ($P = 0.21$). With respect to hybrid differences due to processing, HMC improved G:F between 2.26 to 8.53 % compared to steers fed DRC within each hybrid; with hybrid H-8803 having the most improvement and hybrid 33P67 improving the least. Steers fed hybrid H-9485 were numerically most efficient (0.161) while steers fed hybrid H-8803 were the least efficient (0.155), but not statistically different. These results confirm that processing method impacts cattle performance while hybrid had no significant effect on finishing performance in this study.

Key Words: corn hybrid, corn processing, finishing cattle

262 Growth and carcass quality of steers finished with corn or high-tannin sorghum. R. Larraín*, D. Schaefer, and J. Reed, *University of Wisconsin*, *Madison*.

The objective of this study was to test if finishing diets containing half or all grain as high-tannin sorghum (HTS) affect growth of steers and carcass quality. Steers (n=42) were randomly allocated to 4 diets containing: 132 g/kg supplement, 100 g/kg corn silage and 768 g/kg grain. Grains were corn (C, control), HTS (S) and a 1:1 mix (CS). A fourth corn diet was supplemented with 2000 IU•animal^{-1}•d^{-1} vitamin E (E). Animals were individually penned. Feed was offered once daily. If bunks were clean 2 consecutive mornings, about 450 g were added to the daily ration. Initial and final BW were the average of 2 weights before feeding in consecutive days. Animals were also weighed at d 14, 28, 56, and 84. Animals were killed in 2 groups after 102 and 123 d. Reductions of 5.2% and 7.6% of BW were observed in S steers compared to C after 56 and 84 d (P=0.043 and 0.007). Average daily gain was reduced from 1.86 ± 0.06 kg/d in C to 1.47 ± 0.06 in S (P<0.001). Average daily feed intake was not affected by diet. Gain:Feed ratio (G:F) was reduced from 0.193 ± 0.005 in C to 0.166 ± 0.005 in S (P=0.001). When G:F was compared within weight period, S was not lower than C between d 28 and 56 and CS was higher than C at the same period (0.236 ± 0.011 vs 0.197 ± 0.011, P=0.016). Ribeye area, marbling score, kidney-heart-pelvic fat (%), calculated yield grade and longissimus pH were not different between treatments and C. Shrunk BW was lower in S than C (572 ± 10.3 vs 612 ± 9.9 kg, P=0.022). Hot carcass weight was lower in S than C (339 ± 6.2 vs 370 ± 5.9 kg, P=0.002). Trimmed weight was reduced from 355 ± 5.8 kg in C to 327 ± 6.1 kg in S (P=0.005). Dressing was lower in CS than C (58.1 ± 0.5 vs 60.5 ± 0.5 %, P= 0.008). Backfat was thinner in S than C (0.76 ± 0.08 vs 1.03 ± 0.07 cm, P=0.041). Yield grade assigned by USDA was reduced from 2.5 ± 0.18 in C to 1.5 ± 0.18 in S (P=0.001). Feeding HTS as the only grain in finishing diets for steers reduced growth and affected carcass attributes. Using a 1:1 corn:HTS ratio produced animals of similar weight and quality as using only corn.

Key Words: proanthocyanidins, sorghum, steers

263 Effect of corn hybrids and kernel traits on digestibility. F. W. Harrelson*[1], G. E. Erickson[1], T. J. Klopfenstein[1], D. S. Jackson[1], and W. A. Fithian[2], [1]*University of Nebraska*, *Lincoln*, [2]*Golden Harvest Seeds, Inc.*, *Waterloo, NE*.

Recent research has provided evidence that corn kernel traits, which vary between hybrids, can affect digestibility. An experiment was designed to identify kernel traits which may predict performance based on digestibility. Approximately 132 commercially available hybrids were grown in 2 replicate plots within 3 separate locations (Iowa, Illinois, and Nebraska), sampled at harvest and transported to the University of Nebraska for laboratory analysis. Kernel traits measured were 1,000 kernel weight, Stenvert hardness evaluation, oil and protein extractions, starch, and extractable starch analysis. Samples were analyzed in duplicate for each test. Based on results from the trait analysis, 30 hybrids were selected, representing a wide range in trait measurements, for in situ dry matter disappearance (DMD) analysis. A hybrid×location interaction was observed for most traits. Hybrid and location significantly influenced kernel weight, percentage hard, oil, protein, and starch ($P < 0.01$). DMD was also impacted ($P < 0.01$) by hybrid, location, and a hybrid×location interaction. Kernel weight was negatively correlated to hard percentage ($P < 0.01$), and starch content ($P < 0.01$), however the relationship was not strong for either ($r = -0.10$). Kernel weight was also positively correlated with oil content ($P < 0.01$). The hard percentage was also negatively correlated with the oil content ($P = 0.01$), though the relationship was weak ($r = -0.12$). DMD was negatively correlated to protein content ($P < 0.01$), and positively correlated to starch ($P < 0.03$) and extractable starch ($P < 0.01$), though none of the relationships were strong ($r = -0.26$, $r = 0.18$, and $r = 0.22$ respectively). There were no significant relationships between other kernel traits and DMD. The results of this study indicate that hybrids perform differently based on location and that this interaction can influence digestibility.

Key Words: corn hybrid, digestibility, finishing cattle

264 Liver abscess score and carcass characteristics of feedlot cattle. M.S. Davis*, W.C. Koers, K.J. Vander Pol, and O.A. Turgeon, Jr., *Koers-Turgeon Consulting Services, Inc.*, *Salina, KS*.

Effects of liver abscess incidence on hot carcass weight (HCW), quality grade (QG), yield grade (YG), marbling score (MS), loin muscle area (LMA), and 12th rib fat (BF) were evaluated by compiling individual carcass measurements and liver abscess score (LAS) from trials conducted at Bos Technica Research Services, Inc. Hot carcass weight, QG, YG, and MS were obtained on 20,455 steers (14 trials) and 9103 heifers (12 trials). Backfat, LMA, and KPH were obtained on 16,294 steers (10 of 14 trials) and 4608 heifers (5 of 10 trials). Trained personnel collected LAS using the following criteria; 0 = no abscess; A- = one or two small abscesses; A = two to four well organized abscesses; A+ = one or more large, active abscesses with inflamed liver tissue or liver was adhered to the diaphragm. Livers receiving an A+ designation were segregated by presence (AD) or absence (NO AD) of an adhesion. All cattle received 90 mg tylosin/d and were fed a minimum 96% concentrate diet. Days on feed for steers and heifers averaged 185 (min. = 142; max. = 229) and 169 (min. = 110; max. = 189), respectively. Percentage of steers with LAS of 0, A-,

A, and A+ were 87.5, 6.2, 2.5 and 3.8% (A+ NO AD = 1.2%; A+ AD = 2.6%), respectively. Hot carcass weight of 0, A- and A steers were similar (avg. = 364.2 kg), however HCW of A+ NO AD and A+ AD were reduced 3.2 ($P \leq 0.10$) and 13.2 ($P \leq 0.01$) kg, respectively. Liver abscess score did not affect MS and BF of steers, but LMA was reduced 2.19 cm^2 ($P \leq 0.01$) for A+ AD. Percentage of heifers with LAS of 0, A-, A, and A+ were 89.8, 5.9, 1.5, and 2.8% (A+ NO AD = 0.7%; A+ AD = 2.1%), respectively. Hot carcass weight of 0, A- and A heifers were similar (avg. = 333.8 kg) and averaged 11.3 kg heavier ($P \leq 0.01$) than A+ AD heifers. Liver abscess score did not affect MS of heifers. Heifers with A- LAS had larger ($P \leq 0.05$) LMA than A LAS heifers. Effects of LAS on QG or YG of steers and heifers were equivocal. Severe liver abscesses represent considerable reductions in HCW of feedlot cattle with no affect on quality grade

Key Words: liver abscesses, finishing steers, finishing heifers

265 An overview of fatty acid biotransformations in the rumen. T. C. Jenkins* and Y.-J. Lee, *Clemson University*, *Clemson, SC*.

Lipid reaching the intestines of ruminant species is similar in quantity but dramatically different in structure compared with lipid consumed. Dietary lipid consists mainly of polyunsaturated fatty acids esterified as triaclyglycerols in cereal grains and galactolipids in forages. Upon entering the reticulo-rumen, dietary lipid is hydrolyzed releasing free fatty acids that are then susceptible to structural rearrangement via enzymes of microbial origin. Rearrangements result from the action of isomerases that shift double bond location to conjugated positions and alter geometrical orientation from *cis* to *trans*. Recent attention has been given to enzymatic hydration and oxidation reactions in the rumen resulting in the formation of hydroxy and keto fatty acyl derivatives. Ruminal losses of linoleic and linolenic acids average 85 and 96% of intake, respectively. Apparent ruminal loss of oleic acid is lower in most duodenal flow studies due to a significant intestinal flow of a metabolic oleic acid fraction. The metabolic oleic acid fraction most likely is due to microbial synthesis of an octadecenoic acid isomer that was indistinguishable from oleic acid in most studies, and the possibility of *trans* to *cis* isomerization of the *trans*-9 C18:1 isomer. True ruminal loss of oleic acid, after accounting for the metabolic fraction, is similar to linoleic acid (85%). As many as 15 conjugated linoleic acid (CLA) isomers have been identified in ruminal contents of cattle with a mean daily production of about 15 g/day. The *cis*-9, *trans*-11 CLA isomer is usually present in greatest proportion followed by the *trans*-10, *cis*-12 CLA isomer. Production and proportion of CLA isomers are influenced by pH and fatty acid concentrations in ruminal contents. Research to identify transformation intermediates and their regulation, especially for the omega-3 fatty acids, continues to be a priority.

Key Words: rumen, lipid, biohydrogenation

266 Feeding fats for regulation of milk fat and fatty acid profiles. A. R. Hippen*, K. F. Kalscheur, and D. J. Schingoethe, *South Dakota State University*, *Brookings*.

The impact of lipids in diets of dairy cows on milk fat has been recognized for some time. Feeding marine oils has been observed to decrease milk fat dramatically, but may also alter the fatty acid composition of milk fat. Likewise, dietary sources of vegetable oils, blends of animal and vegetable fats, grease, and tallow have been demonstrated to have similar effects, though to lesser degrees as saturation or hardness of the fat increases. With decreasing concentrations of fat in milk as unsaturation of dietary lipid increases, spreadability of butter from milk increases. The first effect, milk fat depression, has long been attributable to effects of polyunsaturated fats on ruminal organisms, fiber digestion, and fermentation profiles that were less amenable to milk fat synthesis. The second effect, lower melting point for butters, has been attributed to increased content of dietary unsaturated fatty acids and decreased content of fatty acids from mammary de novo synthesis as available substrate decreased. As researchers abilities to identify isomers of fatty acids along with methods to define processes of fatty acid synthesis have evolved, so has understanding of mechanisms of milk fat depression and alteration of milk fatty acids. These advances have included identification of isomers of 18 carbon fatty acids having trans and conjugate configurations that have profound effects on milk fat synthesis. These isomers are the result of a combination of ruminal biohydrogenation of dietary lipid and mammalian cellular processes. Manipulation of these processes is possible by feeding sources of lipids with varying content of precursor fatty acids, specifically linoleic and linolenic acids, allowing regulation of milk fat concentrations and milk fatty acid profiles. Fortunately for the dairy industry, some of the unique fatty acids that result from these alterations have positive impacts on human health. The dairy industry is entering an exciting age of designer dairy products with enhanced fatty acid profiles by manipulation of lipid nutrition of the dairy cow.

Key Words: lipid, diet, dairy cow

267 Modification of insulin resistance in dairy cattle by manipulation of plasma nonesterified fatty acids. J. A. Pires and R. R. Grummer*, *University of Wisconsin*, *Madison*.

Periparturient dairy cows may develop fatty liver during elevated plasma nonesterified fatty acids (NEFA). Elevated plasma NEFA is primarily due to increased adipose lipolysis and reflects changes in endocrine status of the cow. Insulin resistance (IR) at or immediately after parturition is well documented in nonruminant mammals and appears to occur in ruminants. The ability of insulin to inhibit hormone sensitive lipase and suppress NEFA release from adipose tissue is impaired in IR states. IR probably contributes to elevated plasma NEFA in periparturient dairy cows. Both short and long term elevation of plasma NEFA causes IR in nonruminants. If this occurs in ruminants, IR could lead to a vicious cycle where higher plasma NEFA would promote greater mobilization of body reserves, potentially leading to metabolic disorders such as fatty liver. To test this hypothesis, we used

five nonlactating, nongestating Holstein cows in a crossover design. Treatments were iv infusion of saline or triglyceride (TG) emulsion derived from tallow. Infusion of TG emulsion induced IR. Because infusion of TG emulsion increased plasma NEFA and TG, NEFA couldn't specifically be implicated as the causative agent for IR. Next, we feed restricted cows to elevate plasma NEFA, and examined insulin responsiveness after postruminal infusion of saline or nicotinic acid (NA) to lower plasma NEFA. NA treatment reduced NEFA and increased insulin sensitivity, as measured by glucose tolerance test. NA is a possible feed additive to reduce plasma NEFA; however, it is degraded in the rumen and must be supplied postruminally. Additionally, after a pulse dose of NA to the abomasum, there was an initial decline followed by a dramatic increase in plasma NEFA (> 1000 uEq/L). Therefore, NA must be continuously supplied postruminally to achieve a sustained reduction in plasma NEFA. Using this approach, plasma NEFA of feed restricted cows were 553 and <100 uEq/L during an 8 h postruminal infusion of saline or NA (6 mg/kg/h). Reduction of plasma NEFA may decrease the likelihood of fatty liver directly by reducing hepatic uptake of NEFA and indirectly by modifying IR.

Key Words: insulin resistance, fatty acid, niacin

268 Reproductive responses by beef cows fed lipid supplements. B. W. Hess*, *University of Wyoming*, *Laramie, WY*.

Provision of supplemental lipid to the beef cow has been investigated as a management strategy to improve reproduction. Mechanisms by which lipid supplementation affects reproductive performance of beef cows seem to involve increased functional capacity at the ovarian level. Results of experiments conducted to elucidate potential reproductive responses of postpartum beef cows to supplemental lipid generally indicate that cows will have increased numbers of ovarian follicles in the larger classification groups. Although supplementing lipid to beef cows in estrus often stimulates ovarian follicular growth and development, luteal responses have been inconsistent. Supplementing lipid to postpartum beef cows has not typically influenced length of postpartum anestrus. Likewise, it is often reported that overall pregnancy rates are not affected by feeding supplemental lipid to postpartum beef cows. In some cases, circulating concentrations of $PGF_{2\alpha}$ metabolite (PGFM) increase in beef cows fed supplemental lipid. A transient increase in PGFM during the period when the uterus involutes, however, does not seem to impact subsequent reproductive processes. Alternatively, increased PGFM may be related to decreased first service conception rate if corpus luteal regression ensues. Evidence is also beginning to indicate that supplementing lipids high in linoleic acid influence IGF-I within many critical tissues of the reproductive axis. Potential reproductive impacts associated with perturbations in the IGF-I system as a result of feeding postpartum beef cows supplements high in linoleic acid remain to be determined. Although feeding lipid supplements to postpartum beef cows cannot be recommended as a method to improve reproduction, overall pregnancy rates have not been affected. The decision to include supplemental lipid in the diet of postpartum beef cows should be based on whether or not this strategy is economically feasible and compatible with a producer′s supplemental feeding program.

Key Words: beef cows, fat supplements, reproduction

269 Dietary fat and bovine somatotropin (bST) for Holstein cows: Responses in early lactation. M. Carriquiry*, W.J. Weber, and B.A. Crooker, *University of Minnesota*, *St. Paul*.

Dietary fat and bST administration have the potential to improve milk yield and reproductive performance. Meta-analysis indicated initiation of bST before 35 DIM increased milk (2.5 ± 0.6 kg/d) and 3.5% FCM (3.4 ± 0.7 kg/d) yields during the first 70 to 90 DIM and increased milk fat (0.35 ± 0.10%) but not milk protein. There was no effect of bST on DMI or BW loss. Energy balance (**EB**) nadir was not altered but bST prolonged the interval of negative EB and decreased EB during the first 70 to 90 DIM. Dietary fat increased FCM and milk yields and did not modify effects of bST on production except for a decreased effect on milk fat content and yield. In our study, fat was provided at calving as whole sunflower seeds (10% of dietary DM; source of linoleic acid) or a mixture of Alifet-High Energy® and Alifet-Repro® (3.4% and 1.5% of dietary DM, respectively; source of linolenic, EPA and DHA; **AF**) and bST was initiated at 12 DIM. Fat source did not affect milk yield or composition. Dietary AF provided more NEL at actual production intakes, decreased the impact of bST on overall EB, increased linolenic, EPA and DHA content in milk fat, and reduced the omega-6 to omega-3 fatty acid ratio in milk. Dietary AF decreased the number of medium size follicles, increased growth rate and size of ovulatory follicles, and increased CL development during the early luteal phase. Incidence of estrous cycles with 3-follicular waves was increased in bST-treated cows fed AF. This should produce smaller, younger oocytes and benefit reproductive performance. Hepatic PPARα mRNA increased in cows fed AF fed but decreased in AF cows treated with bST. Thus PPARα might be involved in mediating some interactions of bST and dietary fat. In contrast to the prevalent perception, but similar to effects of bST during mid or late lactation, initiation of bST at 12 DIM increased milk (0.8 kg/d) and FCM yields (3.5 kg/d) through 70 DIM and increased plasma IGF-I and hepatic mRNA abundance for the GH receptor, IGF-I, and IGFBP3 even when cows were in negative EB.

Key Words: milk yield, ovarian activity, hepatic gene expression

270 Fat from corn coproducts and dairy cow performance. M. Abdelqader*, *South Dakota State University*, *Brookings*.

Feeding fat to dairy cows is a common practice to increase the energy density of the ration. Vegetable oil, oilseeds, and soaps of long-chain fatty acids (FA) are common fat sources used in dairy cow diets. Feeding fat supplements often alter rumen fermentation that results in alteration of the ruminal biohydrogenation process. The extent to which fat supplements can alter the ruminal microbial ecosystem is highly dependent on the amount and form of fat being supplemented. Feeding fat supplements rich in linoleic and linolenic acids cause modifications in milk FA profile with increased concentrations of unsaturated FA and decreased concentrations of saturated FA. It is well documented that these changes in milk FA profile will increase the concentrations of health-beneficial FA such as conjugated linoleic acid (CLA) and vaccenic acid. Unfortunately, fat supplementation is frequently linked to a decrease in milk fat percentage. Milk fat depression has been highly correlated to an increase in the concentrations of trans-10 C18:1 FA and trans-10, cis-12 CLA. Several dietary factors can influence the response of milk fat to increasing

concentrations of both trans-10 C18:1 FA as well as trans-10, cis12 CLA. Alternative fat sources are becoming available in the form of corn coproducts such as corn germ (CG), and dry and wet distillers grains (DGS). Corn coproducts are major sources of linoleic acid, which is a precursor of CLA and C18:1 isomers. Feeding DGS in properly formulated rations has shown no adverse effect on milk fat percentage or yield. Milk fat depression, however, was reported when DGS was fed in combination with low forage diets. Research data on CG is lacking and no data have been published evaluating the potential of CG as a fat source in dairy feeds. The potential of using CG as an alternative fat source and its effect on milk fat and milk FA is currently under investigation. Preliminary results demonstrated that CG could be used as an alternative fat source in dairy diets, providing as much as 2.8% additional dietary fat without causing milk fat depression.

Key Words: DGS, corn germ, dairy cows

271 WITHDRAWN

272 Influence of linoleic and high-oleic acid sunflower oil on site and extent of organic matter and fatty acid digestion in steers fed high-grain diets. E. R. Loe*[1], J. S. Drouillard[2], B. E. Depenbusch[2], M. J. Quinn[2], A. S. Webb[2], and P. H. Walz[3], [1]*South Dakota State University*, *Brookings*, [2]*Kansas State University*, *Manhattan*, [3]*Auburn University*, *Auburn, AL*.

Six steers cannulated in the rumen, proximal duodenum, and distal ileum were used in a replicated, 3 × 3 Latin square experiment to measure the effects of sunflower oil on fatty acid (FA) digestion in steers fed high-grain diets. Dietary treatments were 1) no-added lipid (control); 2) 2.5% linoleic acid sunflower oil (62% linoleic acid); and 3) 2.5% high-oleic acid sunflower oil (81% oleic acid). Diets were based on steam-flaked corn and contained 8% alfalfa hay. Duodenal, ileal, and fecal samples were collected over 48 h with ruminal pH and VFA being measured on the last d of each of the three 14-d periods. Ruminal pH (mean pH = 5.5), total VFA, and acetate to propionate ratio were not affected by treatment ($P \geq 0.39$). Total FA intakes were 359, 555, and 581 ± 34 g/d and duodenal flows were 368, 475, and 482 ± 36 g/d for control, linoleic, and high-oleic sunflower oils, respectively (sunflower oil effect; $P \leq 0.002$). Oleic acid intake was greater when steers were fed high-oleic sunflower oil vs linoleic sunflower oil ($P < 0.001$) and for sunflower oil vs control ($P < 0.001$). Duodenal flows of oleic acid were 23, 28, and 36 ± 4 g/d for control, linoleic, and high-oleic sunflower oil, respectively (tendency for sunflower oil effect, $P \leq 0.07$). Duodenal flows of stearic acid and total FA were 153 and 137% greater, respectively, for sunflower oil compared with control ($P \leq 0.008$). Small intestinal digestion of total, saturated, unsaturated, monounsaturated, and trans FA were decreased 24, 32, 10, 10, and 14%, respectively, with supplementation of sunflower oil ($P \leq 0.05$). Ruminal biohydrogenation (BH), expressed as percent of total C18 FA, was not affected by diet ($P \geq 0.21$; mean BH = 65.0%); however, quantity (g/d) of unsaturated FA ruminally BH was greater for oil supplementation ($P < 0.001$), with high-oleic greater than linoleic sunflower oil ($P = 0.04$). Sunflower oil, regardless of FA profile, is extensively ruminally BH. In order to increase flow of saturated FA to the small intestine, it seems that sunflower oil needs to be fed in a protected form.

