M223   Effects of nonstructural carbohydrate and protein sources on performance, ruminal fermentation, total tract digestibility and feeding behavior in growing calves. A. Rotger, A. Ferret, S. Calsamiglia*, and X. Manteca, *Universitat Autònoma de Barcelona Edifici V, Campus UAB, Bellaterra 08193, Barcelona, Spain.*

Four rumen fistulated Holstein calves (BW 132.3 $\pm$ 1.61 kg) fed high concentrate diets (10 to 90, forage to concentrate ratio) were assigned to a 4 x 4 Latin square design to investigate the effects of nonstructural carbohydrate (barley or corn) and protein (soybean meal or sunflower meal) sources on ruminal fermentation and animal performance. The following 2 x 2 factorial arrangement of treatments (13.7% CP, 2.8 Mcal ME/kg DM) was used: 1) Barley-Soybean meal; 2) Barley-Sunflower meal; 3) Corn-Soybean meal and 4) Corn-Sunflower meal. Data were analyzed using the PROC MIXED procedure of SAS, main factors being nonstructural carbohydrate source, protein source and their inter-

action. Calf and period were considered random effects. Intake of DM was higher in the corn vs. barley based diets (P < 0.05), without affecting ADG (1.2 $\pm$ 0.12 kg/d). Consequently, feed efficiency was higher for the barley based diets. Average ruminal pH, total VFA and NH_3N concentration were not affected by main factors (6.6 $\pm$ 0.14, 116.4 $\pm$ 5.27 mM and 5.9 $\pm$ 2.17 mg/dL, respectively). Total VFA per kg of DM intake was lower in the corn vs. barley based diets (20.07 vs. 25.42 mM/kg DMI, P = 0.02) and no significant effects were observed for the proportions of individual VFA. Nonstructural carbohydrate and protein sources did not affect total tract digestibility of DM and OM, estimated with chromium oxide (64.5 $\pm$ 2.67 and 65.1 $\pm$ 2.74 %, respectively). Feeding behavior, measured by scan sampling at 5 minute intervals, did not vary significantly among treatments. Calves spent 9.97, 2.11, 25.13 and 62.79% of the time eating, drinking, ruminating and resting, respectively. In conclusion, while nonstructural carbohydrate source affected intake, feed efficiency and total VFA per kg of DM intake, protein source did not affect these measurements.

Rabbit Species

M224   Effects of dietary mannan oligosaccharide in comparison to oxytetracyclin on cecal fermentation and performance of rabbits. A.P. Fonseca[1], L. Falcäo[1], P. Spring*[2], and A. Kocher[3], [1]*Universidade Técnica de Lisboa Instituto Superior de Agronomia, Lisboa, Portugal,* [2]*Swiss College of Agriculture, Zollikofen, Switzerland,* [3]*Alltech Biotechnology Center, Dunboyne, Co. Meath, Ireland.*

Digestive disorders in rabbits are quite frequent. Feed additives, which can lower the risk of digestive disorders and enhance performance are useful tools to the rabbit nutritionist. The aims of the present trials were to compare the effects of mannan oligosaccharide (MOS) and oxytetracycline (OTC) on rabbit performance and intestinal fermentation. Two trials were set up as complete randomized designs with Hybrid Hyla rabbits (31 to 70 days). Rabbits were housed individually in metabolic cages. Grower feed was offered through day 46 and finisher feed from day 47 to the end of the trial. The diets did either contain 2000ppm of MOS (Bio-Mos®, Alltech Inc.) or OTC (20%) in the grower and 1000ppm of MOS or OTC in the finisher diet, respectively. Trial 1 was performed with 48 rabbits. Performance as well as purine derivates excreted in the urine and caecotrophes (soft feces) composition was determined.

Trial 2 involved 24 rabbit. Performance, diet digestibility and cecal pH and VFA concentrations were determined. All data were subjected to ANOVA. Average daily gain and FCR did not differ between treatments. ADG was 41.7g and 44.1g for the MOS treatment vs. 42.7g and 43.9g for the OTC treatment in trial 1 and 2, respectively (RSD 4.2 and 2.9). Average feed conversion was 3.05 in trial 1 and 3.50 in trial 2 and was not affected by treatment. Composition of the soft feces did not differ among treatments. Diets did affect purine derivatives excretion. Allantoin and uric acid excretion did not differ between treatments; however, rabbits fed MOS did excrete significantly less hipoxantin and xantin. Diet digestibility in trial 2 was modestly affected by treatment, with a significant improvement in ADL digestibility for MOS compared to OTC. Average cecal pH was 6.2 for both treatments. Total VFA concentrations averaged 36 mmol/l and did not differ between treatments. Under the present trial conditions performance with MOS was similar to performance with OTC. MOS did show a reduction in mortality. Differences in cecal fermentation patterns and diet digestibility were modest between the two additives.