Key Words: cattle, fatty acids, sunflower oil

273 Effect of supplemental fat from dried distillers grains with solubles or corn oil on cow performance, IGF–1, GH, and NEFA concentrations. A. Bartosh*, C. Wright, A. Wertz-Lutz, and G. Perry, *South Dakota State University*, *Brookings*.

Research has demonstrated that supplemental fat and(or) changes in GH or IGF–1 concentrations may affect reproductive performance in beef females. Dried distillers grains with solubles (DDGS) contain approximately 10% to 15% fat; however, minimal research to date has investigated DDGS specifically as a supplemental fat source. The objective of this experiment was to investigate whether supplemental fat from either DDGS or raw corn oil impacts cow performance, plasma GH, IGF–1, or NEFA concentrations. Sixty open beef cows (BW = 553.5 ± 38.7 kg; BCS = 5.4 ± 0.53) were stratified by BW and BCS and allotted to 15 pens (n = 4 per pen; 14.6 m × 37.2 m). Pens were randomly assigned to one of three dietary treatments: 1) DDGS, 2) a combination of high-protein dried distillers grain, corn bran, and corn oil (OIL), or 3) a combination of high-protein dried distillers grain and corn bran (HPBRAN). The DDGS, OIL, or HPBRAN treatments comprised 35% of the diet DM. Thirty-five percent was selected based upon the S content of dietary ingredients and water, estimated water intake, and the maximum tolerable S concentration for cattle on forage-based diets (0.5%). In addition to dietary treatments, cattle were provided grass hay (7.7% CP) and a pelleted supplement containing vitamins and minerals as part of a totally mixed ration. Cows were fed once daily, in the morning, for 60 d. All diets were iso-nitrogenous (15.3% CP from d 0 to 47 and 15.1% from d 48 to 60) and total diet fat concentrations were 5.1% for DDGS and OIL and 3.5% for HPBRAN. Weights and blood samples were taken prior to feeding on d -1, 0, 28, 59, and 60. Dry matter intake, ADG, final BW, and G:F were not ($P > 0.05$) affected by treatment. Treatment had no effect ($P > 0.05$) on plasma GH, IGF–1, or NEFA concentrations. These results suggest that providing low concentrations of supplemental fat, as DDGS or raw corn oil, to a forage-based diet does not influence animal performance, plasma GH, IGF–1, or NEFA concentrations in open cows.

Key Words: fat, distillers grains, cows

274 Effect of CRINA RUMINANTS AF, a mixture of essential oil compounds, on ruminal fermentation and digestibility. N. F. Meyer*[1], G. E. Erickson[1], T. J. Klopfenstein[1], P. Williams[2], and R. Losa[3], [1]*University of Nebraska*, *Lincoln*, [2]*DSM Nutritional Products, Inc.*, *Parsippany, NJ*, [3]*CRINA SA*, *Gland, Switzerland*.

Eight ruminally fistulated beef steers were used in a metabolism experiment to determine effects of an essential oil feed additive in altering ruminal fermentation characteristics and nutrient digest-

ibilities in finishing beef steers compared with no additives or feeding Rumensin®. Using a replicated 3x4 Latin rectangle design, yearling steers were fed 3 treatments: 1) Control (CON) 2) CRINA RUMINANTS AF (CRINA) and 3) Rumensin® (RUM); however, two steers were removed due to very low DMI. Dry matter intake averaged 10.8, 11.5, and 9.3 kg/d for CON, CRINA, and RUM, respectively ($P = 0.39$). There were no differences in DMI, OM intake, total tract DM, or OM digestibilities among treatments. Dry matter digestibility was numerically highest in the CRINA treatment (84.4%) and least in the CON (82.0%). Steers receiving the CRINA treatment consumed 10.7% fewer meals than CON ($P = 0.67$) and spent numerically more time eating (425 vs. 396 min). Average ruminal pH was 5.75, 5.62, and 5.60 for CON, CRINA, and RUM, respectively. Cattle fed RUM had greater time below a rumen pH of 5.0 compared to CRINA treatment ($P < 0.05$). Total VFA concentration was 111.0, 128.8, and 108.0 mM for the CON, CRINA, and RUM, respectively. Ruminal acetate concentrations were 54.9, 64.5, and 52.5 for the CON, CRINA, and RUM treatments respectively. Total VFA concentrations and acetate concentrations were greater for the CRINA treatment ($P < 0.05$) compared to CON and RUM. Acetate:propionate was 1.78, 1.49, and 1.43 for CON, CRINA, and RUM, respectively. The results of this study suggest the addition of CRINA RUMINANTS AF favorably alters rumen fermentation end products without negatively affecting intake or rumen pH.

Key Words: cattle, feed additives, metabolism

276 Effect of cane molasses on ruminal absorptive capacity of dairy cows during the periparturient period. W. F. Miller*, B. J. Johnson, E. C. Titgemeyer, J. F. Smith, J. E. Shirley, and T. G. Nagaraja, *Kansas Sate University*, *Manhattan*.

Six multiparous Holstein cows with rumen cannulas were used in a randomized complete block design to evaluate ruminal absorptive capacity in response to the addition of cane molasses to diets during a 60-d dry period. A control diet without molasses or a diet containing molasses was individually fed during the far-off period (d -60 to -30) and the close-up period (d -29 to 0 relative to projected calving date). During lactation all cows were individually fed a common lactation diet. Molasses was 3.3% of DM in the far-off molasses diet and 3.6% of DM in the close-up molasses diet. Rumen absorptive capacity was measured on d -60, -30, -3, 2, 16, 30, 44, 58, and 72 relative to calving by bolus dosing a 1-L solution containing 2 mol valerate and 4 g Co-EDTA adjusted to pH 6.0 with NaOH. Ruminal fluid was collected over an 8-h period to determine liquid passage rates and valerate disappearance. Valerate absorption was greater (P = 0.02) during the close-up than the far-off period but did not differ for cows fed control (31.2%/h) or molasses (32.8%/h) diets. During lactation, valerate absorption did not differ for cows previously fed control (35.3%/h) and molasses (43.2%/h) diets. Ruminal liquid volume, dilution rate, and outflow were similar between diets during the dry period. Total VFA concentration during the dry period did not differ between cows fed control and molasses nor did molar percentage of acetate, propionate, butyrate, or isovalerate. Total VFA concentration and molar percentage of propionate were greater whereas acetate molar percentage was less during the close-up period versus the far-off period. DMI was greater (P = 0.002) during the close-up period for cows fed molasses diets. DMI during lactation tended (P = 0.08) to be greater and milk production was greater (P = 0.02) for cows previously fed molasses diets. Inclusion of cane molasses in diets for non-lactating cows did not significantly improve ruminal absorptive capacity but had positive effects on DMI and milk production.

Key Words: rumen, valerate, absorption

277 Effects of increasing level of distiller's dried grains plus solubles for steers fed moderate-quality forage. J. L. Leupp*, G. P. Lardy, and J. S. Caton, *North Dakota State University*, *Fargo*.

Five ruminally and duodenally cannulated beef steers (446 ± 42 kg of initial BW) were used in a 5 x 5 Latin square to evaluate effects of increasing level of supplemental corn distiller's dried grains with solubles (DDGS; 25.4% CP, 9.8% fat, DM basis) on DM intake, site of digestion, ruminal fermentation, and microbial efficiency. Diets consisted of a moderate-quality grass hay (10.2% CP; DM basis) offered ad libitum, free access to water and trace mineral salt block, and one of five levels of DDGS. Treatments consisted of 0, 0.3, 0.6, 0.9, and 1.2% BW DDGS. Diets met or exceeded DIP requirements (microbial yield = 10.5%). All supplements were fed at 0600 prior to forage. Steers were adapted to diets for 14 d followed by a 7-d collection period. Hay OM intake decreased (linear; $P < 0.0001$) while total OM intake increased (linear; $P < 0.0001$) with DDGS increasing level. Total CP intake, duodenal bacterial OM flow, and total tract OM digestibility increased (linear; $P < 0.0001$) with increasing level of DDGS. Duodenal CP flow increased (linear; $P = 0.0001$) with increasing DDGS level. Apparent ruminal, true ruminal, and total tract CP digestibility increased linearly ($P \leq 0.02$) with increasing DDGS level and total tract CP digestibility increased quadratically ($P = 0.05$) with increasing DDGS level. No differences ($P \geq 0.22$) in NDF or ADF digestibility were observed. Average ruminal pH was not different ($P = 0.89$) among treatments. Ammonia concentration increased (linear; $P < 0.0001$) with increasing DDGS. Acetate proportions decreased (linear; $P < 0.0001$) while propionate and butyrate proportions increased (linear; $P \leq 0.05$) with increasing DDGS. Ruminal DM fill decreased (linear; $P = 0.0007$) with increasing levels of supplementation and fluid dilution rate increased (linear; $P = 0.003$) with increasing DDGS. Using moderate to high levels of DDGS as a forage supplement resulted in no adverse effects on forage digestion or ruminal fermentation and resulted in increased nutrient supply in steers fed moderate-quality forage.

Key Words: distiller's dried grains with solubles, moderate-quality forage, steers

278 Effect of increasing pea level on feedlot performance and carcass characteristics in finishing beef steers. D. M. Larson*, G. P. Lardy, M. L. Bauer, and K. Maddock-Carlin, *North Dakota State University*, *Fargo*.

Production of field peas has increased rapidly in North Dakota. Our objective was to determine the effect of increasing level of field peas

on finishing performance and carcass traits. One hundred forty-four crossbred beef steers (433 ± 19 kg initial BW) were used in the study. Steers were blocked by weight and assigned randomly to treatment (6 steers per pen; 6 pens per treatment). The basal diet contained 80% dry rolled corn, 5% alfalfa/grass hay, 5% pressed beet pulp, 5% concentrated separator byproduct, and 5% supplement (DM basis). Field peas (without hulls) replaced corn and soybean meal at 0, 10, 20, and 30% of the diet DM. Diets were formulated to contain a minimum (DM basis) of 13.0% CP, 0.70% calcium, 0.27% phosphorus, and contained monensin (27.5 mg/kg) and tylosin (11 mg/kg). Steers were implanted with Synovex Choice on d 0. Steers were fed for 70 to 98 d and then harvested at a commercial abattoir. Following a 24-h chill, LM area, 12th rib fat thickness, KPH, and marbling score was collected. Linear, quadratic, and cubic contrasts were used to determine the effects of field pea level. There were no differences (P = 0.36 to 0.75) in ADG (1.96 ± 0.05 kg/d), DMI (10.8 ± 0.3 kg/d), G:F (182.1 ± 3.9 g/kg), dietary NEm (2.20 ± 0.04 Mcal/kg), or dietary NEg (1.52 ± 0.04 Mcal/kg). Likewise there were no differences (P = 0.45 to 0.95) in HCW (352.6 ± 6.7 kg), LM area (83.9 ± 1.2 cm2), 12th rib fat thickness (0.98 ± 0.05 cm), USDA yield grade (2.65 ± 0.11), or marbling score (393 ± 11; 300 = Slight 0 marbling). Data from this research indicate field peas have a similar NEg to corn and soybean meal, and no differences in feedlot performance or carcass characteristics result from feeding up to 30% field peas in corn-based finishing diets.

Key Words: field peas, finishing, steers

279 Effects of distillers grains composition and level on performance of steers consuming high quality forage. M. Corrigan*[1], T. Klopfenstein[1], G. Erickson[1], K. Vander Pol[1], M. Greenquist[1], M. Luebbe[1], K. Karges[2], and M. Gibson[2], [1]*University of Nebraska*, *Lincoln*, [2]*Dakota Gold Research*, *Sioux Falls, SD*.

One-hundred twenty crossbred steer calves (249 ± 12 kg) were used in an 84 d trial to determine the effects of dried distillers grains (DDG) supplementation level and composition on growing steer performance. All steers were fed a basal diet ad libitum that consisted of 58.8% alfalfa hay, 39.2% sorghum silage, and 2% vitamin and mineral supplement. A 4 × 5 factorial treatment structure was used. The first factor was DDG supplementation level (0.25, 0.50, 0.75, or 1.00% of BW), and the second factor was DDG solubles level (0, 5.4, 14.5, 19.1, and 22.1% DDG DM). Final BW increased linearly ($P < 0.01$; 366, 379, 385, 386 kg) and forage intake decreased linearly ($P < 0.01$; 6.9, 6.6, 6.3, and 5.6 kg) with increasing DDG supplementation level. No effect of solubles level on final BW, forage intake, or DDG intake was observed. A DDG supplementation level × solubles level interaction ($P < 0.01$) was observed for both ADG and G:F. This interaction may have been related to fat intake, as DDG fat levels increased (6.9, 8.9, 10.4, 12.7, and 13.3% fat, DM basis) with increasing solubles level. Linear ($P < 0.01$) improvements in ADG were seen with increasing DDG supplementation across the intermediate solubles levels, but a quadratic ($P < 0.05$) response to DDG supplementation level was observed for the highest solubles level. At higher fat levels, a depression in fiber digestion may have overcome the increased energy supplied by the supplemental fat, possibly explaining the interaction observed in this trial.

	DDG Solubles Level, % DM				
DDG, % BW	0.0[a]	5.4[b]	14.5[b]	19.1[b]	22.1[c]
0.25[d]	1.17	1.06	0.97	1.01	1.13
0.50[e]	1.08	1.14	1.29	1.13	1.40
0.75	1.30	1.28	1.27	1.37	1.33
1.00[d]	1.26	1.39	1.41	1.27	1.24

[a]Cubic effect of supplementation level ($P < 0.05$). [b]Linear effect of supplementation level ($P < 0.01$). [c]Quadratic effect of supplementation level ($P < 0.05$). [d]Quadratic effect of solubles level ($P < 0.05$). [e]Linear effect of solubles level ($P < 0.01$).

Key Words: dry distillers grains, high quality forage, growing steers

280 Ruminal methane production is differentially affected following replacement of dietary forage or concentrate with dried distillers grains plus solubles. E. J. Behlke*, T. G. Sanderson, T. J. Klopfenstein, and J. L. Miner, *University of Nebraska*, *Lincoln*.

Our objective was to determine the influence on ruminal methanogenesis of replacing either forage or corn with dried distillers grains plus solubles (DDGS) in low and high concentrate diets, respectively. Experiment 1 used a replicated Latin square design. Intact (n = 9) and ruminally fistulated (n = 3) lambs were offered a brome hay-based ration (1% BW) that contained 30% corn bran (CON), 30% DDGS (30DDGS), or 30% DDGS and 30% corn bran (DDGS+BRAN). Experiment 2 used a cross-over design. Intact lambs (n = 9) were offered a ration (3% BW) containing 71% corn (CORN) or one in which DDGS replaced corn for 30% of the diet (CORN+DDGS). Following adaptation to diet, exhaled gas was collected (2 d) to determine CH_4 production by the SF_6 tracer technique. Feces and orts were collected (5 d) to determine digestibility, and ruminal fluid was collected (1 d) for determination of pH and VFA concentrations. In experiment 1, we detected a main effect of diet ($P < 0.01$) on CH_4 production rate per unit of digested DM. The CON animals produced 69.4 mL/min•kg, which was greater ($P < 0.05$) than that of the 30DDGS or DDGS+BRAN animals (57.7 and 50.7 mL/min•kg, respectively). The CON diet resulted in greater ($P < 0.05$) ruminal propionate concentrations compared to the DDGS+BRAN diet (11.3 vs 10.2 mM), which was greater ($P < 0.05$) than that of the 30DDGS diet (9.0 mM). The main effect of diet was not significant for ruminal pH or acetate or butyrate concentrations. In experiment 2, replacement of corn with distillers grains increased ($P < 0.05$) CH_4 production rate per unit of digested DM from 20.9 to 30.2 mL/min•kg. There were no differences in ruminal pH or acetate, propionate, or butyrate concentrations between the CORN or CORN+DDGS diets. We conclude that the impact of feeding DDGS on CH_4 emissions from ruminants will be desirable to the extent that these coproducts replace forage rather than grain.

Key Words: ruminants, methane, dried distillers grains plus solubles

281 Effects of corn processing method and wet distillers grains with solubles inclusion level in finishing steer diets. M. Corrigan*, G. Erickson, T. Klopfenstein, K. Vander Pol, M. Greenquist, and M. Luebbe, *University of Nebraska*, *Lincoln*.

Four hundred eighty crossbred steer calves (314 ± 18 kg) were used in an experiment to determine if an interaction exists between corn processing method and wet distillers grains with solubles (WDGS)

inclusion level in finishing steer diets fed for 168 d. A randomized complete block design was utilized with a 3 × 4 treatment structure. Diets were based on dry-rolled corn (DRC), high-moisture corn (HMC), or steam-flaked corn (SFC) with increasing levels of WDGS (0, 15, 27.5, 40% diet DM). A corn processing × WDGS level interaction ($P < 0.01$) was observed for final BW, ADG, G:F and HCW. In steers fed DRC based diets, final BW, ADG and G:F improved linearly ($P < 0.01$) with increasing WDGS levels. In steers fed HMC, ADG responded quadratically ($P = 0.04$) and G:F improved linearly ($P = 0.02$) with increasing WDGS levels. In steers fed SFC, final BW ($P < 0.01$) and ADG ($P = 0.02$) responded quadratically to WDGS inclusion level, with steers fed 15% WDGS having the numerically highest final BW and ADG. Dry matter intake, fat thickness, and marbling score responded quadratically to WDGS inclusion level and incidence of liver abscess decreased linearly with increasing levels of WDGS. In summary, a corn processing × WDGS level interaction on finishing steer performance was observed. Gain efficiency improved linearly in DRC and HMC fed steers in response to increasing dietary inclusion levels of WDGS. In steers fed SFC, no improvement in G:F was observed, however the numerically optimal G:F was observed in steers fed 15% WDGS.

Table 1[a]

Item	WDGS Level, % DM 0.0	15.0	27.5	40.0	*P*-value Linear	Quadratic
DRC						
ADG, kg	1.65	1.71	1.76	1.78	< 0.01	0.60
G:F	0.163	0.170	0.181	0.185	< 0.01	0.77
HMC						
ADG, kg	1.67	1.80	1.80	1.75	0.15	0.04
G:F	0.183	0.189	0.197	0.194	0.02	0.25
SFC						
ADG, kg	1.66	1.70	1.63	1.56	< 0.01	0.02
G:F	0.182	0.186	0.182	0.183	0.91	0.40

[a]Corn processing method × WDGS level interaction for ADG and G:F ($P < 0.01$).

Key Words: WDGS level, corn processing method, finishing steers

282 Effect of wet distillers grains level on feedlot cattle performance and nitrogen mass balance. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist, *University of Nebraska*, *Lincoln*.

A winter feedlot trial was conducted to evaluate the impact of wet distillers grains plus solubles (WDGS) level on performance and N mass balance. Ninety-six calves (294 ± 33 kg) were stratified by BW and assigned randomly to 12 pens. Calves were fed for 167 d from November to May. Treatments consisted of 0, 15, and 30% dietary inclusion of WDGS (CON, 15WDGS, 30WDGS, respectively), replacing corn. Basal diets consisted of high-moisture and dry-rolled corn, fed at a constant 1:1 ratio (DM basis), 7.5% alfalfa hay, 5% molasses, and 5% supplement (DM basis). The CON and 15WDGS diets were balanced for metabolizable protein using the 1996 NRC and 30WDGS was in excess of requirements. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Total N lost was calculated by subtracting manure and runoff N from excreted N. Dry matter intake tended (P=0.08) to increase linearly with WDGS level. Final BW, HCW, and ADG increased (P=0.05) with WDGS level. Gain efficiency, fat depth, and LM area were not influenced (P>0.20) by WDGS level. However, marbling score was greater (P<0.01) for 30WDGS compared with CON and 15WDGS. Manure DM was not different (P=0.37) among treatments. Manure OM linearly increased (P=0.05) with WDGS level. Nitrogen intake was greatest (P<0.01) for 30WDGS (44.6 kg), intermediate for 15WDGS (36.2 kg), and least for CON (31.5 kg). Nitrogen retention increased linearly (P=0.03) with WDGS level due to ADG response. Excretion of N was greatest (P<0.01) for 30WDGS (38.4 kg), intermediate for 15WDGS (30.1 kg), and least for CON (25.6 kg). Runoff N was not different (P=0.22) among treatments and averaged 0.043kg/hd. Manure N tended (P=0.07) to increase linearly with WDGS level. Percent N loss was not different (P=0.37) among treatments and were 55.1, 63.8, and 55.0% for CON, 15WDGS, and 30WDGS, respectively. Additionally, N removed in manure as a percent of intake was not different (P=0.67) among treatments. These results indicate that greater N intake and excretion for calves fed WDGS increased the amount lost, but not as a percentage of N excreted.

Key Words: cattle, nitrogen, waste management

283 The effect of field pea inclusion in high concentrate diets for steers on intake and digestibility. B. A. Stoltenow*[1], G. P. Lardy[1], T. C. Gilbery[1], V. L. Anderson[2], and M. L. Bauer[1], [1]*North Dakota State University*, *Fargo*, [2]*Carrington Research Extension Center, NDSU*, *Carrington, ND*.

A 4 x 4 Latin square design study was conducted to evaluate the effects of increasing field pea level in high-concentrate diets on intake, digestion, and ruminal fermentation in steers. Four ruminally and duodenally cannulated steers (582 ± 40 kg initial BW) were used in the study. Experimental periods were 14 d in length (9 d adaptation, 5 d collection). The basal diet consisted of 79.75% dry-rolled corn, 5% corn silage, 4.8% concentrated separator byproduct, 5% alfalfa hay, and 5.45% supplement (DM basis). Field peas replaced dry-rolled corn at 0, 10, 20, and 30% of the diet DM to form the treatments. Dry matter intake increased linearly (P = 0.009) from 12.17 to 13.78 ± 0.52 kg/d with increasing field pea. Organic matter intake also increased linearly (P = 0.03) with increasing pea level from 11.28 to 12.71 ± 0.47 kg/d. Total tract OM digestibility (74.4 ± 2.4%) was not affected by treatment (P = 0.65). Crude protein intake increased quadratically (P = 0.02) with increasing field pea, while total tract CP digestibility (60.9 ± 5.1%) was not affected (P = 0.30). Intake of ADF and NDF were not affected by increasing field pea level (P ≥ 0.22). Total tract ADF and NDF digestibility did not change with increasing field pea level (P ≥ 0.13). There was no effect of treatment on ruminal molar proportion of acetate, propionate, or butyrate (P ≥ 0.60). There was a treatment by time interaction for total VFA concentration (P = 0.06). Total VFA concentration increased with increasing levels of peas (117.4, 113.6, 118.3 and 129.1 mM; P = 0.05). Ammonia concentration responded quadratically to the addition of field peas (6.30, 5.42, 4.37, and 9.62 mM; P = 0.004). Average ruminal pH was not affected by treatment (6.28 ± 0.05; P = 0.24). The results indicate that inclusion of field pea in high concentrate diets for beef cattle increases DM intake and total VFA concentration, but does not change molar proportion of acetate, propionate, and butyrate, ruminal pH, or total tract digestibility of various components.

Key Words: field pea, intake, digestibility

284 Characterization of a modified dry distillers byproduct and dry distillers grains for use in growing beef cattle. C. D. Buckner*[1], T. J. Klopfenstein[1], G. E. Erickson[1], K. J. Vander Pol[1], K. K. Karges[2], and M. L. Gibson[2], [1]*University of Nebraska*, *Lincoln*, [2]*Dakota Gold Marketing*, *Sioux Falls, SD*.

A growing steer trial was conducted to characterize a new byproduct, Dakota Bran Cake (DBRAN), by comparing it to dry distillers grains with solubles (DDGS) at two inclusions as a 2X2 factorial arrangement. Dietary treatments were 15% DBRAN, 30% DBRAN, 15% DDGS, and 30% DDGS, replacing a blend (70:30 ratio) of brome hay and alfalfa haylage (DM basis). All diets contained 2% dry supplement. DBRAN is produced by prefermentation fractionization and contains corn bran and distillers solubles. DBRAN and DDGS were similar in NDF (30.3 and 29.2%) but different for CP (15.5 and 30.4%). Backgrounded steer calves (n=256; 281 ± 23.2kg) were used in a RCBD (three weight blocks, sixteen steers/pen, four pens/treatment) to evaluate steer calf performance over an 82 d feeding period. There were no significant interactions between byproduct type and level. Final BW, ADG, DMI, and G:F increased (P<0.01) as inclusion level increased from 15 to 30% DM for both byproducts. Feeding DDGS significantly improved ADG (P=0.05) and G:F (P=0.01) compared to DBRAN, but byproduct type did not affect DMI. Feeding DBRAN and DDGS in growing diets to steer calves improved performance at higher dietary inclusion levels. As dietary protein requirements were met, DBRAN was estimated to have 84% the energy value of DDGS, likely due to lower fat content.

Table 1. Performance for cattle fed DBRAN and DDGS at 15 and 30% DM.

	Level			Type			
Item	15	30	P-value	DBRAN	DDGS	P-value	Inter
DMI, kg/d	0.98	1.14	<0.01	1.03	1.09	0.05	0.35
ADG, kg	8.57	8.89	0.01	8.75	8.71	0.77	0.63
G:F	0.113	0.128	<0.01	0.117	0.124	0.01	0.19

Key Words: byproducts, growing, cattle

285 Distillers byproducts alters carcass fat distribution of feedlot cattle. C. D. Reinhardt*[1], A. DiCostanzo[2], and G. Milliken[1], [1]*Kansas State University*, *Manhattan*, [2]*University of Minnesota*, *St. Paul*.

Data from twenty-one individual animal feeding trials from 6 states were pooled in order to determine the effects of feeding various levels of distiller's byproducts (DG) to feedlot cattle on subsequent carcass fat distribution. Data were analyzed using PROC MIXED of SAS with treatment mean within a study as the individual observation, replications per treatment as a weighting factor and individual study as a random effect. Because not all studies reported both marbling score (MARB) and calculated yield grade (YG), number of observations (n) varies between analyses. Byproducts used included wet distiller′s grains (n = 64), dry distiller′s grains (n = 34) and condensed distiller′s solubles (n = 8), and DM inclusion level of DG fed ranged from 0 to 75% across all studies. Linear and quadratic terms were included in analyses for effect of DG level on MARB and YG (P < 0.10). Linear and quadratic effects of DG along with the interactive terms of both with YG were included in analysis of effects on MARB to determine degree of covariance between MARB and YG. Resulting equations from analyses were: MARB=516.73+1.055DG-0.032DG^2 (R^2=0.933; n=86); YG=2.56+0.0080DG-0.00014DG^2 (R^2=0.903; n=89); MARB = 374.72-6.44DG+54.67YG+2.54DG*YG+0.139DG^2-0.062DG^2*YG (R^2=0.962; n=74). When unadjusted for changes in YG, MARB increases by 8.7 units at 16%DG, then declines below control levels at 33%DG; however, when adjusted for the concomitant quadratic increase in YG, MARB increases by 3.7 units at 12%DG and declines below control levels at 23%DG. These results indicate that feeding low levels of DG results in increased marbling score, feeding moderate levels results in a increased marbling score but a greater relative change in overall body fatness than the change observed in marbling score, and feeding high levels results in depressions in marbling score.

Key Words: distillers grains, carcass fat, marbling

286 Evaluation of degermed corn distiller's grains fed to finishing heifers. B. E. Depenbusch*, E. R. Loe, M. J. Quinn, M. E. Corrigan, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

Yearling crossbred heifers (n = 610; 347 ± 5 kg initial BW) were fed for 118 d in a finishing study to evaluate performance and carcass characteristics when steam-flaked corn was partially replaced with ethanol byproducts. Diets contained 6% alfalfa hay (DM basis) and 94% concentrate. The concentrate fraction consisted primarily of steam-flaked corn (CONTROL), flaked corn combined with 13% (DM basis) dry corn distiller's grains with solubles (DDGS), or flaked corn with 13% (DM basis) of a partially degermed dry corn distiller's grains with solubles (DEGERM). Heifers fed DEGERM consumed less (P<0.05) feed than those fed CONTROL or DDGS, (9.1, 9.4, and 8.9 kg/day for CONTROL, DDGS, and DEGERM, respectively). Average daily gain, feed efficiency, and final weights were similar (P>0.16) among treatments. Apparent total tract digestibility for DM, OM, and phosphorus also were determined using chromic oxide as an indigestible marker. Dry matter digestibility (75.9, 72.3, and 72.2% for CONTROL, DDGS, and DEGERM, respectively) and OM digestibility (80.1, 76.1, and 76.8% for CONTROL, DDGS, and DEGERM, respectively) were lower (P<0.05) for heifers fed DDGS and DEGERM compared to those fed the CONTROL diet. Phosphorus intake was higher (P<0.05) for DDGS than for CONTROL or DEGERM (31.3, 23.6, and 24.3, respectively), but apparent total tract digestibilities of phosphorus were not different (55.0, 49.5, and 50.2, respectively; P>0.10). Dressing percent, carcass characteristics, and liver abscesses were not different among treatments (P>0.27). Ethanol byproducts yielded performance comparable to that achieved by feeding steam-flaked corn. Compared to traditional distiller's grains, feeding partially degermed distiller's grains is an effective strategy for reducing phosphorus intake and phosphorus excretion in feedlot cattle.

Key Words: distillers grains, phosphorus, digestibility

289 Efficacy of feed additives in flaked corn finishing diets with and without corn wet distiller's grains with solubles. B. E. Depenbusch*, E. R. Loe, M. E. Corrigan, M. J. Quinn, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

Yearling crossbred heifers (n = 371; 299 ± 9 kg initial BW) were used in a randomized complete block design finishing study to evaluate

responses to monensin and monensin plus tylosin in diets containing steam-flaked corn (SFC) or flaked corn with 25% (DM basis) wet distiller's grains with solubles (WDG). Within each basal diet, each of three feed additive regimens were applied: no additives (NONE), 300 mg Rumensin per heifer daily (RUMENSIN), or 300 mg Rumensin + 90 mg Tylan per heifer daily (RUM+TYL). Dry matter intake was not impacted by basal diet (P=0.34). Heifers fed the SFC gained 9% faster (P=0.01) and were 7% more efficient (P=0.01) than heifers fed WDG. In addition, carcass weight was 3% heavier (P=0.01), dressing percent was 1% greater, and longissimus muscle area was 3% greater for heifers fed SFC compared to those fed WDG. Marbling score and USDA Choice carcasses both were higher (P<0.05) for heifers fed SFC. Daily gain and feed efficiency were similar (P>0.20) for heifers fed NONE, RUMENSIN, and RUM+TYL. Marbling score, USDA Quality Grades, and USDA Yield Grades were not different (P>0.44) among feed additive treatments. Subcutaneous fat thickness and KPH were similar (P>0.55) for main effects of diet and feed additive. RUMENSIN and RUM+TYL decreased incidence of severe liver abscesses in cattle fed SFC, but had no effect in cattle fed WDG (Diet × Additive interaction, P=0.09). Adding wet distiller's grains to flaked corn finishing diets decreased heifer performance, HCW, and marbling. Tylan was more efficacious in SFC diets than when added to diets containing WDG.

Key Words: distiller's grains, rumensin, Tylan

290 Summary analysis of yearling cattle response to distillers grains supplementation. M. A. Greenquist*[1], T. J. Klopfenstein[1], L. Lomas[2], D. Blasi[2], D. C. Adams[1], W. H. Schacht[1], S. E. Morris[1], K. H. Gustad[1], R. N. Funston[1], J. C. MacDonald[1], and M. Epp[2], [1]*University of Nebraska*, *Lincoln*, [2]*Kansas State University*, *Manhattan*.

Eight grazing experiments were summarized reflecting yearling performance when supplemented with distillers grains (DG) at an average of 0.48% BW (LOW: 1.6 kg of DG DM) and 0.92% BW (HIGH: 3.4 kg of DG DM). Study sites included pastures located in Nebraska Sandhills upland range, Kansas Flint Hills, and smooth brome grass in Nebraska and Kansas. Mean BW of the yearlings at the start of the summer grazing seasons was 296 kg with a range of 185 to 369 kg. Daily gains averaged 0.73 kg/day and ranged from 0.49 to 1.05 kg/day for the non-supplemented cattle. Feeding LOW levels of DG increased (P<0.01) ADG to 0.97 kg/day and feeding HIGH levels of DG increased (P<0.01) ADG to 1.13 kg/day. The response in ADG for each 1% BW of supplementation was similar for both supplementation levels (0.45 kg and 0.43 kg for LOW and HIGH, respectively). Subsequent feedlot performance was measured in 6 of the 8 experiments and was not influenced by DG supplementation on grass. Body weight was maintained throughout the feeding period with 24 kg heavier (P<0.01) slaughter weights for the LOW cattle and 39 kg heavier (P<0.01) for the HIGH cattle. Six additional experiments were summarized where growing calves were fed harvested forage and supplemented with DG. Calves fed harvested forages supplemented with 0.68 kg/day of DG (controls) gained 0.74 kg/day which is comparable to gains of the yearlings on grass. The mean substitution rate was 0.48 kg of forage per 1 kg of DG supplemented. Calves fed harvested forage increased gain by 0.18 kg/day for 1 kg of DG DM supplemented. The grazing yearlings increased gain less (0.13 kg/day) for 1 kg of DG DM. In these two summaries, the return for the extra gain, forage savings (100 d), and heavier slaughter weights for grazing yearlings supplemented with DG is $1.41 to $1.94 for each $1.00 spent on DG. Some of the response to DG in this summary is likely due to the response to the protein in the DG. The overall response is due to protein and the concentrated energy in DG. Forage is replaced by DG while feedlot performance is not negatively affected by DG supplementation on grass.

Key Words: distillers grains dupplementation, forage, beef cattle

291 Nutritive value of fall-grown cereal-grain forages over time. M. S. Akins*[1], E. B. Kegley[1], J. L. Gunsaulis[2], W. K. Coblentz[3], K. S. Lusby[1], R. K. Ogden[3], J. D. Caldwell[1], R. K. Bacon[1], and K. P. Coffey[1], [1]*University of Arkansas*, *Fayetteville*, [2]*University of Arkansas Extension - Washington County*, *Fayetteville, AR*, [3]*USDA-ARS*, *Marshfield, WI*.

Changes in the nutritive value of fall-grown cereal-grain forages over time can affect cattle performance. The objective of this study was to evaluate the nutritive value of various fall-grown cereal-grain forages over time. One variety each of hard red (HR) and soft red (SR) winter wheat (*Triticum aestivum* L.), oat (*Avena sativa* L.), rye (*Secale cereale* L.), and triticale (*X Triticosecale rimpau* Wittm.) were planted September 8, 2004, in Fayetteville, AR and September 5 and 6, 2005, in Fayetteville and Batesville, AR, respectively. Forages were sampled randomly on six dates at 2-wk intervals beginning 6 wk after planting. Samples were obtained from a different harvested strip on each sampling date. Forage x sample date interactions (P<0.05) occurred within all site-years for NDF and in vitro organic matter digestibility (IVOMD), and during 2004 in Fayetteville and 2005 in Batesville for N. In 2004 at Fayetteville, SR had the greatest IVOMD (P<0.05) and lowest NDF (P<0.05) among all forages and rye exhibited the greatest N (P<0.05). In 2005 at Fayetteville, HR, rye, and SR were greater (P<0.05) in IVOMD than oat and triticale. Oat was higher in N than triticale (P=0.04) and tended to be higher in N than HR (P=0.05) and SR (P=0.06). Rye contained less (P<0.05) NDF than all other forages. At Batesville, oat had the lowest IVOMD (P<0.05), triticale tended to have greater (P=0.08) IVOMD than HR, but no differences among HR, SR, and rye were found. Oat was greater (P<0.05) in N than all others, except for rye (P=0.12). Also, oat had the greatest average NDF content (P<0.05), but there were no differences (P>0.05) among other forages. Overall, results were inconsistent among site and year but rye, SR, and HR showed the highest digestibilities and lowest NDF contents of the forages tested. Nitrogen content ranged from 2.75 to 5.75% in these forages which meets requirements of growing cattle.

Key Words: cereal-grain forage, nutritive value, winter annual

292 Performance by spring-calving cows grazing tall fescue pastures with either the wild-type toxic endophyte or a non-toxic novel endophyte. K. P. Coffey*[1], W. K. Coblentz[2], R. K. Ogden[2], J. D. Caldwell[1], D. H. Hubbell, III[1], T. W. Hess[1], L. J. Martin[1], C. P. West[1], M. S. Akins[1], Z. B. Johnson[1], and C. F. Rosenkrans, Jr.[1], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA-ARS*, *Marshfield, WI*.

Cows grazing ′Kentucky-31′ tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh.] infected with its wild-type endophyte (*Neotyphodium coenophialum*; E+) generally display suboptimal performance. Recently, endophyte strains that do not produce compounds toxic to cattle have been incorporated into tall fescue varieties to reduce tall fescue toxicosis and maintain the positive benefits the endophyte imparts to the plant. Our objectives were to compare performance by spring-calving cows grazing E+ tall fescue with that by cows grazing a non-toxic endophyte-tall fescue association developed at the Univ. of Arkansas (HM4). Gelbvieh x Angus crossbred cows (n=156; 492±19.2 kg initial BW) were allocated randomly by weight and age to one of four 10-ha pastures in 2005 and to one of eight 10-ha pastures in 2006. Pastures consisted predominantly of E+ or HM4. Cows confirmed as pregnant began grazing the pastures October 15, 2004 and November 30, 2005. Cows remained on their assigned pastures until weaning in 2006, but were removed from HM4 in the summer of 2005 because of low forage availability from extremely dry summer conditions. Cow BW were greater (P<0.05) and hair scores were lower (P<0.05) at weaning from HM4 than E+, and cow BW at the end of the breeding season tended (P=0.07) to be greater from HM4 than E+. A greater percentage (P<0.01) of cows grazing HM4 were pregnant at the time of weaning in 2005. Calf birth date and birth weight were not different (P>0.48) between forages, but actual and adjusted weaning weight, and calf gain from birth to weaning were greater (P<0.05) from HM4 compared with E+ (240, 229, and 193 kg respectively from HM4 vs. 209, 199, and 169 kg respectively from E+). Therefore, replacing toxic tall fescue pastures with non-toxic, novel endophyte-infected tall fescue may improve calf growth and cow reproductive performance.

Key Words: cow, tall fescue, novel endophyte

293 The quality of smooth bromegrass in monoculture pastures before and after grazing by yearling steers. L. B. Baleseng*, M. A. Greenquist, K. J. Vander Pol, T. J. Klopfenstein, W. H. Schacht, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

A grazing trial was conducted to determine the effect of N fertilization of smooth bromegrass pasture and supplementation of dried distillers grains with solubles (DDGS) on quality of cattle diets at predetermined dates during the growing season. Yearling diet samples were also collected to compare quality of diets collected at the midpoint of a grazing period versus the average quality of diets collected before (pre-grazing) and after (post-grazing) grazing. Yearling steers (349 kg ± 10; n=45) were used in a randomized complete block design (RCBD) with three replications and three treatments. The treatments were non-fertilized smooth bromegrass (Control), fertilized (88 kg N/ha) smooth bromegrass, and supplementation of non-fertilized smooth bromegrass with DDGS. Six (2/paddock) crossbred fistulated steers (261±19 kg) were used to collect diets at midpoint of each grazing period for each cycle but during cycle 2, 3, and 4 collection was also done pre-grazing and post-grazing. The length of first cycle was 24 days with 4-day grazing periods (6 paddocks). The length of the second, third, and fourth cycles was 36 days with 6-day grazing periods. Cycle 5 was only 18 days long with 3-day grazing periods. Masticate CP was higher in fertilized pasture than control pasture in cycle 1 (P< 0.05) and in cycle 2 through 5 there was no treatment differences. Neither masticate in vitro dry matter digestibility (IVDMD) or NDF content were affected by treatment (P> 0.05). Midpoint masticate CP was not significantly different from the average of pre-grazing and post-grazing CP (P> 0.05). Midpoint masticate IVDMD was not significantly different from average of pre-grazing and post-grazing IVDMD (P> 0.05) except in cycle 4. The quality of animal diets declined with maturation of grass. Midpoint diet quality reflects diet quality of a given grazing period in a homogenous stand of smooth bromegrass pastures.

Key Words: masticate samples, forage quality, distillers grains

294 Growth performance by fall-calving cows grazing stockpiled tall fescue pastures with different proportions stockpiled until late fall. J. D. Caldwell*[1], K. P. Coffey[1], W. K. Coblentz[2], R. K. Ogden[2], J. A. Jennings[1], T. F. Smith[1], D. S. Hubbell, III[1], and C. F. Rosenkrans, Jr.[1], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA-ARS*, *Marshfield,WI*.

Tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh.] is often stockpiled to reduce winter feed costs for cattle, but the optimal proportion of the total hectares to stockpile is not known. Over two consecutive years, a total of 158 Gelbvieh x Angus fall-calving cows (599 ± 6.0 kg initial BW, 6.5 ± 0.04 initial BCS) were stratified by weight and age and allocated randomly to one of eight 10-ha tall fescue pastures at a stocking rate of one cow/ha to determine the impact of stockpiling different proportions of total pasture area on cattle performance. All pastures were subdivided into six 1.6 ha paddocks. Treatments consisted of no area stockpiled (S0), or 33 (S33), or 50% of the total area stockpiled (S50). Cows assigned to S0 were rotated through all six paddocks using 5 to 6-d grazing intervals. Cows assigned to S33 and S50 were rotated through 33 or 50% of the paddocks until September 10 in both years, then were rotated through the remaining paddocks to allow the early-grazed paddocks to stockpile until mid-November. Stockpiled paddocks were strip-grazed at the start of the breeding season in mid-November of both years. Cow weights (P= 0.85) and BCS (P = 0.41) did not differ across treatments. Calf ADG tended to be greater (P = 0.08) during the breeding season and calf weights were greater (P = 0.04) at the end of the breeding season for S33 than S50. Total hay offered tended (P = 0.09) to be greater for S0 than S33 and S50. Available forage was lower (P =0.01) from S33 than S50 and forage CP tended (P = 0.09) to be higher for S0 compared with S33 and S50. In vitro dry matter disappearance and ergot alkaloids did not differ (P ≥ 0.60) among treatments. Therefore, 33 % of tall fescue pasture area can be stockpiled to help meet the nutritional needs of fall-calving cows and reduce supplementation costs through the winter.

Key Words: cows, fescue, stockpile

296 Effect of low vitamin A diets with high-moisture- or dry- corn on marbling of beef steers. M. Gorocica-Buenfil, F. Fluharty, T. Bohn, P. Tirabasso, G. Lowe, and S. Loerch*, *The Ohio State University*, *Wooster*.

Angus-based steers (n = 165; BW = 300.0 kg) were used in a feedlot trial to evaluate the effect of low vitamin A diets with high-moisture (HMC)- or dry (DC)- corn on marbling. Steers were distributed in 24 pens (7 steers each). The experiment had a completely randomized design with a 2 x 2 factorial arrangement of treatments: Low vitamin A (Lo, no supplemental vitamin A) – HMC (LoHMC); LoDC; High vitamin A (Hi, supplemented with 2,200 IU/kg DM) – HMC (HiHMC); and, HiDC. Diets contained 77 % corn, 10% corn silage, 10% protein supplement and 3% soybean oil. Samples of feed ingredients were taken for carotenoid analysis. Blood samples were taken for serum retinol determination. Steers were harvested after 145 days on feed. Carcass characteristics and LM composition were determined. High-moisture corn had a greater vitamin A content based on its carotenoid content than DC (614.3 vs. 366.0 IU/kg DM, P < 0.01). No vitamin A x corn type interactions were detected for feedlot performance, carcass characteristics and serum, and liver retinol content. Thus, main effects are reported. Average daily gain, DMI, and F:G were not affected by vitamin A or corn type (P > 0.05). Marbling score (Lo = 555.8 vs. Hi = 525.4) and quality grade (Lo = 5.2 vs. Hi = 4.9) were greater (both, P < 0.05) in Lo vs. Hi steers. Hot carcass weight, back fat, and yield grade were not affected by the treatments (all P > 0.05). Vitamin A and corn type did not affect LM composition (DM, OM, CP and ether extractable fat, all P > 0.05). Serum and liver retinol content were not affected by vitamin A supplementation (P > 0.05) but s.c. fat retinol was reduced in Lo steers at harvest (Lo = 0.8 vs. Hi = 1.4 µg/g, P < 0.01). Regardless of the corn type used, feeding low vitamin A diets for 145 days to Angus-based steers increased marbling and quality grade without affecting yield grade, animal health or performance.

Key Words: beef, marbling, vitamin A

297 Effect of vitamin A restriction on carcass characteristics and immune status of feedlot beef steers. M. Gorocica-Buenfil, F. Fluharty, P. Tirabasso, G. Lowe, and S. Loerch*, *The Ohio State University*, *Wooster*.

Angus based steers (n = 68; BW = 227 kg) were used in a feedlot experiment to evaluate the effects of dietary vitamin A restriction on marbling and immune status. Steers were randomly allotted to one of two treatments: Lo (no supplemental vitamin A); and Hi (diet supplemented with 2,200 IU vitamin A/kg DM). Diets contained 60% high-moisture corn, 20% roasted soybean, 10% corn silage and 10% of a protein supplement. Steers were individually penned and fed. For the first 141 d, steers were limit fed to achieve a gain of 1.1 kg/d. The last 75 d of the experiment, steers were offered feed ad libitum. To evaluate immune status, on d 141 and d 163 steers were injected with an ovoalbumen vaccine. On d 182, blood samples were taken to determine serum antibody titers by ELISA. Steers were harvested after 216 d on feed. Carcass characteristics and LM composition were determined. Fatty acid composition was determined in s.c. fat. Feedlot performance (ADG, DMI, and G:F) was not affected by vitamin A restriction (all P > 0.10). Hot carcass weight, back fat and yield grade did not differ between Lo and Hi steers (all P > 0.10). Marbling score (Lo = 574.4 vs. Hi = 567.6, P = 0.79) and i.m. fat (Lo = 5.0 vs. Hi = 4.7 % ether extractable fat, P = 0.57) were not increased by vitamin A restriction. Serum (Lo = 18.7 vs. Hi = 30.3 µg/dL, P < .01) and liver (Lo = 6.3 vs. Hi = 38.1 µg/g, P < 0.01) retinol levels were lower in Lo steers at harvest. Immune status was not affected by vitamin A restriction (Lo = 13.1 vs. Hi = 12.8 $_{titerslog2}$, P = 0.60). Slight changes in the fatty acid profile of steers were detected. A greater proportion of MUFA (Lo = 41.7 vs. Hi = 39.9%, P < 0.05) and less saturated fatty acids (Lo = 47.1 vs. 48.7, P < 0.05) were observed in vitamin A restricted steers. This suggests that vitamin A restriction may affect the activity of desaturase enzyme. Feeding a low vitamin A diet for 216 d to Angus-based steers did not affect feedlot performance, marbling score or animal health and immune status. Slight changes in the fatty acid profile were observed suggesting that vitamin A restriction may have affected desaturase enzyme activity.

Key Words: beef, vitamin A, marbling

298 The effect of feeding milk replacer with psyllium or whole milk on calf growth and health. T. J. Earleywine*, T. E. Johnson, H. B. Perry, and B. L. Miller, *Land O'Lakes, Inc.*, *Webster City, IA*.

Calf milk replacer containing psyllium or whole cow′s milk was evaluated to determine the effect on performance and scour data when fed to Holstein bull calves. A total of 72 calves with an average initial weight of 44.8 kg were randomly assigned according to body weight and blood gamma globulin concentration to one of two treatments: 1) 22% CP / 20% fat all milk protein milk replacer providing 5 g of psyllium per feeding or 2) whole cow's milk. The solids content of the whole milk was determined weekly so that intake of milk replacer and whole milk was equalized. Calves were individually housed in crates and fed twice daily at 700 and 1615 hours through 28 days. Calf milk replacer or whole milk was fed averaging 401 g of solids per calf daily. Starter (18% CP texturized) was offered to all calves throughout this 42 day trial. Weight gain, daily scour scores (1-4 scale: 1=normal, 2=loose, 3=water separation, 4=3 with severe dehydration) and scour days were calculated weekly. Calves fed the milk replacer containing psyllium had improved starter intake and experienced a reduced incidence and severity of diarrhea.

Item	Trt 1	Trt 2	S.E.M.	P-Value
BW gain, kg	17.99	17.59	0.794	0.803
CMR/Milk Solids, DM, kg	11.22	11.17	0.024	0.339
Starter, DM, kg	26.92	20.42	1.186	0.0044
Total DM Intake, Kg	38.14	31.59	1.192	0.0043
Scour score	1.15	1.23	0.020	0.0405
Scour days	3.21	4.48	0.368	0.0841

Key Words: calf, milk replacer, psyllium

299 The effect of supplementing milk replacer with synthetic amino acids on calf performance and health. B. L. Miller*, T. E. Johnson, H. B. Perry, and T. J. Earleywine, *Land O'Lakes, Inc.*, *Webster City, IA*.

Calf milk replacer supplemented with lysine and methionine was evaluated to determine the effect on performance and scour data when fed to Holstein bull calves. A total of 45 calves with an average initial weight of 45.79 kg were randomly assigned according to body weight and blood gamma globulin concentration to one of three treatments: 1) 18% CP / 20% fat all milk protein milk replacer; 2) 18% CP / 20% fat all milk protein milk replacer supplemented with lysine and methionine equal to 20% CP; and 3) 20% CP / 20% fat all milk protein milk replacer. Calf milk replacer was fed averaging 780 g of powder per calf, daily. Milk replacers were medicated (280 mg neomycin / kg, 140 mg oxytetracycline / kg). Calves were individually housed in crates and fed twice daily at 700 and 1615 hours through this 28 day trial. No calf starter was offered to calves during this trial. Weight gain, feed efficiency, daily scour scores (1-4 scale: 1=normal, 2=loose, 3=water separation, 4=3 with severe dehydration) and scour days were calculated weekly and for the entire trial. Addition of supplemental amino acids to an 18% CP milk replacer did not improve performance or scour score of calves in this trial.

Item	Trt 1	Trt 2	Trt 3	S.E.
BW gain, kg	12.01[b]	10.87[b]	14.09[a]	0.53
CMR, DM, kg	21.41	20.72	20.85	0.34
Feed/gain	1.80[b]	2.01[b]	1.50[a]	0.09
Scour score	1.33	1.27	1.19	0.05
Scour days	6.50	5.20	4.08	1.00

[a,b] Means within a row differ (P<.05)

Key Words: calf, milk replacer, amino acids

300 *In situ* ruminal phosphorus availability from corn and soybean feedstuffs. K. MJOUN*, K.F. KALSCHEUR, D. J. SCHINGOETHE, and A.R. HIPPEN, *SDSU*, *Brookings, SD, USA*.

Byproducts of corn and soybeans have high phosphorus (P) content, but little is known about their P ruminal disappearance kinetics in lactating dairy cows including water soluble fraction (Ap), slowly available fraction (Bp), rate of phosphorus disappearance (Kd), and effective disappearance of phosphorus (EDp). *In situ* availability of P from corn and soybean feedstuffs was determined in two experiments. In experiment 1, three sources of dried distillers grains with soluble (DGS) and one wet DGS source were incubated for 3, 6, 12, 24, 36 h on replicate days in the rumen of two cannulated lactating dairy cows. Fraction Ap varied from 82.7 to 90.3% with the wet DGS being the least soluble. Wet DGS had a greater (P<0.05) Bp fraction (15.8%) compared to dried DGS (9.5%).Wet DGS had the lowest EDp (88.1%), whereas dried DGS ranged from 89.7 to 92.7%. In experiment two, three ruminally cannulated lactating dairy cows were used to estimate *in situ* P disappearance of nine feed ingredients that include three sources of dried DGS, corn, corn germ, solvent extracted soybean meal (44% CP; SBM), expeller soybean meal (SoyPlus®; SP), extruded soybeans (ES), and soyhulls (SH). Nylon bags were incubated in the rumen of each cow for 2, 6, 12, 18, 24, 36, and 48 h. Fraction Ap was greater (P<0.05) in dried DGS (82.1%) and lesser in corn germ (77%), whereas SH had the least Ap among the feedstuffs (45%). The remaining feedstuffs (SBM, SP, ES, and corn) were similar in Ap (64.2%). Fraction Bp was greater in SH (45.6%), lesser in DGS (13.5%), and intermediate (31.4%) in SBM, EB, SP, and corn. Effective disappearance of P in the rumen was greater for dried DGS (93.5%), whereas corn germ, ES, SBM, and SP followed with an EDp of 93.3, 88.0, 87.5, and 87.0%, respectively. Corn and SH were lower (P<0.05) than the other feedstuffs in EDp with 83.3 and 69.1%, respectively. Rate of phosphorus release (Kd) was similar for all feedstuffs (0.162/hr). Corn and soybean byproducts tested with the exception of SH have high ruminal P availability as measured with the nylon bag technique.

Key Words: phosphorus availability, *in situ*, feedstuffs

301 The effect of roasting field peas on in vitro estimated rumen undegradable protein. T. C. Gilbery*[1], G. P. Lardy[1], M. Caglar-Tulbek[1], M. L. Bauer[1], and V. L. Anderson[2], [1]*North Dakota State University*, *Fargo*, [2]*North Dakota State University*, *Carrington*.

An experiment was conducted to evaluate the effects of dry-roasting and temper-roasting (water + heat) field peas on the rumen undegradable protein (RUP) properties of field peas. Treatments included: 1) dry roasting field peas at 121° and 149°C, for 0 to 14 min (2 min intervals) for a total of 8 time-points for each temperature, and 2) temper-roasted field peas at 121° and 149°C for 14 min only. Field peas were tempered by submerging in distilled water at 50°C for 60 min. After roasting, field pea samples were ground through a 1-mm screen and incubated with ruminal fluid/McDougall's buffer for 18 h. Nitrogen released as ammonia was used to estimate rumen degradable protein (RDP) of field peas which was set to a level of 80% for non-roasted peas; 1 – RDP equaled RUP. There was a temperature x time interaction for RUP ($P < 0.01$) when dry-roasting peas at 121 and 149°C. Dry-roasting field peas at 121°C yielded no difference ($P \geq 0.22$) in RUP. Field peas roasted at 149°C for less than 8 min were not different ($P \geq 0.10$), however, at 8 min RUP (28 ± 3%) was greater ($P = 0.04$) than 0 min. Roasting peas for 10 min at 149°C tended to increase ($P = 0.06$) RUP (27 ± 3%) while roasting for 12 min or longer increased RUP (33 ± 2%; $P \leq 0.001$). There was no tempering x roasting temperature interaction ($P = 0.98$). Tempering and roasting peas for 14 min increased RUP ($P < 0.001$; 54 ± 2% vs. 33 ± 2%, respectively) compared to dry roasted peas.

Key Words: field peas, rumen undegradable protein, roasting

302 In situ dry matter disappearance evaluations of Readco®/calcium oxide treated corn replacement pellets when compared to native forms. J. R. Sewell*[1], L. L. Berger[1], M. J. Cecava[2], P. H. Doane[2], J. L. Dunn[2], M. K. Dyer[3], A. H. Grusby[3], and N. A. Pyatt[2], [1]*University of Illinois*, *Urbana*, [2]*ADM Animal Nutrition Research Center*, *Decatur, IN*, [3]*ADM James R. Randall Research Center*, *Decatur, IL*.

Growth in number of ethanol plants is so rapid that experts are predicting by 2010, ethanol production could reach 56.78 billion L per year, requiring 5.5 billion bushels of corn. Ruminants will be first to reduce corn use due to poor feed efficiency compared to swine and poultry. The goal of this research is to develop a corn replacement pellet (CRP) that will provide similar digestibility, nutrient value, and palatability of corn. A study was conducted to evaluate in situ DM degradation (DMD) of lower quality feedstuffs when processed through a Readco® processor. Objectives were 1) evaluate in situ DMD of Readco® processed corn stover, wheat straw, wheat chaff, and corn fiber/wheat chaff (3:1 blend), with/without dry distillers grains with solubles (DDGS), with/without calcium oxide (CaO), and 2) compare in situ DM degradation of these feedstuffs to their native forms (NAT). The Readco® processor is a continuous mixer with shearing, compounding, and pelleting capabilities. These processes along with additional moisture, CaO, and frictional heat of processing, aid the increase of in situ DMD when compared to its NAT form. DDGS were added to the Readco® prior to pelleting at 25% of final DM. A ruminally cannulated steer was used to determine DMD of each feedstuff for a 48-hour incubation period. When corn stover CRP was compared to NAT ground corn stover DMD increased from 26.7% to 51.1% respectively ($P < 0.0001$). Wheat straw CRP exhibited a similar response increasing in situ DMD from 28.2% to 43.4% ($P < 0.0001$). In situ DMD of wheat chaff CRP increased from 31.5% to 54.9% ($P < 0.004$). The CRP 3:1 blend increased in situ DMD from 43.4% to 75.9% ($P < 0.0001$). CaO increased in situ DMD by 12.7% and 6.3% units respectively when added at 5% of DM to wheat straw and corn stover CRP ($P<0.05$). All treatments except the 3:1 blend showed significant improvement ($P<0.05$) of NDF and ADF when compared to NAT. Overall, chemical/mechanical treatment of the tested feedstuffs significantly increased in situ DMD when compared to NAT.

Key Words: corn replacement pellet, in situ dry matter disappearance, Readco®

303 *In vitro* examination of rumen biohydrogenation (BH) of four dietary fats. M. Carriquiry*[1], W. J. Weber[1], L. H. Baumgard[2], and B. A. Crooker[1], [1]*University of Minnesota*, *St. Paul*, [2]*University of Arizona*, *Tucson*.

Rumen microbial BH of unsaturated fatty acids in dietary fats (Alifet High-Energy® (**AHE**), Alifet-Repro® (**AR**), Megalac® (**MG**), and Energy Booster® (**EB**)) that differ in fatty acid content, method of protection from rumen BH, or both factors was assessed. Fats (20 mg) were incubated at 37°C with strained rumen fluid diluted 5-fold with 16 mL of medium, 0.8 mL of reducing solution buffer and 200 mg of a purified, synthetic diet. Total contents were collected after 0, 6, 24, and 36 h and change in fatty acid content used to estimate rate of BH. For oleic acid, loss after 36 h (about 60%) and rate of BH (4.0 ± 1.3 vs. 6.1 ± 1.9 %/h) did not differ between EB and AHE. For MG, rate of BH was 4-times greater for linoleic than for oleic (4.0 ± 1.3 vs. 0.9 ± 0.2 %/h) acid. Only 20% of the oleic acid but 65% of the linoleic acid disappeared from MG after 36 h. In contrast, BH of oleic, linoleic and linolenic from AR were similar (2.6 ± 1.1, 2.5 ± 1.1, and 2.4 ± 0.9 %/h, respectively) and 95, 65, and 65% of these fatty acids remained after 36 h. Only AHE and AR contained *trans*-18:1 but total *trans*-18:1 increased with time of incubation for all dietary fats. *Trans*-10 and *trans*-11 were the predominant *trans*-isomers in AHE and AR incubations whereas *trans*-9 and *trans*-10 were the predominant isomers in EB and MG incubations. None of the fats contained conjugated linoleic acid (**CLA**) but CLA was in the inoculum. Although not affected by fat source, the amount of CLA decreased with incubation time. Only AR contained eicosapentaenoic (**EPA**, 20:5) and docosahexaenoic (**DHA**, 22:6) and loss of EPA and DHA was minimal (10 and 5%, respectively). The expected increase in BH of fatty acids with degree of saturation occurred with MG but neither degree of saturation nor chain length affected BH of fatty acids in AR. Results suggest that fatty acids in AR are protected from rumen metabolism and that AR can deliver significant amounts of EPA and DHA to the ruminant intestine.

Key Words: biohydrogenation, protected fats, *in vitro*

304 Effects of feeding a polyclonal antibody preparation against selected rumen bacteria on rumen pH of lactating dairy cows. N DiLorenzo*, C. R. Dahlen, J. E. Larson, R. K. Gill, and A. DiCostanzo, *University of Minnesota*, *St Paul, MN, USA*.

A series of experiments were conducted to evaluate the effects of feeding an avian-derived polyclonal antibody preparation against selected proteolytic, amylolytic and Gram negative bacteria (RMT) on rumen pH of lactating dairy cows. Exp 1: 13 rumen cannulated dairy cows in late lactation were used in a cross-over design consisting of a 13-d adaptation period followed by 1 d of sample collection. Cows were fed a basal diet containing 1.72 Mcal NE_l/kg DM, 17.5% CP, 0.65% Ca and 0.35% P. Cows received 10 mL RMT or a preparation made with generic eggs (Control) daily top-dressed at 0900. Rumen pH was measured at 0, 2, 6 and 8 h post feeding on d 14. Exp 2: A batch culture incubation was done using rumen fluid from early lactation donor dairy cows supplemented with RMT or Control (10 ml/d) for 13 d. Flasks (250 mL) were incubated at 39°C with 10% glucose added as substrate. Each flask received 0.5 mL of RMT or Control, and pH was measured over time. Exp 3: Four rumen cannulated dairy cows in early lactation were used in a cross-over design with two 3-d pH-monitoring periods. Cows received 250 mL of RMT or Control solution on d 0 through the rumen cannula. During days -1 to 1, rumen pH was recorded every 20 min by means of an indwelling pH electrode. Exp 1: No significant effects ($P > 0.05$) of RMT were observed in rumen pH of late lactation dairy cows. Exp 2: pH at 4.5 h (6.04 vs. 5.85) and 6 h (5.20 vs. 5.08) of incubation was greater ($P < 0.05$) in flasks infused with RMT. Exp 3: mean daily rumen pH (6.07 vs. 5.75) and mean daily maximum rumen pH (6.82 vs. 6.36) were greater ($P < 0.05$) for cows receiving RMT. Mean daily minimum rumen pH tended ($P = 0.06$) to be greater for cows receiving RMT (5.48 vs. 5.06). Feeding an avian-derived polyclonal antibody preparation against specific rumen microorganisms was effective at maintaining a greater rumen pH in

early lactation dairy cows; this finding may have positive implications on health and performance of dairy cows.

Key Words: antibodies, acidosis, rumen pH

305 Plasma ghrelin and GH concentrations are elevated with long-term feed intake restriction that results in BW change. A. E. Wertz-Lutz*[1], J. A. Clapper[1], D. C. Beitz[2], and A. Trenkle[2], [1]*South Dakota State University*, *Brookings*, [2]*Iowa State University*, *Ames*.

Four steers (BW 566±19.3 kg) were used in a crossover design to determine the effects of long-term feed intake restriction on plasma ghrelin and GH concentrations. A common diet was offered at 2.4 times intake necessary for BW maintenance **(2.4xM)** or 0.8 times intake necessary for BW maintenance **(0.8xM)**. All steers were adjusted to 2.4xM during a pre-trial adaptation period. At initiation of period 1, 2 steers remained at 2.4xM, whereas intake for the remaining 2 steers was restricted to 0.8xM. Feed allotments, in equal aliquots, were offered twice daily at 0800 and at 2000. On 7, 14, and 21 d following initiation of intake restriction, serial blood samples were collected via indwelling jugular catheter at 15-min intervals. Plasma samples were assayed for ghrelin, GH, and NEFA. Subsequent to analyses, hormone data were pooled by hour for statistical analyses. Following period 1, steers were weighed and intake amounts were recalculated. Dietary treatments were switched between steer groups, 2.4xM intake was established, and sampling period 2 was initiated as described for period 1. Data were analyzed statistically as repeated measures in time. Average BW change was -2.2 kg/d for 0.8xM steers and 1.8 kg/d for 2.4xM steers. Elevated ($P<0.001$) plasma NEFA concentrations for 0.8xM compared with 2.4xM steers indicate mobilization of lipid reserves. Plasma ghrelin concentrations for 0.8xM steers were elevated ($P<0.001$) when compared with 2.4xM steers (171 vs. 81 ± 4.5pg/mL, respectively). For 0.8xM steers, plasma ghrelin concentrations were similar regardless of length of restriction (160,196, 156 ± 7.8 pg/mL 7, 14, 21 d, respectively). Plasma GH concentrations for 0.8xM steers were elevated ($P<0.001$) compared with 2.4xM steers (15 vs. 9 ± 0.45 ng/mL, respectively) and remained elevated throughout the imposed restriction. These data are consistent with the hypothesis that ghrelin is involved in tissue remodeling when feed intake is restricted.

Key Words: cattle, feed intake restriction, ghrelin

306 Net energy in finishing diets for steers containing corn or high tannin sorghum. R. Larraín*, D. Schaefer, and J. Reed, *University of Wisconsin*, *Madison*.

The objective of this study was to evaluate the net energy content for maintenance (NEM) and gain (NEG) of finishing diets for steers containing half or all grain as corn and high-tannin sorghum (HTS). Steers (n=42) were randomly allocated to 4 diets containing: 132 g/kg supplement, 100 g/kg corn silage and 768 g/kg grain. Grains were corn (C), HTS (S) and a 1:1 mix (CS). A fourth corn diet was supplemented with 2000 IU•animal^{-1}•d^{-1} vitamin E (E). Animals were individually penned and weighed 408 ± 2.61 kg at the beginning of the trial. Feed was offered and intake recorded once daily. If bunks were clean 2 consecutive mornings, about 450 g were added to the daily ration. Animals were killed in 2 groups after 102 and 123 d. Energy calculations were made using the procedure of Zinn et al. (J. Anim. Sci. 1998. 76: 2239-2246). ANOVA was used to assess differences among diets and shrunk body weight (SBW). Harvest group was used as blocking factor. Multiple comparisons adjusted by Tukey-Kramer were used when ANOVA had $P<0.05$. Values for NEM expressed as Mcal/kg DM were 2.41 ± 0.047, 2.28 ± 0.049, 2.43 ± 0.047 and 2.49 ± 0.049 for diets C, S, CS and E, respectively. Diet S was lower than E ($P=0.022$). Values for NEG (Mcal/kg DM) were 1.69 ± 0.041, 1.59 ± 0.043, 1.72 ± 0.041 and 1.77 ± 0.043 for diets C, S, CS and E, respectively. Diet S was lower than E ($P=0.021$). Shrunk BW was 612.1 ± 9.87 kg for C, 572.1 ± 10.34 for S, 606.5 ± 9.87 for CS and 624.9 ± 10.34 for E. Although the difference between C and S was not significant for both NEM and NEG ($P=0.24$ and 0.32), the magnitude of the difference was reflected in a reduction in SBW ($P=0.039$). The differences in both NEM and NEG between E and S were also reflected in the different SBW ($P=0.005$) of the steers. There was also a tendency for higher SBW between CS and S ($P=0.094$). Finishing diets containing HTS as their only grain produced animals with lower SBW, although NEM and NEG were not different compared to a corn diet. A 1:1 mix of corn and HTS had the same energy value and produced steers with same SBW as a corn-based diet.

Key Words: energy, sorghum, steers

307 Evaluation of a diet containing mustard bran for lactating dairy cows. H. A. Maiga*[1], C. Dahlen[2], P. Nester[3], M. L. Bauer[3], and M. Badaruddin[4], [1]*University of Minnesota*, *Crookston*, [2]*Northwest Research and Outreach Center*, *Crookston, MN*, [3]*North Dakota State University*, *Fargo*, [4]*Minn-Dak Growers, Ltd.*, *Grand Forks, ND*.

Thirty four lactating Holstein cows (DIM ≥ 50 d) were used in a switch back design to determine the lactational and DMI responses to a diet containing 8% oriental mustard bran (MB) versus a control diet (CONT). A by-product of mustard seed milling industry, oriental mustard bran is a good source of crude protein (17.5%), crude fat (16.5%) and NDF (45-60%). Mustard bran replaced 26% of CP from soybean meal in the CONT diet. Treatment periods were 14 d with each period preceded by a baseline period of 14 days of which the last seven days were used as a covariate to adjust treatment means if $P \leq 0.15$. DMI and daily milk yield data were collected during the entire baseline and treatment periods. Milk composition data were collected during the last five days of baseline and treatment periods. Milk organoleptic evaluation was conducted only during the last five days of the second period. Milk yields (43.0 and 44.7 ± 0.3 kg/d) were higher ($P = 0.007$) for cows fed the MB diet; however, the 3.5% FCM yields (42.8 and 43.5 ± 0.4 kg/d) were similar ($P = 0.29$) for cows fed CONT and MB diets, respectively. Percentages of milk fat, protein, lactose, SNF, and total solids were not affected ($P \geq 0.07$) by treatment. Milk fat yields (1.49 and 1.48 ± 0.02 kg/d) were similar ($P = 0.80$). Milk protein yields (1.22 and 1.27 ± 0.01 kg/d), lactose yields (2.10 and 2.18 ± 0.02 kg/d), and SNF (3.33 and 3.45 ± 0.03 kg/d) were higher ($P < 0.004$) for cows fed the MB diet. Milk urea N (13.2 ± 0.2 mg/dL) and SCC (208 ± 63x10^3/mL) were not affected ($P \geq 0.13$) by treatment.

There were no differences (P ≥ 0.07) between the organoleptic qualities (odor and taste) of milk from cows fed either diet. DMI (24.0 and 24.1 ± 0.2 kg/d) were similar (P = 0.70). Adding mustard bran to lactating cow diets increased daily milk production, but did not affect DMI or adversely affect milk components or quality.

Key Words: mustard bran, DMI, lactating cows

308 Altering milk production and composition of early lactation dairy cows fed flax seed. P. L. Nester*, J. W. Schroeder, K. A. Vonnahme, M.L. Bauer, W. L. Keller, and D. E Schimek, *North Dakota State University*, *Fargo, North Dakota, USA*.

The objective of this study was to measure the effects of feeding ground flax seed on body weight (BW), body condition score (BCS), milk yield, and milk composition of early lactating dairy cows. Twenty-four multiparous Holstein cows (644.4 ± 21.9 kg BW and 7 ± 3 d in lactation) were assigned to one of three treatments in a randomized complete block design of 12 cows/block. Experimental diets containing whole sunflower seed (CON; 8.32% of diet DM), ground flax seed (FLX; 10.06% of diet DM), or linseed oil (LIN; 3.37% of diet DM) were fed from d 7 through d 105 in lactation. Diets were balanced to be similar in energy density (1.68 Mcal/kg of NE_L), crude protein (CP; 17.4%), and CP degradability by combining corn gluten meal, blood meal, feather meal, sunflower meal, and urea with ground corn and equal portions of vitamins, minerals, and monensin (13 mg/kg of DM). Experimental diets contained equal portions of alfalfa hay, alfalfa haylage, corn silage, and beet pulp. Cows were housed individually in tie-stalls and fed twice daily. BW, BCS, and milk samples were collected at d 7 and every 14 d of the experiment. Cows were milked and weights recorded twice daily. Initial BW and BW change were similar ($P \geq 0.12$) among treatments. Cows fed LIN had higher initial BCS ($P = 0.002$) and lost more body condition ($P = 0.02$). Milk yields were similar ($P = 0.23$) among treatments, but yield of 3.5% fat-corrected milk (FCM) and solids-corrected milk (SCM) were higher ($P \leq 0.03$) for cows fed FLX. Concentrations of milk fat ($P = 0.06$) and milk urea nitrogen ($P = 0.01$) were greater for cows from the FLX treatment. However, cows fed FLX or LIN had lower percentages of milk protein, lactose, and solids-not-fat ($P \leq 0.05$) when compared to CON. Diets for early lactating dairy cows supplemented with 10% ground flax seed increases milk fat concentration and yields of FCM and SCM when compared to diets supplemented with linseed oil or whole sunflower seed, although the mechanism is unclear.

Key Words: flax seed, linseed oil, sunflower seed

309 Response of yearling Holstein steers to ractopamine hydrochloride. J. W. Lehmkuhler* and M. Ramos, *University of Wisconsin*, *Madison*.

A total of 192 yearling Holstein steers were utilized to investigate the response to ractopamine hydrochloride. Three different groups of yearling Holstein steers (n= 57, 59 and 76) were finished at one of two sites over a two year period. Steers were stratified by weight and blocked into two groups. Steers were implanted with a single combination implant following the warm-up period after being removed from pasture. Treatments investigated were control versus 200 mg of ractopamine hydrochloride for the last 33 days prior to harvest. Animals were slaughtered at commercial processing sites and data were collected following either a 24 or 48 h chill. Carcasses were assigned a grid classification score of 1-4 based upon ribeye area similar to a common Holstein grid. Data from the separate trials were pooled for analysis resulting in a total of 14 pens per treatment. Data were analyzed using a mixed model analysis with pen being the experimental unit while test site and block were used as random variables in the model. Initial average pen weights were not different between the treatments (P=0.84). Following the 33 d treatment period, live weights at slaughter were heavier for steers receiving ractopamine (P=0.03). Yearling Holstein steers receiving ractopamine had ADG that were 19% greater than controls (P<0.01). Hot carcass weight, backfat thickness, ribeye area, marbling score and grid classification were similar across treatments (P>0.05). These data suggest that the inclusion of ractopamine hydrochloride into the finishing diet of yearling Holstein steers 33 d prior to slaughter improved animal performance without having detrimental effects on carcass characteristics.

Key Words: feedlot, holstein steer, ractopamine hydrochloride

310 Performance and carcass effects of increasing dietary fat in finishing diets containing no roughage. D. O. Alkire* and M. S. Kerley, *University of Missouri*, *Columbia*.

One hundred and fifty-seven crossbred calves (56 heifers and 101 steers; 362 kg) were used to evaluate the effects of supplemental fat in finishing diets with or without roughage. Treatments were arranged in a 2 x 2 x 2 factorial with main effects of dietary fat (6.5 % vs. 4.2 % total fat), roughage (10 % of total diet or no roughage), and sex. All diets were formulated to provide adequate post-ruminal amino acid flow and either met or exceeded NRC recommendations. Animals were housed in a total of 16 pens with 2 pens per treatment per sex. For performance evaluation, individual pen was the experimental unit. There were no interactions ($p > 0.19$) for total gain, ADG, feed efficiency (FE), days on feed (DOF) or feed intake. Inclusion of roughage had no effect on total gain, ADG, FE, or DOF ($p > 0.13$). However, animals fed roughage had a greater average daily intake ($p < 0.01$) compared to those fed roughage-free diets (9.9 kg/d and 8.75 kg/d respectively). Neither supplemental fat nor sex had an effect on growth performance ($p > 0.10$). For carcass measurements, individual animal was the experimental unit. There were no interactions ($p > 0.12$) for HCW, marbling, backfat (BF), REA, KPH, or YG. No effects were seen in HCW, marbling, BF, REA, or YG due to roughage inclusion. However, animals fed roughage free diets had slightly higher KPH compared to those fed roughage ($p < 0.02$; 2.56 and 2.33 %, respectively). Fat supplementation resulted in a decrease in REA ($p = 0.06$; 74.9 vs. 79.9 cm2) but had no effect on other carcass measurements ($p > 0.16$). Numerically, fat supplementation increased BF, KPH, and YG supporting the reduced REA observation. An effect of sex was noted for both BF thickness ($p < 0.01$) and marbling number ($p < 0.04$). Heifers had 1.1 cm of BF and a marbling number of 43.6 while steers had 1.3 cm of BF and a marbling number of 40.2.

Inclusion of roughage in these finishing diets had no impact on growth performance and little effect on carcass measurements. In addition, fat supplementation caused a decrease in REA.

Key Words: fat supplementation, no roughage diets, carcass measurements

311 The effects of natural source vitamin E supplementation on reproductive efficiency in beef cows. M. J. Richardson*[1], S. L. Lake[1], R. P. Lemenager[1], N. Pyatt[2], and M. Hilton[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

The objective of this study was to determine the effect of supplemental natural-source vitamin E (NSVE) and a commercially available mixture containing NSVE on reproductive efficiency in beef cows. Eighty Angus-cross beef cows (initial BW = 608 kg; initial BCS = 5.9) were randomly assigned to one of three isocaloric dietary treatments: 1) corn-based supplement with no added vitamins or minerals (CON), 2) corn-based supplement containing 1000 IU NSVE/d (VITE), and 3) corn-based supplement containing a commercially available mixture formulated to contain 1000 IU of NSVE/d (VITE+). Supplementation began 5 wk prepartum and continued through wk 8 of lactation. Beginning 20 d postpartum, blood samples were collected every 7 d to determine return to estrus. Cows were synchronized using Co-Synch + CIDR and bred by AI based on heat detection. Non-responding cows were time bred (AI) sixty-six hours after prostaglandin injection. Cows returning to estrus following AI were bred by natural service. Dietary treatment did not affect change in BCS ($P = 0.65$) or BW ($P = 0.31$). A greater percentage of cows supplemented with VITE and VITE+ ($P = 0.08$) were cycling prior to the breeding season (CON 48.0%, VITE 65.4%, VITE+ 79.2%). First service ($P = 0.40$; CON 25.9%, VITE 40.7%, VITE+ 42.3%) and overall conception rate ($P = 0.52$) were not different due to dietary treatment. However, more VITE and VITE+ supplemented cows tended ($P = 0.15$; CON 55.5%, VITE 66.7%, VITE+ 80.7%) to be bred through the first two breeding cycles compared to CON cows. The data indicates that supplementation of VITE and VITE+ appeared to decrease PPI, resulting in a tendency for a greater percentage of cows to be bred during the first two cycles of the breeding season. Therefore, supplementing NSVE has potential to be used as a strategy to improve reproductive efficiency in beef cows.

Key Words: beef cows, reproduction, vitamin E

312 Effects of natural vs. conventional feedlot protocol on performance and carcass characteristics in beef heifers. P. J. Gunn*, S. L. Lake, K. Hendrix, and D. Lofgren, *Purdue University*, *West Lafayette, IN*.

Forty-one spring-born Angus heifer calves (270 ± 21 kg initial BW) were randomly assigned post-weaning to either a conventional feedlot protocol (85% corn-based diet with Rumensin, Tylan, MGA, and implanted with Revalor I-H at both d 30 and 120; Control) or a natural protocol (85% corn-based diet; no additives or implants; Natural) to determine the effects of such protocols on heifer performance, carcass quality, and carcass value. Diets were fed to meet or exceed dietary requirements of a finishing heifer with free access to water. Heifers were fed to a common 12th rib fat depth endpoint (1.3 ± 0.1 cm) and carcass data were obtained from official USDA graders at the harvest facility. Control heifers had a greater ADG ($P < 0.01$; 1.34 vs. 1.19 kg), heavier finish weight ($P = 0.03$; 503 vs. 481 kg), HCW ($P = 0.01$; 324 vs 304 kg), and a higher dressing percent ($P = 0.01$; 64.4 vs 63.2) compared with natural heifers. Days on feed ($P = 0.49$) and DMI ($P = 0.37$) were not affected. Although REA was smaller in natural heifers ($P = 0.04$; 76.1 vs. 73.5 cm^2), 12th rib fat depth ($P = 0.43$), marbling ($P = 0.62$), yield grade ($P = 0.41$), and G:F ($P = 0.31$) were not affected by finishing protocol. Natural heifers tended to have a greater percentage of carcasses grading choice or prime ($P = 0.17$; 100 vs. 90.5%). However, the combination of heavier HCW and acceptable quality from control heifers resulted in a greater numerical carcass value ($P = 0.27$; $944.96 vs. $910.24). Due to the cost of additives and implants in the conventional protocol, cost to finish weight was $13.20/hd greater for control heifers. Although there was no significant difference in carcass value, the control protocol resulted in a net increase of $21.52/hd for conventionally fed heifer calves. Heifers from each protocol had statistically similar carcass values and a similar quality end product; however, data from the current study showed a numerically greater net value for conventionally finished heifers.

Key Words: beef heifers, conventional, natural

313 Production responses of dairy cows fed wet distillers grains during the transition period and early lactation. G. S. Mpapho*, A. R. Hippen, K. F. Kalscheur, and D. J. Schingoethe, *South Dakota State University*, *Brookings, SD, USA*.

Thirty-four multiparous Brown Swiss (n = 16) and Holstein (n = 18) cows were used in a randomized block design to determine the effects of feeding wet corn distillers grains (WDG) on transition cow performance. Cows were randomly assigned to one of two treatments and blocked by breed and expected calving date. Experimental diets contained 25% corn silage and 25% alfalfa hay (DM basis). The treatment group was fed WDG at 15% of diet DM. In the control diet (CON), WDG was replaced by corn grain, soybean meal, and extruded and expeller soybean meals. The energy density and crude protein were 1.44 and 1.58 Mcal NEl/kg and 14.5 and 17.2 % for pre- and postpartum diets, respectively, and were similar for CON and WDG. Prepartum diets were fed from -28 days in milk (DIM) until calving whereas postpartum diets were fed from calving to 70 DIM. Prepartum dry matter intake (DMI) tended to be greater for cows fed CON than WDG (14.2 and 12.2 kg; P = 0.10) whereas postpartum, DMI did not differ between treatments (22.5 and 23.2 kg; P = 0.46). Cows fed WDG had a shorter transition period than those fed the CON diet (22.2 vs 27.0 d). Milk production during the first 70 DIM for CON and WDG (41.6 and 40.1 kg/d; P = 0.41) and 4% fat-corrected milk (42.2 and 40.1 kg/d; P = 0.21) were not different. Concentration and yield of milk components were also not affected by diet, except for milk protein percentage which was decreased for CON diet (2.98 and 3.10 %; P = 0.03). Milk urea nitrogen did not differ between the two treatments but was greater for Brown Swiss than Holstein cows (13.6 and 11.8

mg/dL; P = 0.04). Body weight (BW) at the beginning of the transition period for CON and WDG was not significantly different; however, cows fed WDG lost less BW relative to those fed CON diet (52.6 vs 66.2 kg; P < 0.05) postpartum (0 to 21 DIM) and tended to increase BW (21 to 70 DIM) at a greater rate (39.3 vs 17.7 kg; P < 0.05). Feeding wet distillers grains throughout the transition period did not effect production but improved BW.

Key Words: transition cows, distillers grains, milk production

314 Effect of source of selenium and vitamin E supplementation on performance and immune response in young dairy calves. M. Mahmoud*[1], L. Braun[1], A. Hippen[1], C. Chase[1], and A. Harrison[2], [1]*South Dakota State University*, *Brookings*, [2]*Alltech, Inc.*, *USA*.

Selenium (Se) and vitamin E are essential dietary nutrients for ruminants. The objectives of the study were to evaluate the effect of source of Se, and the interaction of source of Se and vitamin E dosage, on growth, performance, and immune response of dairy calves. Twenty four 1-d old Holstein calves were divided into four treatment groups (three males and three females in each group) and supplemented with:1. 0.3 ppm Sel-plex (organic Se) and 1000 IU of vitamin E/calf/day. 2. 0.3 ppm Sodium selenite and 1000 IU of vitamin E/calf/day. 3. 0.3 ppm Sel-Plex and 250 IU of vitamin E/calf/day, and 4. 0.3 ppm Sodium Selenite and 250 IU of vitamin E/calf/day. Treatments were incorporated into milk replacers and starter feeds and fed for 85 days. Immune responses were evaluated by PHA-stimulated lymphocyte proliferation and phagocytosis assays. Animal performance parameters and health parameters were also measured. The proliferative response of lymphocytes to PHA stimulation was greatest in females across all treatments, particularly in treatment 1 which averaged 0.32 for females compared with 0.18 for males (p < 0.01). Phagocytosis in contrast was greater in males in 3 out of 4 treatments with the greatest response in treatment 4 which averaged 77.33 compared with 62.70 for females in treatment 2 (p <0.01) . The DMI of males in treatment 2 were significantly greater than for females in treatments 3 and 4, and averaged 15.64 Kg/week, 11.99 Kg/week,and 11.69Kg/week respectively(p <0.04 and 0.02 respectively) .The ADG was the least in treatment 4 compared with treatment 2 (0.79 vs. 0.97 Kg/d, p < 0.01). For feed: gain ratio, treatment 4 was greatest compared with treatment 1(2.70 vs. 2.01 Kg feed per Kg gain, p < 0.01). Treatment 1 had the least and treatment 4 had the greatest number of sick days. We concluded that 1000 IU/d of vitamin E and organic selenium improved animal performance.

Key Words: vitamin E, selenium, calves

315 In vitro release of ammonia nitrogen from various nitrogen sources in batch culture. N. DiLorenzo* and A. DiCostanzo, *University of Minnesota*, *St. Paul*.

An experiment was designed to evaluate the kinetics of NH_3-N release in batch culture. Rumen fluid was collected from an Angus steer fitted with a rumen cannula at 0900 h prior to feed delivery. The steer was adapted (> 30 d) to receive a diet of 95% corn silage and 5% protein supplement (DM basis). Batch cultures were conducted in 250-mL flasks fitted with a one-way rubber valve, which were inoculated with a 1:4 solution of rumen fluid:nutritive solution. Treatments (sources of N) were: blank (BLK; no N source added), Nitroshure™ (NTS; Balchem Encapsulates, New Hampton, NY), soybean meal (SBM), biuret (BIU), urea (URE), or Fermenten® (FER, Church & Dwight Co., Inc, Princeton, NJ). All flasks except BLK received equal amounts of N (155 mg; equivalent to 2 g of SBM) based on their N content. Ammonia N in rumen fluid was measured at 0, 0.5, 2, 4, 6, 8, 12 and 24 h. The study was analyzed as a completely randomized design with 8 replicates per treatment, and repeated measures over time. A significant treatment x time interaction was observed (P < 0.01). From 4 to 24 h, URE led to greatest (P < 0.05) NH_3-N release, and greater (P < 0.01) NH_3-N release when compared to that elicited by NTS at all times. From 4 to 24 h, BIU had the lowest (P < 0.05) NH_3-N concentrations of all the NPN sources, demonstrating the reduced biuretase activity in the rumen of cattle not adapted to biuret. During the first 2 h, FER had the greatest (P < 0.05) NH_3-N release. The release of NH_3-N by FER was greater (P < 0.01) than NTS, BIU, SBM and BLK at all times. The patterns of NH_3-N release by the sources of N tested in vitro showed marked differences. Synchrony between rumen carbohydrate fermentation rates and release of NH_3 is one of the primary goals to maximize microbial crude protein synthesis. Thus, choosing the source of N that best matches the carbohydrate fermentation profile may improve animal performance.

Key Words: batch culture, beef, non-protein nitrogen

316 Relationships among ewe body condition scores, lamb vigor, colostral quality, milk composition and reproductive performance. K. J. Rozeboom, B. D. Neale, and C. S. Darroch*, *University of Tennessee*, *Martin*.

This study focused on the relationships among ewe body condition scores (BCS) at lambing, lamb vigor scores, colostral immunoglobulin G (IgG) levels, milk composition, and ewe reproductive performance in a group of 50 Suffolk cross ewes aged 1-6 years. BCS were assigned at lambing and varied from 1.5 to 3.5. BCS did not affect the number of lambs born, or milk fat and protein levels at 30 or 60 d lactation. The average birth weight of lambs 4.4±.13 kg was positively correlated (P=0.06) with ewe prolificacy. Colostral IgG averaged 606±37.5 mg dl^{-1} and was not affected by BCS, but IgG levels were positively correlated with ewe age (P<0.01), height (P<0.01) and body weight (P<0.06) at lambing. IgG was significantly lower (500±46.5 mg dl^{-1}) in 1-2 year old ewes when compared to IgG levels (702±50.5 mg dl^{-1}) in ewes aged 3-6 years. Ewes in the same age ranges had different (P<0.05) total lamb birth weights of 6.9±.51 kg and 8.4±.44 kg respectively, and lamb birth weights were positively correlated (P<0.01) with percentage of lambs weaned at 60 d. While BCS did not influence IgG levels in colostrum, ewe age and body weight may have impacted IgG levels. This may have contributed to observed improvements in lamb birth weights and ewe prolificacy.

Key Words: ewe, body condition score, immunoglobulin G

317 Effects of growth hormone at breeding on the offspring's insulin-like growth factor-I (IGF-I) response to growth hormone releasing hormone challenge. J. M. Koch*, C. O. Lemley, and M. E. Wilson, *West Virginia University*, *Morgantown, WV, United States*.

Lambs born less than 2 kg account for 80% of all mortality observed in the first days following birth. However, if these lambs were to be born only 0.5 kg heavier their chance of survival would increase 50%. Our laboratory is examining how growth hormone (GH), given at breeding, may positively stimulate fetal growth and development. Previously, we demonstrated that lambs born to ewes treated with GH are 25% larger at birth and appear to have an altered body composition compared to control lambs. Therefore, the objective of the current experiment was to assess how GH given at breeding may alter the GH endocrine axis in lambs born to treated dams. Ewes were synchronized using two injections of prostaglandin 8 days apart and the day of the second injection half of the ewes received 500 mg of sustained release GH. All ewes were penned with a fertile ram. At birth a serum sample was collected from all lambs to determine IGF-I concentrations. At 100 days-of-age ewe lambs were weighed and challenged with growth hormone releasing hormone. At 0, 10, 20, 30, 45, 60 and 90 minutes following challenge plasma was collected for determination of plasma IGF-I. Lambs born to treated ewes were 23% heavier than control lambs at day 100 (34.7 ± 1.7 vs. 28.0 ± 2.1 kg; $p < 0.05$). Overall, during the GH releasing hormone challenge the control lambs had a greater IGF-I response than the GH lambs with the control lambs reaching a maximum concentration of 0.36 ± 0.12 ng/ml ($p < 0.05$) while the GH group reached a maximum concentration of 0.19 ± 0.05 ng/ml which was similar to the control starting concentration (0.19 ± 0.04 ng/ml). At birth the growth hormone group had a tendency for a decreased level of IGF-I with a 50% reduction in IGF-I compared to control (0.29 ± 0.07 vs. 0.59 ± 0.15; $p = 0.09$). The data reported here are consistent with our previous observation that GH lambs have a decrease in liver expression of GH receptor and IGF-I. Overall, GH treatment at breeding appears to alter the GH axis in GH lambs leading to larger lambs at birth, that tend to weigh more at 100 days.

Key Words: growth hormone, IGF-I, challenge

Swine Extension

318 Pork Information Gateway attracts new users looking for swine and pork information. D. J. Meisinger*[1] and M. T. See[2], [1]*US Pork Center of Excellence*, *Ames, IA*, [2]*North Carolina State University*, *Raleigh*.

The U.S. Pork Center of Excellence (USPCE) launched the Pork Information Gateway (PIG) in June, 2006. The website address is www.porkgateway.com. PIG contains 200 peer-reviewed fact sheets, over 1200 references, 550 definitions in a glossary, and over 2000 frequently asked questions and answers. In addition, an event calendar provides the latest information on swine extension meetings around the country. The site is public and free although to view the answers to questions in the system, one must register. Only those individuals connected to the pork industry as producers, extension educators, teachers, researchers, or allied industry can be designated as premium users which allows these individuals to submit questions to PIG. Several advisory committees representing 75 extension personnel and others are prepared to provide answers to submitted questions in a timely manner. The questions and answers then become part of the database. After only three months of operation, the site had over 300 registrants and over 5000 page views per month. Co-branding of the website is an option offered all partners. The USPCE is a public/private partnership with partners consisting of 22 universities, 11 state pork associations, National Pork Board, National Pork Producers Council, USDA Agricultural Research Service (ARS), and USDA Cooperative State Research Education and Extension Service (CSREES). The mission of the organization is to add value to the pork industry by facilitating research and learning for U.S. pork producers through national collaboration.

Key Words: Pork Information Gateway, swine extension, electronic information delivery

319 Characteristics of U.S. boar studs. T. Safranski*, *University of Missouri*, *Columbia*.

Proportion of U.S. sows mated by artificial insemination has grown from less than 25% to over 80% in the past 15 years. Semen comes from a variety of boar studs; there exists no organization representing them and no systematic characterization of their productivity has been performed. A two-day seminar was offered in 2004 for managers of boar studs. Over 135 registrants participated. They represented 10,124 boars and 70 studs from 18 states, estimated to be about half of the boars in stud in the U.S. One representative per stud was asked to complete a survey tool, a summary of which follows. Inventory averaged 158 boars with a range from 0-690. Of respondents 13 had 20 or fewer and 11 had 300 or more boars inventoried. Staffing averaged 3.9 full-time and 2.2 part-time workers. The oldest stud was over 30 years old, but 52 were built since 1995. This is consistent with the history of utilization of artificial insemination in the U.S. Fourty-six studs used some combination of stalls and pens to house boars with 6 and 18 using pens and stalls exclusively, respectively. Average output was 3,862 useable doses per week, or 24.4 per boar inventoried. On average 8.3% of ejaculates were discarded, but the range was wide; 17% of studs discarded less than 5% of ejaculates, 36% less than 10%, 10% less than 15% and the remainder discarded 15-25% of ejaculates. Quality problems were identified as overwhelmingly associated with retention of cytoplasmic droplets with 52% of respondents claiming them to be the number 1 and 33% the number 2 quality problem. Respondents indicated 3.3% of boars were unable to be trained to mount the dummy. Over 20% claimed no boars were untrainable, and only 12.5% of studs found 10% or more of boars untrainable. Delivery of semen was mostly achieved with their 'own courier' (73.5%), with 'overnight', 'picked up' and 'other' representing 8.6, 1.1 and 7.5%, respectively. Survey results suggest that boar studs have a reasonably high degree of productivity. It is recognized that this group represented studs managed by those willing to commit two days to manager training and may somewhat overestimate U.S. productivity.

Key Words: boar stud, survey

320 The economic analysis of feeding cull sows to heavier weights. R. F. Fitzgerald*, K. J. Stalder, L. Karriker, C. J. Johnson, L. Layman, T. J. Baas, and J. W. Mabry, *Iowa State University*, *Ames*.

The objective of this study was to estimate the quantity of feed and associated costs of adding BW to thin cull sows. Twenty-nine sows were purchased from an integrated pork operation, placed into pens (n = 12) and gestation crates (n = 17), and categorized into one of five initial BCS. Sows were fed ad lib and were removed from the trial upon reaching a BCS of 5 or failing to gain weight for 4 consecutive wk. Performance measures (ADG and G:F) were calculated from daily recorded feed intake and bi-wk BW gain. Data represent the incremental performance of adding 1, 2, 3, or 4 condition scores to sows from each initial BCS. Jowl, heart, and flank girth measurements along with tenth and lastrib back fat, loin muscle area, and loin depth were collected approximately every 14 d. Statistical analysis was performed using PROC MIXED of SAS (SAS Inst., Inc., Cary, NC). Initial BCS and housing type were included as fixed effects and initial BW nested within initial BCS was included as a linear covariate in analysis models. Using lastrib back fat, 8 (Mean±SEM of BW (kg), 199.43±11.36), 17 (235.99±9.66), and 4 (264.74±11.82), sows were initially classified into body condition scores of 1, 2, and 3, respectively. Gain:Feed was most efficient (P = 0.03) for sows that began the trial as a BCS 1 (0.44 kg/kg) and increased 1 score when compared to the efficiency of adding an additional BCS to sows that initially had a BCS of 2 (0.28 kg/kg) or 3 (0.21 kg/kg) . The ADG when adding a single BCS to sows with initial BCS of 1, 2, or 3 was 2.04, 1.62, and 0.96 kg/day, respectively. As sows increased BCS, the efficiency of adding weight decreased within all initial BCS. After sows added their first BCS, sows decreased in G:F and ADG by as much as 15 to 50 %, regardless of which BCS the sows were categorized at trial initiation. Breakeven prices were estimated for 3 feed costs ($0.11, $0.15, and $0.20 / kg) and 4 daily fixed costs ($0.25, $0.50, $0.75, and $1.00) levels. Weight could be profitably added to cull sows when feed prices were below $0.15 kg-1 and fixed costs below $0.50 $sow^{-1}*day^{-1}$.

Key Words: body condition score, performance, cull sows

321 Determination of diurnal feed intake pattern of multiparous lactating sows when fed ad libitum. R. E. Howdyshell*[1], D. C. Mahan[1], and D. G. Levis[2], [1]*The Ohio State University*, *Columbus*, [2]*Southeast Research and Extension Center, University of Nebraska*, *Ithaca, NE*.

Multiparous Yorkshire-Landrace sows (n=89) from two farm units were evaluated from 7 to 21 d postpartum from June to September, 2004 to determine the quantity and duration of feed consumed ad libitum over 24 h periods. Six sows were randomly selected from each group with data collected continuously starting at 0600. Sows were housed in crates and fed conventional C-SBM diets provided ad libitum from d 3 postpartum to weaning. Sows were individually monitored for 24 h to determine duration of feed consumption but at 6 h intervals feed intake was measured. Environmental temperatures were recorded at 3 h intervals. The data were analyzed by least squares analysis of variance and each variable correlated to feed intake. The results demonstrated that feed intakes for 0000-0600, 0600-1200, 1200-1800, and 1800-2400 were 1.53±0.08, 2.50±0.14, 1.25±0.10, and 1.11±0.10 kg, respectively. Duration of feed consumption for these periods was 16.6±1.4, 46.1±2.7, 17.4±1.8, and 17.7±1.3 min, respectively. Total duration of time eating (TDTE) was 97.98±4.3 min/d. Average backfat was16.0±0.4 mm, body weight 219.3±3.2 kg, and litter size 9.3±0.2 pigs. A negative correlation occurred between backfat and total feed intake (-0.39; P=.01). A correlation of 0.40 was found between litter size and TDTE (P=.01). Body weight and TDTE were negatively correlated (-0.29; P=.02). A positive trend was determined between day of lactation and TDTE (P=0.08). Similar results were found at both locations. The crate temperature ranged from 23-27 °C at Farm 1 and 22-29 °C at Farm 2. Likewise, the outside temperature ranged from 19-26 °C at Farm 1 and 20-29 °C at Farm 2. Room °temperatures ranged from 23-26 °C at Farm 1 and 23-31 °C at Farm 2. These results suggest that over 62% of the daily feed intake of lactating sows occurred between midnight and noon. Future feeding strategies should reflect sow responses by providing access to feed during times of active consumption.

Key Words: feed intake, lactation, sow

322 Effect of "Skip-a-Heat" breeding on reproductive performance of weaned first parity sows. A. Wellen*, J. Patterson, P. Zimmerman, M. Dyck, and G. Foxcroft, *Swine Research & Technology Centre, University of Alberta.*, *Edmonton, Alberta, Canada*.

The relative lack of an effect of lactational catabolism on many measures of post-weaning fertility is evident in contemporary commercial primiparous sows. However, second parity litter size is still often negatively impacted ("second parity dip") in sows that lose large amounts of body tissues during first lactation. In earlier studies, sows bred at the second ("skip-a-heat") compared to their first estrus after weaning, an increase in total litter size born was reported but increased the risk of sows not returning to 2nd estrus. The present study re-examined the response to "skip-a heat" breeding in contemporary commercial dam-line sows. Based on similar weaning-to-estrus intervals (111.7 ± 5.8 vs. 113.6 ± 5.9 h), pairs of first parity sows were allocated to be bred at either their 1st (PE1) or 2nd (PE2) post-weaning estrus. Twenty-four hours after detection of the onset of estrus, and every 8 h until ovulation, real time ultrasonography was used to measure the diameter of the largest pre-ovulatory follicle. At breeding, the largest follicle detected in PE2 sows was greater ($P \leq 0.05$) (8.2 ± 0.2; range 4.9 to 9.9 mm) than PE1 (7.2 ±0.2; range 4.9 to 9.9 mm) sows. Sow weight-change to breeding, was greater in PE2 than PE1 sows (11.9 ± 1.6 vs. -7.2 ± 1.6 kg, respectively; $P \leq 0.05$). The percentage of PE2 and PE1 sows bred (96.0 vs. 100.0 %, respectively) and pregnant at d 30 of gestation (91.7 vs. 92.6 %, respectively) did not differ. Reproductive tracts were recovered after slaughter at 30.0 ± 1.5 d of gestation and dissected on-site. In the absence of any difference in ovulation rate in PE1 and PE2 sows (19.6 ± 0.6 vs. 19.0 ± 0.6, respectively), PE2 sows had greater numbers of live embryos (15.2 ± 0.8 vs. 12.9 ± 0.8, respectively; $P \leq 0.05$) and higher embryonic survival (77.4 ± 3.6 vs. 68.1 ± 3.6 %; respectively; $P \leq 0.05$) than PE1 sows. This study confirms that breeding weaned first parity sows at 2nd post-weaning estrus increases potential litter size, mainly as a result of increased embryonic survival to d30 of gestation.

Key Words: weaned sow, Skip-a-heat, productivity

323 Responses to delayed estrus after weaning in sows using oral progestagen treatment. J. Patterson*[1], A. Wellen[1], M. Hahn[1], M. Smit[1], A. Pasternak[1], J. Lowe[2], S. DeHaas[2], D. Kraus[2], N. Williams[3], and G. Foxcroft[1], [1]*Swine Research & Technology Centre, University of Alberta*, *Edmonton, Alberta, Canada*, [2]*The Maschhoffs, Inc*, *Carlyle, IL*, [3]*PIC, Inc.*, *Franklin, KY*.

In weaned sows, oral progestagen treatment extends the weaning-to-estrus interval (WEI). Particularly in lower parity sows, this may allow recovery from lactational catabolism and improve sow productivity. However, the optimal duration of progestagen treatment in contemporary dam-line sows is unclear. Therefore, sows (n = 552) weaned over consecutive 3-wk periods in July and August were organized into two breeding groups using one of three strategies: 1) No progestagen treatment (NAT0; n = 179); 2) Oral progestagen (MATRIX™) treatment for 2 d before and 5 d after weaning (MAT7; n = 207); or 3) MATRIX™ for 2 d before and 12 d after weaning (MAT14; n = 166). MATRIX™ was administered directly into the sows mouth at a dosage of 6.8 mL (15 mg altrenogest) daily. Sows were bred using artificial insemination at first detection of estrus after weaning (NAT0) or MATRIX™ withdrawal and every 24 h thereafter, until they no longer exhibited the standing reflex. The WEI for NAT0 sows was 5.1 ± 0.1d. Estrus was recorded sooner after withdrawing treatment (P ≤ .0001) in MAT14 than in MAT7 sows (6.9 ± 0.1 vs 7.4 ± 0.1 d, respectively). More (P < .0001) MAT14 sows (88.6 ± 2.5 %) were bred within 10 d of MATRIX™ withdrawal than MAT7 (71.0 ± 3.2 %) sows, or within 10 d of weaning in NAT0 sows (77.1± 3.1 %). Reproductive tracts were recovered after slaughter at either d30 or d50 of gestation and dissected on-site. Both ovulation rate and number of viable embryos at d30 of gestation in MAT7 sows (23.9±.4 and 17.1±.5, respectively) were greater (P ≤ 0.001) than in MAT14 (21.6±.4 and 16.0±.5, respectively) or NAT0 (21.8±.4 and 14.3±.5, respectively) sows. However, at d50 of gestation, the number of viable fetuses in MAT14 sows (14.5±.5) was higher (P ≤ 0.001) than in MAT7 (12.8±.5) and or NAT0 (12.2±.5) sows, due to increased embryo survival in MAT14 sows to d50. Use of oral progestagen to delay the return to post-weaning estrus for greater than 18 d appears to have potential for improving weaned sow productivity.

Key Words: weaned sow, progestagen, productivity

324 The frequency of the HAL-1843 mutation of the RYR gene in dead and non-ambulatory/non-injured pigs on arrival at the packing plant. M. Ellis*, M. J. Ritter, G. R. Hollis, and J. M. Schlipf, *University of Illlinois*, *Urbana*.

Losses of harvest-weight pigs during transport to the slaughter plant (dead and non-ambulatory animals) are of concern to the US pork industry from both animal welfare and economic perspectives. Historically, the HAL-1843 mutation of the RYR gene (commonly called the Halothane or Stress Gene) was responsible for a substantial proportion of transport losses. Most breeding stock suppliers selected against this unfavorable mutation and there are claims that it has been eliminated from most commercial swine populations. There is evidence, however, that the mutation is still present in US commercial pigs. Even at a low frequency, this mutation could be an important causal factor in transport losses. Four Midwestern packing plants were visited on 53 occasions and tissue samples were collected from 2019 pigs to determine the frequency of the HAL-1843 mutation of the RYR gene in dead (DOA; n = 644), non-ambulatory/non-injured (NANI; n =726), and normal (n = 649) animals. The pigs sampled came from a total of around 130,000 animals from 454 farms that were transported on 861 trailer loads with ~152 pigs/load, with an average weight of ~125 kg/pig. Frequency of animals with the HAL-1843 mutation was low with only 2.7% of pigs being either homozygous recessive (nn; 0.45%) or carriers (Nn; 2.3%) for the mutation and 97.3% of pigs being homozygous for the normal allele (NN). The mutation was present in all three classes of pig with 1.8% of normal, 1.9% of NANI, and 4.7% DOA animals having at least one copy. There was a trend (P = 0.08) for the frequency of carriers to be higher in DOA than in Normal and NANI pigs (3.74 vs. 1.64 and 1.61%, respectively; SEM 0.93). The 55 pigs with at least one copy of the mutation came from 53 different farms and, therefore, the mutation was relatively widespread, being present, in ~11% of farms sampled. The results of this study suggest that, although the HAL-1843 mutation is still present in commercial pig populations in the U.S., its low frequency means that it is not a major cause of transport losses.

Key Words: pig, HAL-1843, RYR gene

325 Modeling the impact of birth and twenty-day body weight on the postweaning growth of pigs. A. P. Schinckel*[1], R. Cabrera[2,3], R. D. Boyd[2,4], S. Jungst[2], C. Booher[2], M. Johnston[2,4], P. V. Preckel[1], and M. E. Einstein[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Pig Improvement Company*, *Franklin, KY*, [3]*Ralco Nutrition*, *Marshall, MN*, [4]*Hanor Company, Inc*, *Franklin, KY*.

A stochastic pig BW growth model was developed to reproduce the nonlinear relationships of birth, weaning and nursery exit BW with later grow-finish BW. Serial grow-finish BW measurements of barrows and gilts were fitted to mixed-model Generalized Michaelis-Menten equations. The equation has the form, $WT_{i,t} = (WT_0\, K^C) + (WF\, t^C)/(K^C + t^C)$ where $WT_{i,t}$ is the BW of the ith pig at t days of age, WF is mean mature BW, WT_0 is the mean birth BW, K is a parameter equal to the days of age in which one-half WF is achieved and C is a parameter related to changes in relative growth and shape of the curves. Each pig′s actual birth BW ($WT_{i,0}$) was used. Two random effects, the values of wf_i and c_i were predicted as linear-quadratic functions of birth and 20-d weaning BW. Equations were developed to produce a simulated population of pigs that reproduced the variances and covariance of the random effects. The stochastic model reproduced the variances of the random effects, serial BW′s and days to achieve 125 kg BW. The simulation model also reproduced the nonlinear relationships of 20-d and 70-d BW′s with days to 125 kg and 168-d BW. The simulation model slightly over-predicted 168-d BW and under-predicted days to 125 kg BW of barrows with 20-d BW′s less than 5 kg. Overall, the relationships between days to 125 kg BW and 168-d BW with 70-d BW were similar for observed and simulated data. The model could be used to identify optimal management of pigs to reduce variation in BW growth.

Key Words: pig growth, growth equations, stochastic model

326 Modeling the impact of sorting pigs based on weaning or nursery weight on the mean and variation in postweaning growth of pigs. A. Schinckel*[1], R. Cabrera[2,3], R. Boyd[2,4], S. Jungst[2], C. Booher[2], M. Johnston[2,4], P. Preckel[1], and M. Einstein[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Pig Improvement Company*, *Franklin, KY*, [3]*Ralco Nutrition*, *Marshall, MN*, [4]*Hanor Company, Inc.*, *Franklin, KY*.

A stochastic pig BW growth model was developed to reproduce the nonlinear relationships of birth, weaning and nursery exit BW with later grow-finish BW. Pigs were simulated to have been farrowed over a 7-d period with a mean weaning age of 20 d, and 1,000 pigs of each sex farrowed each day. The pigs were simulated to be moved from the nursery to the grow-finish facility at a mean age of 70 d (mean BW of 33 kg, SD=5.6 kg). Four sorting strategies were evaluated: 1) sorting within sex at weaning, 2) sorting across sexes at weaning, 3) sorting within sex at movement from the nursery and 4) sorting across sexes at movement from the nursery. Three levels of sorting were evaluated: 1) splitting the pigs in upper and lower 50 percentile groups, 2) sorting out of the lightest 15% of the pigs, and 3) sorting out the lightest 5% of the pigs based on BW. The simulation model predicted that the lightest 5% of the pigs at weaning had substantially reduced SD in weaning BW ($P<0.05$) with no reduction in their SD for days to 125 kg or 168-d BW. As sorting intensity based on nursery BW increased, differences between groups for birth, 20-d, and 168-d BW increased and days to 105 and 125 kg BW increased. The SD's for days to 125 kg BW were greater ($P<0.01$) for the light BW groups of pigs at each level of sorting. Sorting based on nursery exit BW was more effective in producing groups of pigs with large differences in days to 125 kg BW than sorting based at weaning. The model could be used to identify optimal management strategies of pigs to reduce variation in BW growth.

Key Words: pig growth, growth equations, stochastic model

327 Impact of birth and twenty-day weight on the postweaning growth of pigs with different weaning management. A. Schinckel*[1], R. Cabrera[2,3], R. Boyd[2,4], S. Jungst[2], C. Booher[2], M. Johnston[2,4], and M. Einstein[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Pig Improvement Company*, *Franklin, KY*, [3]*Ralco Nutrition*, *Marshall, MN*, [4]*Hanor Company, Inc.*, *Franklin, KY*.

A total of 700 pigs from 112 litters were assigned to three treatments and their growth to 125 kg BW determined. The treatments were: Sow-reared (SR) to 20 d of age, weaned at 14 d of age (14W), and weaned at 2 d of age (2W). Sows from litters assigned to the 14W treatment were removed at 14 d of age from the crate and remaining litter fed a milk replacer until the day the SR litters were weaned. The 2W sows were removed from the crate 2 days after birth and then the piglets were fed milk replacer for 19 d. Pigs were individually weighed at birth, at about 20 d of age, at 32 kg BW and every two wks thereafter to 125 kg BW. The BW data from 32 to 125 kg were fitted to a mixed-model Generalized Michaelis–Menten equation. The SR gilts had lower ($P < 0.01$) ADG than 2W or 14W gilts at 70, 84 and 98 d of age. After 126 d of age, SR gilts had a greater ($P < 0.01$) ADG than 14W and 2W gilts. The 14W barrows had a greater ADG than 2W and SR barrows at 70 and 84 d of age ($P < 0.001$). By 98 and 112 d of age, ADG of SR and 14W barrows was greater than the 2W barrows ($P < 0.01$). At 140, 154 and 168 d of age, ADG′s of SR barrows exceeded that of 14W and 2W barrows. After 100 kg BW, SR gilts had greater ADG than 14W gilts which in turn had greater ADG than 2W gilts. The 14W and SR barrows had greater ADG than 2W barrows at 50, 65 and 80 kg BW. After 95 kg BW, SR barrows had greater ($P < 0.01$) ADG than 14W and 2W barrows. This study demonstrates the length of nursing by the sow ultimately determines how rapidly piglets grow. The weaning treatments affected the shape of the BW growth curves.

Key Words: pig growth, milk supplement, growth equations

Teaching and Career Development

328 Experiential learning model for value-added agricultural marketing. G. Onan* and B. Boetel, *University of Wisconsin*, *River Falls*.

The objective of the project was to develop a novel curriculum for direct marketing of value-added agricultural products. The target audience of the curriculum included traditional production agriculture students. There was a perceived need for this curriculum based on graduate feedback and the rapid growth of direct-to-consumer sales as a means for marketing agricultural products (37% increase between 1997 & 2002). The curriculum consisted of two courses. The introductory course, taught with a traditional lecture/discussion approach, required students to develop comprehensive marketing plans for a product either from their own family farms or from fictitious farms they may own in the future. A total of 17 students enrolled in this course over two semesters. The second-level course utilized an experiential learning model in which students developed and implemented a marketing plan for the sale of pork produced by the University swine herd. Ten students were enrolled in this course. Exit surveys were administered to students (n = 7 completed). Using a Likert Scale of 1(unfavorable) to 10 (favorable), students gave very high ratings indicating that:

a) the experiential course was a good learning tool (mean = 9.75)
b) the experiential learning model was more effective than lecture (mean = 9.00)
c) the experiential learning experience helped them to effectively realize the potential obstacles of a direct marketing venture (mean = 9.00)

Based on enrollment and student feedback, it was concluded that this curriculum is a valuable addition and will be continued, but that the dual-course approach will be condensed into one offering. This project was initially supported by a USDA Challenge Grant. An unexpected benefit of the project is that the pork marketing has generated enough profit to support faculty buy-out time for teaching the curriculum following expiration of the grant.

Key Words: experiential learning, direct marketing

329 Pork Industry Fellows program at Iowa State University. T. J. Baas*, M. G. Hogberg, and A. E. Christian, *Iowa State University*, *Ames*.

The Pork Industry Fellows Program is a new teaching program in the Department of Animal Science at Iowa State University designed for undergraduate students who have a sincere interest in a career in the pork industry after graduation. Students currently learn swine management principles and concepts by completing science-based courses in the Animal Science curriculum at ISU. The Pork Industry Fellows Program then provides a unique opportunity for students who want to work in some facet of the pork industry to better understand how the pork industry functions and how various components of the industry interact. Through a combination of industry field trips and experiences, students gain valuable knowledge that is generally not possible in the traditional classroom setting. Specific program objectives are for students to: 1) Gain an understanding of the integration and application of swine management principles to the pork industry; 2) Understand the structure of the pork industry and how segments of the industry work together; and 3) Interact with industry leaders to examine how decisions are made and prioritized. All applicants to the program must be enrolled as undergraduate students at ISU and have completed Animal Science 225, Swine Science, with a grade of B or higher in the course. Applicants must be able to demonstrate a sincere interest in a career in the pork industry and communicate how participation in the Pork Industry Fellows Program will be beneficial to them in reaching their career goal. Program objectives are met through a variety of learning experiences including classroom discussions with guest speakers, participation in field trips, and industry experiences. Through these activities, students gain an understanding of the role that various segments play in the pork industry. In addition, students complete an industry project that may be conducted independently or in a group setting. The Pork Industry Fellows Program teaches students about the industry and lays the foundation for future success in their chosen careers.

Key Words: career, student, teaching

Undergraduate Student Competitive Research Papers

330 Growth and carcass parameters of hogs finished in a deep-bedded hoop structure vs. a confinement structure. J. Magolski* and G. Onan, *University of Wisconsin-River Falls*, *River Falls, WI.*

The objective of this study was to compare growth and carcass performance of hogs finished in a deep-bedded hoop structure verses the performance of hogs finished in a confinement structure with partially slatted floors. The study was performed at the Laboratory Farms of the University of Wisconsin-River Falls and consisted of five replications carried out between February of 2004 and March of 2006. Three of the trials were performed during the colder half of the calendar year and the remaining two during the warmer half. Beginning and ending weights for each animal were recorded for each trial. Average daily gain was calculated for each animal. Group feed efficiency was calculated for each treatment of each trial. There were no statistically significant differences for beginning weight, ending weight, gain, or average daily gain between the treatments. Overall, there was no significant difference in feed efficiency, however, separation of data into warm season and cold season revealed a nearly significant decrease in efficiency for hoop-raised hogs during the cold season (hoop: 3.69 Kg. feed/Kg. gain; confinement: 3.40 Kg. feed/Kg. gain; P = .057) A random selection of twelve to fourteen hogs was picked from each trial for carcass evaluation. Hoop-raised hogs were fatter at both last rib (hoop: 2.40 cm.; confinement: 2.11 cm.; P = .005) and tenth rib (hoop: 2.13 cm.; confinement: 1.65 cm.; P = .001). There was no difference in loin muscle area between the treatments. Percent lean was therefore higher for confinement-raised hogs (hoop: 52.4%; confinement: 55.1%; P = .002). Breakdown of carcass data by season indicated no difference in tenth rib fat during the warm season but during the cold season hoop-raised hogs were fatter (hoop: 2.11 cm.; confinement: 1.60 cm.; P = .002) and had lower percent muscle (hoop: 52.5%; confinement: 55.2%; P = .007). In conclusion, hoop-raised hogs compare favorably with confinement-raised hogs during the warm season, but tend to have slightly poorer feed efficiency and lower yielding carcasses during the cold season.

Key Words: hoop structures, growth performance, carcass performance

331 Dry Matter Determination of Different Ethanol Byproducts. M. F. Wilken*[1], G. E. Erickson[1], J. R. Benton[1], C. D. Buckner[1], T. J. Klopfenstein[1], K. Karges[2], and M. Gibson[2], [1]*University of Nebraska*, *Lincoln*, [2]*Dakota Gold Marketing*, *Sioux Falls, SD*.

Four techniques to measure DM were evaluated with four different distillers byproducts. Traditional wet distillers grains plus solubles (WDGS), modified distillers grains (MWDGS), Dakota Bran Cake (DBran), and distillers solubles (Syrup) were sampled and replicates tested using oven drying (n=8) at 105 degrees Celsius and 60 degrees Celsius, vacuum oven testing (n=3) and a toluene distillation process (n=8). The 105 degree oven was tested for 3, 8, and 24 h. The 60 degree oven was tested for 24 and 48 h. The distillation process was conducted for 90 minutes. For WDGS, no difference was observed between either the 60 degree oven drying for 24 or 48 h compared to toluene distillation. However, drying at 105 degrees for 3, 8, or 24 h resulted in lower estimates of DM compared to toluene and drying at 60 degrees for 24 h. For Dbran and Syrup, a similar trend was observed with the best agreement between 60 degree oven drying for 24 h and toluene distillation. The drying methods were subtly different between 60 degree oven drying and toluene distillation for MWDGS. Interestingly, vacuum oven drying resulted in elevated DM estimates compared to all methods and feeds except for syrup. We conclude that the most accurate DM (or moisture) determination is using 60 degree drying ovens for 24 h or toluene distillation for wet distillers

byproducts; however, the 60 degree oven drying method is less tedious and costly than toluene distillation.

Table 1. Dry matter percentages of four different distillers byproducts evaluated by different methods.

	60°C		105°C				
Sample	24h	48h	3h	8h	24h	**Toluene**	**Vacuum**
WDGS	33.2[a]	33.0[ab]	32.7[b]	32.2[c]	31.6[c]	33.2[a]	35.2[a]
CV%	*0.58*	*0.57*	*0.97*	*0.01*	*1.03*	*1.36*	*0.49*
MWDGS	44.1[a]	43.7[a]	42.9[b]	42.2[c]	41.3[d]	43.3[b]	45.0[e]
CV%	*0.20*	*0.14*	*0.67*	*0.01*	*0.55*	*0.47*	*0.34*
DBran	54.0[a]	53.7[a]	52.8[b]	52.1[c]	51.3[d]	53.7[a]	55.4[e]
CV%	*0.38*	*0.38*	*0.62*	*0.22*	*0.71*	*0.46*	*0.34*
Syrup	50.5[ab]	50.1[a]	48.9[c]	47.9[d]	47.0[e]	50.8[b]	50.7[b]
CV%	*0.55*	*0.54*	*0.66*	*0.02*	*0.67*	*1.09*	*0.14*

[a,b,c,d,e]Means with different superscripts differ (P<0.05).

Key Words: dry matter, moisture, byproducts

332 Hypergravity exposure affects lipid synthesis in rat mammary gland during pregnancy and lactation. M. VanKlompenberg*, O.V. Patel, and K. Plaut, *Michigan State University*, *East Lansing,Michigan,United States*.

Lipid metabolism is essential in the rat mammary gland for lactogenesis as the need for milk fat synthesis is greatly increased. Fatty acid synthase (FAS), acetyl-coA carboxylase (ACC), and lipoprotein lipase (LPL) are key enzymes involved in lipid synthesis. ACC is a regulatory enzyme in milk fat synthesis and is responsible for obtaining precursors for fatty acid synthesis. FAS uses these precursors to synthesize milk fats. LPL hydrolyses stored body triglycerides. Previous reports have shown that hypergravity (2g) exposure leads to a reduction in lipid synthesis from glucose in rats. Therefore the objective of this study was to determine whether gravitational force and physiological state affect the genes involved in lipid metabolism in the rat mammary gland. Rats were placed on a centrifuge at 2g (HG) starting at gestation day 11(G11) until 1 day after parturition (P1). Stationary control (SC) rats were housed in the same room at 1g. On G20 (n=5 per g-level) or P1 (n=4 per g-level), rats were anesthesized, mammary tissue collected and stored at -80°C. RNA was extracted from mammary tissue using Trizol®, reverse transcribed and relative gene expression was quantified using qPCR and calculated using the ΔΔct method. All 3 genes decreased in response to HG (P<.005) and increased from pregnancy to lactation (P<.001). There was also a significant interaction (P<.01) for all genes. The ACC mRNA abundance was less at G20 in HG compared to SC. ACC increased 34 fold from G20 to P1 in SC but only 20 fold in HG. The abundance of FAS was nearly 3 fold less in HG than SC G20. FAS mRNA abundance increased from G20 to P1 approximately 50 fold in SC but only 7 fold in HG rats. At G20, mRNA levels of LPL were 7 fold lower at HG compared to SC. LPL increased 22 fold between G20 and P1 in SC but only 7 fold in HG. While gene expression increased in HG and SC in the transition from pregnancy to lactation, HG animals had a smaller magnitude of response. These data indicate that changes in gene expression may account for observed differences in lipid synthesis.

Key Words: gravity, lipid, mammary

333 Solid-liquid separation of swine slurry is effective and affordable. D.S. Stoner*, P.M. Walker, A.L. Shreck, and K.P. Rhykerd, *Illinois State University*, *Normal, IL, US*.

Following removal of a portion of the separable solids (SS) with a gravity screen roll press separator (GSS), a polyacylamide assisted gravity belt thicker was utilized to separate unprocessed raw swine slurry (RS) into its solid and liquid phases. The chemical flocculent (copolymeracrylamide: DMAEA QUAT MeCL) used to coagulate the solids fraction was Zetag 8160® sold by Ciba specialty chemicals, Suffolk, VA.

Following separation the solids fraction was mixed with woodchips and composted. The separated effulent (SE) was stored in a slurry store and subsequently land applied to growing corn using a center pivot irrigator. The unprocessed slurry was composed of co-mingled slurry from a 200 sow farrow to finish operation. During a five month period month period 3785 kL of SE was produced and 2828 kL of SE were irrigated. The RS contained 1.3% DM, 95.4 ml/L SS, 878.5mg/L total suspended solids (TSS), 0.0 mg/L dissolved oxygen (DO), 57,126.9 mg/L chemical oxygen demand (COD), 0.19% nitrogen and 0.05% phosphorus. The SE had significantly lower DM, SS, TSS, COD, N, and P concentrations. Reductions were 69.2%, 98.4%, 98.2%, 89.6%, 60.6%, and 91.7% for DM, SS, TSS, COD, N and P, respectively, in SE compared to the RS. The SE was found to contain 44.9% increased (p<0.05) DO compared to RS. The N/P ratio was changed from 3.8/1 in the RS to 20.0/1 in the SE. Cost to separate the effluent including polymer, power, labor, and equipment depreciation was ;0.0099/gallon ($0.0026/L and $0.001/gallon ($0.00026/L) to irrigate the SE. The data collected during this phase of study suggests chemical separation coupled with irrigation can be an affordable and environmentally acceptable method to land apply swine slurry.

Key Words: slurry, separation, irrigation

334 Effects of field pea inclusion in high grain diets for beef steers on beef tenderness, postmortem proteolysis and calpastatin activity. E.L. Slinden*[1], G.P. Lardy[1], M.L. Bauer[1], V.L. Anderson[2], R.J. Maddock[1], and K.R. Maddock Carlin[1], [1]*North Dakota State University*, *Fargo, ND*, [2]*NDSU Carrington Research Extension Center*, *Carrington, ND*.

The objective of this study was to determine if increasing levels of field peas in finishing diets affected tenderness and sensory evaluation of beef steaks. One hundred forty-four steer calves (433 ± 19 kg initial BW) were blocked by BW and allotted to 24 pens with six pens assigned to each treatment. The control diet contained 80% dry rolled corn, 5% alfalfa/grass hay, 5% pressed beet pulp, 5% concentrated separator byproduct, and 5% supplement (DM basis). Field peas replaced corn and soybean meal at 0, 10, 20, and 30% of the diet DM. Steers were implanted with Synovex-Ch on d 0, fed for 70 to 98 d, and transported to a commercial slaughter facility. A 7-cm (approximate) portion of longissimus muscle was removed caudally starting from the 12th rib location on the left side of each carcass. A 25-g sample (approximate) was collected from each rib sample for calpastatin activity and evaluation of troponin-T degradation. Longissimus muscle

samples were vacuum packaged, aged for 14 d at 4°C, cut into two 2.54-cm thick steaks, and frozen. One steak was evaluated for Warner-Bratzler shear force (WBSF). The second steak was evaluated by a trained panel for tenderness, juiciness, and flavor using a scale of 1 to 8 (1 = extremely tough, dry, and bland; 8 = extremely tender, juicy, and intense beef flavor). Calpastatin activity (units/g tissue) was determined by inhibition of caseinolytic activity of an m-calpain control. Western blots were used to determine protease activity by the accumulation of the 30 kDa degradation product of troponin-T. No differences were measured for WBSF (3.76 ± 0.95 kg; $P = 0.12$), sensory panel tenderness (5.80 ± 0.32; $P = 0.53$), juiciness (5.43 ± 0.37; $P = 0.81$), or flavor (5.65 ± 0.19; $P = 0.58$). Calpastatin activity was not different between treatments (2.1 ± 1.2 units/g of tissue extracted; $P = 0.33$). Greater troponin-T degradation was observed in 30% field pea treatment versus 0% field pea treatment ($P = 0.04$). Results of this study indicate that dietary field pea inclusion may increase proteolysis of muscle proteins, but does not alter tenderness of steaks from feedlot steers.

Key Words: tenderness, beef, field peas

335 Validation of a ruminant hepatocyte culture for assaying the activity of enzymes responsible for progesterone catabolism, cytochrome P450 (CYP) 2C and 3A. T. A. Wilmoth*, C. O. Lemley, J. M. Koch, K. P. Blemings, and M. E. Wilson, *West Virginia University*, *Morgantown, WV, United States*.

Several authors have suggested that low fertility in dairy cattle results from low concentrations of progesterone. Although research in this area has primarily focused on progesterone production, nearly 90% of the progesterone in hepatic portal blood (which includes ovarian drainage) is cleared by the liver, preventing it from reaching the general circulation. We have demonstrated that altering the composition of the diet, without altering dry matter or energy, stimulated insulin secretion and decreased the catabolism of progesterone. We have demonstrated that hepatocytes challenged with insulin exhibit a dose dependant decrease in progesterone clearance and the activity of the enzymes that catabolize progesterone, CYP2C and CYP3A. However, that demonstration utilized hepatocytes from a monogastric. Therefore, the current work was undertaken to establish ruminant hepatocyte culture for use in furthering our understanding of insulin induced reductions in progesterone catabolism. Ruminant hepatocytes were purchased from ATCC and cultured. Cells were homogenized, centrifuged at 6000 x g for 8 min, the supernatant was centrifuged at 100,000 x g for 45 min and the microsomal pellet suspended in buffer. CYP reductase was measured to determine recovery. Enzymatic activities were measured as the omeprazole (2C) or nifedipine (3A) dependent oxidation of NADPH. In order to validate the assays, a dilution of microsomes with known CYP reductase activity was assayed for both enzymes. Microsomes containing 1.6 to 9.7 μU of reductase oxidized 0.35 to 1.62 pmol of NADPH in the presence of omeprazole, with a linear increase in NADPH oxidation with increasing reductase (R2=0.97). Microsomes containing 19.4 to 77.4 μU of reductase oxidized 0.23 to 1.17 pmol of NADPH in the presence of nifedipine, with a linear increase in the NADPH oxidation with increasing reductase (R2=0.99). The validation of ruminant hepatocyte culture and CYP2C and CYP3A assays will allow us to further our understanding of the insulin dependent decrease in progesterone clearance.

Key Words: hepatocytes, progesterone, clearance

336 Comparison of a complete pelleted diet and a shelled corn-protein supplement diet on the performance and health of dairy-beef steers. A.L. Shreck*[1], P.M. Walker[1], and R.E. Hall[2], [1]*Illinois State University*, *Normal, IL, USA*, [2]*Cooperative Research Farms*, *Richmond, VA, USA*.

Holstein steers (n=128) were stratified by weight (BW=164.6±12.8kg) to 16 pens (n=8/pen) to compare the growth performance, health and carcass characteristics when fed either a complete pelleted diet (TRT) containing by-products (wheat midds and distillers grains) or a diet composed of whole shelled corn and a pelleted protein supplement (SC). The trial was divided into 2 periods where P1 was the first 132d and P2 was the second 206d. During P2 energy density of TRT was increased and dietary CP was reduced for SC. No significant differences in ADG, ADFI, or G:F were observed between TRT or SC in either P1 or P2. When the data for P1 and P2 were combined G:F was improved (p=0.04) for SC steers (0.15/1) compared to TRT steers (0.14/1). No differences (P>0.05) in carcass characteristics were observed except for marbling score and percent choice. Marbling scores were higher (P=0.02) for SC steers (7.1±0.2) compared to TRT steers (6.5±0.1) where 5.0=low choice. More SC (P=0.03) steers graded low choice or higher than TRT steers comparing 83.0% vs. 59.6%. Significantly more TRT steers than SC steers (34.4% vs.10.9 %) required treatment for respiratory illness and more (P<0.01) total treatments were required for TRT steers than SC steers. No significant differences in death loss were observed between TRT and SC steers. This study found similar growth performance for Holstein steers fed either a complete pelleted diet or a whole shelled corn-protein supplement diet but observed less morbidity and higher quality grades for steers fed a whole shelled corn-protein supplement combination.

Key Words: Holstein steers, shelled corn, pelleted diet

337 Evaluation of lean growth and daily gain in two terminal lines of pigs. J.K. Johnson*[1] and T.A. Rathje[2], [1]*Kansas State University*, *Manhattan, Kansas, USA*, [2]*Danbred North America*, *Columbus, Nebraska, USA*.

Nucleus lines of pigs undergoing selection for lean growth will have improved lean gain over time, resulting in changes to patterns of lean tissue accretion within populations. In this trial, two terminal sire lines were evaluated for backfat (BF), loin eye depth (LED) and average daily gain (ADG) to study differences in lean growth patterns between lines and between sexes. A total of 363 Duroc boars, 303 Duroc gilts (DD) and 320 Hampshire x Duroc (HD) crossbred boars were weighed and placed into the trial at an average age of 81 d over an 8 week period beginning in June of 2006. Individual pigs were re-weighed and BF and LED measurements were taken using an Aloka 500 ultrasound machine every 21 d during the trial (total of five weigh points). Two data sets were analyzed from this trial, one containing all Duroc boars and gilts and a second containing Duroc and Hampshire x Duroc boars. Statistical models were fitted to the data using the PROC MIXED procedure of SAS®. The random effects of barn, pen within barn and litter were included in all models. The model for BF and LED included the fixed effect of sex (or line), the linear and quadratic covariate of weight, and all interaction terms. Average daily gain was compared both within weigh period and cumulatively for the entire trial. Non-

significant fixed effects and interaction terms were dropped from the final analysis. The pattern of BF and LED accretion for DD and HD boars was not significantly different and was explained by a second order polynomial (P<.0001). The pattern of LED accretion did not differ between DD boars and gilts however DD boars accumulated less backfat per kg than gilts (P=.0414, P=.0082, linear x sex and quadratic x sex, respectively). DD gilts had higher ADG than DD boars during the first and second periods of the trial (P<.0001) while DD boars had higher ADG during the third and fourth periods and overall (P<.0001). DD boars had higher ADG than HD boars for all periods (P<.0001). Further analysis will done to develop improved adjustment factors for ADG for these lines.

Key Words: lean growth, pigs, selection

338 Hamburger from Fescue Fed Cattle Fed to Humans Reduces Blood Pressure. R. O. McKeith* and K. L. Jones, *Southern Illinois University Carbondale*, *Carbondale IL USA*.

Tall Fescue (Lolium arundinaceum (Schreb.) grasses are commonly infected with an endophyte that produces ergot alkaloids. These alkaloids have physiological impacts on livestock that consume the grass including increased body temperature and vasoconstriction. Endotoxin metabolites have been found in subcutaneous fat of cattle fed endophyte infected (EI) fescue. We investigated the possibility that meat from EI fed cattle could alter human physiology. Three Fall bull calves born between Oct 14 and Oct 25, 2005 were weaned March 24, 2006 and placed on a Timothy/Clover hay diet. An additional three Fall bull calves born between Nov 4 and Nov 5, 2005 were weaned April 28, 2006 and placed on an EI fescue hay diet. After weaning all calves were placed in a dry lot with water and fed ad libitum. All calves were slaughtered and inspected at a local abattoir on June 15, 2006. The meat and fat from the carcasses were pooled according to dietary treatment and ground into 2 batches to form hamburger meat (approximately 95/5 lean to fat).

On Sept 9, 2006 sixteen student volunteers (19-40 years old, 5 females and 11 males, 4 smokers and 12 non-smokers) were divided into two equal groups. The students had been asked to not eat any beef products for two days prior to the study. The following measurements were taken at three time points: body temperature, systolic blood pressure, diastolic blood pressure and pulse. These measures were taken approximately ten minutes after arriving at the testing site and 30 minutes after consuming a 1/3 lb (pre-cooked weight) hamburger. One hour after consumption the students were asked to walk briskly outside for 3.6 km. The ambient temperature was 30OC. The students were asked to sit for ten minutes before taking their final measurements.

Data were analyzed using the repeated measures function of SPSS. Body temperatures, pulse, and diastolic blood pressures were not different between treatments, P=0.665, P=0.883 and P=0.131, respectively. Systolic blood pressure was different (P<0.05). This study suggests that more detailed and prolonged investigations into the consumption of meat from livestock fed EI fescue are warranted.

Key Words: fescue, ergot alkaloids, meat

339 Capillary growth and angiogenesis in uterine tissues during early pregnancy in sheep. M.A. Minten*[1], L.P. Reynolds[1], P.P. Borowicz[1], G. Ptak[2], P. Loi[2], D.A. Redmer[1], and A.T. Grazul-Bilska[1], [1]*Center for Nutrition and Pregnancy, and Dept. of Anim. and Range Sci., North Dakota State Univ.*, *Fargo, ND, USA*, [2]*Dept. of Comparative Biomed. Sci., Univ. of Teramo*, *Teramo, Italy*.

Placental vascular development (angiogenesis) is critical for normal placental function and thus for normal embryonic/fetal growth and development. Use of assisted reproductive techniques, including cloning, results in poor placental angiogenesis, which may contribute to high embryonic loss after transfer. To provide a description of normal placental angiogenesis, uterine tissues were collected on d20, 22, 24, 26, 28, and 30 after mating (n = 5-6/d) and on d9-11 after estrus (n = 5; non-pregnant control). To maintain the morphology, specimen-pins were inserted completely through the uterus and fetal membranes at the level of the external intercornual bifurcation, cross-sections (0.5-cm thick) were taken, and tissues were immersion-fixed in 10% neutral buffered formalin or Carnoy's solution and embedded in paraffin. To determine vascular development, tissue sections were stained with periodic acid-Schiff's reagent or immunostained to detect proliferating cell nuclear antigen, followed by image analysis of endometrial intercaruncular areas. Compared to control, capillary labeling index (proportion of proliferating cells) increased (P < 0.001) 18-fold on d20-24 and 35-fold on d26-30; the tissue area occupied by capillaries and area per capillary increased 1.8-fold and 2-fold on d20-24, and 2.1-fold and 2.9-fold on d26-30, respectively. Labeling index was positively correlated (P < 0.001) with tissue area occupied by capillaries (r = 0.730) and area per capillary (r = 0.843). These data indicate that uterine angiogenesis, manifested by increased capillary cell proliferation and enlargement of capillaries, is initiated very early in pregnancy. This more complete description of early placental angiogenesis in sheep will provide the foundation for determining whether placental vascular development is altered in compromised pregnancies. Supported by NIH grant HL64141 to LPR and DAR, and ND EPSCoR AURA grant to ATGB and MAM.

Key Words: angiogenesis, uterus, early pregnancy

340 Pre-exposure to *Bacillus licheniformis* reduces interleukin 8 response of swine intestinal epithelial cells to *Salmonella enterica* serovar Typhimurium. B.H. Godsey*, K.A. Skjolaas, and J.E. Minton, *Kansas State University*, *Manhattan, KS, USA*.

Bacillus spp. are among the growing group of direct fed microbials available as feed additives. We demonstrated that 24 h of pre-exposure of swine jejunal epithelial cells (IPEC-J2) with *Bacillus licheniformis* (BL) abolished the interleukin 8 (IL8) response to subsequent challenge with *Salmonella enterica* serovar Typhimurium (ST). The current in vitro studies were designed to further investigate this effect using BL pre-exposures of shorter duration. IPEC-J2 cells were grown on permeable membrane inserts and used in experiments employing a 2 x 2 factorial arrangement of treatments. Cells were pre-exposed apically to 10^8 CFU BL (or sterile media) followed by apical treatment with 10^8 CFU ST (or sterile media). The resulting treatments were: 1) control (no bacteria); 2) BL only; 3) ST only; or 4) BL followed by ST. In Exp. 1, cells were pre-exposed to BL 4 h prior to ST treatment, and in Exp.

2 for 8 h. Cells were washed 1 h after ST, and media containing 50 µg/mL gentamicin was added to kill remaining extracellular bacteria. Apical and basolateral media were collected 5 h later and assayed for IL8. At the conclusion of the each experiment, IPEC-J2 cells were extracted to estimate percent invasion by ST. In Exp. 1, ST stimulated IL8 secretion compared to control wells ($P < 0.001$) and pre-exposure with BL blunted ST-stimulated IL8 both apically ($P < 0.01$) and basolaterally ($P < 0.05$). Similarly, in Exp. 2, ST stimulated IL8 secretion, and pre-exposure with BL reduced ST-stimulated IL8 secretion apically ($P < 0.05$) and basolaterally ($P < 0.001$). Pre-exposure to BL did not reduce ST invasion of IPEC-J2 cells in either experiment. The current studies suggest that short pre-exposure of swine intestinal epithelial cells with BL blunts ST-induced IL8. Inhibition of IL8 by BL appears to increase with increased duration of pre-exposure. The mechanism(s) by which BL reduces IL8 response to ST is not completely understood, but does not appear to reflect an ability of BL to reduce ST invasion of swine epithelial cells.

Key Words: Interleukin 8, Bacillus licheniformis, Salmonella Typhimurium

341 Effect of sodium chloride concentration on sensory attributes, shear-force and retail color of moisture enhanced fresh beef steaks. C. K. Weber*, P. S. Kuber, H. N. Zerby, and C. L. Knipe, *The Ohio State University*, *Columbus, Ohio, USA*.

Fresh beef steaks removed from high pressure moisture enhanced (**ME**) *gluteus medius* roasts were evaluated for retail color, palatability and tenderness. Prior to ME, roasts (n = 60) were split in half removing one steak from the center of each roast to serve as a negative control. One roast half (n = 60) was needle tenderized (**NT**) without the addition of a brine solution to serve as a positive control. The remaining roast halves were subjected to high pressure brine injection (**BI**) with a solution consisting of 2.5% sodium lactate, 0.35% sodium tri-polyphosphate and one of four (n = 15 each) sodium chloride (**NaCl**) concentrations (0.35%, 0.45%, 0.55%, 0.65%). After pH measurements, steaks (2.54 cm) were removed from NT and all BI treatments to measure drip-loss (**DL**) at 7 and 14 d postmortem (**PM**); proximate composition; Warner-Bratzler shear-force (**WBSF**) at 3, 7, and 14 d PM; sensory analysis at 14 d PM; objective (L*, a* and b*) and subjective color (5 member panel) measured daily for 5 d on steaks under retail display lighting. Moisture retention was improved ($P < 0.0001$) in BI versus NT steaks. Further, as NaCl concentration increased in treated steaks, a subsequent decrease ($P < 0.0001$) in DL was measured. This improvement ($P < 0.0001$) in DL in BI over NT steaks could be explained by an increase in pH due to treatment and level of NaCl concentration. Steaks within BI treatments did not differ ($P > 0.05$) in WBSF yet all BI were significantly more tender ($P < 0.0001$) than NT steaks. Under retail lighting conditions, objective color readings indicated that BI treated steaks were initially darker (L*), less red (a*), and less yellow (b*) than NT steaks. Subjective color analysis reported that consumers preferred ($P < 0.0001$) NT compared to BI treated steaks. Sensory panel analysis and proximate composition, to be completed, will determine whether the current implications of this study, as measured by the positive effects ME reports on WBSF and DL, are also favored by consumers and supported by proximate composition.

Key Words: beef, moisture enhancement

342 Do Ergot Alkaloids Alter Ruminal E. coli concentrations in an In Vitro System? A Proposed Study. R. O. McKeith*, D. L. Hastings, and K. L. Jones, *Southern Illinois University Carbondale*, *Carbondale IL USA*.

Fescue is a grass species that is abundant through the continental United States, and is the major form of forage in the United States. A toxic fungus inhabits fescue, which produces ergot alkaloids. These ergot alkaloids cause vasoconstriction and alter livestock metabolism. Potentially, these ergot alkaloids could alter the species composition of microbial flora in the rumen of a cow. The aim of this study is to determine if E. coli concentrations are altered by an ergot alkaloid in an in vitro dual flow continuous culture system. Four fermenters will be used as a model of the cow's rumen and will run for 10 days. The average fermenter volume will be 1234 ml. The liquid dilution rate will be maintained at 12% hr-1 using the buffer of Weller and Pilgrim with urea omitted. The solids turnover rate will be 0.66 hr-1, which should provide a mean solids retention time of 15 hrs. All diets will be Timothy Clover hay ground with a Wiley mill and 2mm screen supplemented with vitamins, minerals and fat. Dietary analysis of this hay is 99.5 % DM, 43.8 % ADF, 56.3 % NDF, and 8.1 % protein. Inoculum will be collected from a ruminally cannulated Holstein cow grazing fescue pastures. Ruminal contents will be strained through 2 layers of cheese cloth until sufficient volume is attained to fill all fermenters. Two of the fermenters will contain added ergotamine D-tartrate (Fluka 45510, 1.0 microgram/150 grams of feed) while the other two will not receive any alkaloids. This experiment will be duplicated once. Solid and liquid fermenter samples will be collected every 36 hrs. The samples will be diluted to a 10-2 solution using sterilized water and then plated on a 3M-petri film selective for E. coli. The petri-films will be incubated for 24 hrs at 35oC, and colony counts will be determined. Samples will be collected 6 times for each run, and data will be analyzed using the proc mixed procedures of SAS for repeated measures. We expect that E. coli counts will decrease over the 10-day trial. This data may suggest that ergot alkaloids can alter E. coli concentrations and thus would warrant further investigation.

Key Words: fescue, continuous flow system, ergot alkaloid

343 Effect of pre and peri-pubertal feeding of melengesterol acetate (MGA) on testis characteristics in bulls. S. G. Kruse*, M. M. Baltes-Breitwisch, J. L. Martin, D. M. Larson, D. T. Clopton, and A. S. Cupp, *University of Nebraska-Lincoln*, *Lincoln, NE, USA*.

The objective of this experiment was to determine if feeding MGA prior to and at puberty affects testis characteristics in bulls. Eighty bulls (190 ± 3 kg BW; 6 mo of age) were exposed to one of three treatments. Bulls grazed brome pasture and were supplemented with soybean hulls (60 %) and corn (40 %) (2.7 kg/d, DM basis; 139 d). Control bulls (CON) were castrated at 6, 7, 7.5, 10, and 12 mo. Pre-pubertal bulls (PRE) were fed MGA (1 mg/d; 6 to 7.5 mo) and were castrated at 6, 7.5, 10, and 12 mo. Peri-pubertal bulls (PERI) were fed MGA (1 mg/d; 7 to 10 mo) and were castrated at 7, 10, and 12 mo. Bulls were weighed and scrotal circumference (SC) was assessed at each period. At castration, each testis was weighed, fixed, sectioned, stained and analyzed using Scion Image to determine area of seminiferous tubules and interstitium on four representative sections.

Data were analyzed with PROC MIXED of SAS and mean separation by LSD ($P \leq 0.05$). Supplementation of MGA to PRE and PERI did not affect ($P > 0.10$) final BW (283 ± 9 kg) or gain (0.61 ± 0.05 kg/d) compared to CON. The SC of PRE or PERI (28.6 ± 0.6 cm) were not affected (P=0.43). The combined testis weight (CTW) of PRE (462.72 ± 19.97 g) did not differ ($P > 0.10$) from CON (441.26 ± 19.60 g) at any castration period. The CTW of PERI did not differ ($P > 0.10$) from CON at 7 mo (197.77 ± 49.93 g) or 10 mo (488.55 ± 35.30 g); however, at 12 mo, PERI had lighter CTW (667.16 ± 35.30) than CON (734.89 ± 35.30 g; $P < 0.001$) and PRE (813.62 ± 35.30 g; $P = 0.005$). The seminferous tubule and interstitial area of PERI or PRE did not differ ($P > 0.10$) from CON at any time point. Supplementation of MGA to PRE does not influence testis weight nor seminiferous tubule area in PRE or PERI. However, MGA during the peri-pubertal period influenced testis weight at the 12 mo castration. Therefore, supplementation of MGA during the peri-pubertal period may negatively impact reproductive development in yearling bulls.

Key Words: bulls, MGA, testis weight

AUTHOR INDEX

N

O

P

Q

R

S