Key Words: Rabbits, Mannan Oligosaccharides, Performance

Production, Management and the Environment: Systems, Economics, and Miscellaneous

M225   Minimum dry period length to maximize performance. M. T. Kuhn*, J. L. Hutchison, and H. D. Norman, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.*

The objective of this research was to find the minimum dry period length while maintaining performance in the subsequent lactation. The number of days dry, month of calving in the subsequent lactation, linear and quadratic effects of the last somatic cell score in the previous lactation, linear and quadratic effects of previous days open, and linear and quadratic effects of age at subsequent lactation were included in the model to look at the effect of dry period length on actual milk yield in the subsequent lactation, adjusted for producing ability. Data included Holstein cows first calving from 1997 to 1999. There were 64,100 records with a second lactation, 28,376 with a third lactation, and 11,997 with a fourth lactation. Peak yield during the following lactation occurred at a dry period length of 45 to 60 days for parities 2, 3, and 4. A difference in milk production of +33, +50, and -16 kg between 56 to 60 and 61 to 70 days dry was not significant for lactations 2, 3, and 4, respectively. A dry period length over 70 days resulted in a 250, 622, and 727 kg decrease in milk production for lactations 2, 3, and 4, respectively. Although peak yield in subsequent lactation occurred between 45 and 60 days, the rate of increase from zero to 45 days was not linear. Cows that were dry from zero to 35 days following first, second, and third lactations showed an average decrease of 1111, 491, and 1802 kg in second, third, and fourth lactations, respectively. In contrast, cows that were dry from 35 to 45 days had an average loss of only 280, 172, and 182 kg in lactations two, three, and four, respectively. Further research

will determine optimum dry period length for lifetime yield, somatic cell score, female fertility, fat and protein percentages, and productive life.

Key Words: Dry Period Length, Milk Production, Performance

M226   Effect of photoperiod on milk production in lactating dairy cows. M. J. VanBaale*[1], D. V. Armstrong[1], R. M. Mattingly[2], and J. B. Fiscalini[2], [1]*The University of Arizona, Tucson,* [2]*Fiscalini Dairy Farm, Modesto, CA.*

Ninety-eight multiparous and 60 primiparous Holstein animals were utilized in an extended lighting trial to investigate photoperiods impact on milk yield. After parturition all animals were housed in one pen until 20 DIM under normal daylight/nightlight conditions. On d 21, animals were randomly assigned into two treatment groups receiving supplemental light (SL) or normal daylight and darkness (NL). There were four groups of multiparous cows; two were assigned to SL and two to NL. There were only two groups of primiparous animals that were assigned to SL or NL. While in freestalls both multiparous and primiparous cows in the SL groups were exposed to 17h of natural light and SL above 15 foot candle (FC) and 7h of light below 5 FC in the freestall area. The light exposure for the NL groups followed the normal sunrise-sunset pattern common for the north 40th parallel of sunrise 0530 to 0730 and sunset 1700 to 1900, an average of 12h of light and darkness. Light intensity was measured every two wks at 2200 to 2300 at two points in the freestall barn (feed manger and outside lane at animal head level) and in the milking parlor holding pen (front, middle, and back). Diets for both treatments were balanced for 52 kg milk/d. There was no difference (P = 0.48) observed between primiparous animals assigned to SL (32.9 kg/d) or NL (32.7 kg/d) treatments. Multiparous cows in

SL groups produced more (P < 0.05) milk (49.4 kg/d) than the multiparous groups on the NL treatments (46.5 kg/d). Average pen DMI for multiparous (29.3 vs. 28.4 kg/d) and primiparous (23.4 vs. 22.4 kg/d) animals exposed to SL or NL were not measurably different. Exposure to increased lighting enhanced milk production in multiparous cows but had no effect on primiparous animals. Intakes were similar for the multiparous animal groups exposed to increased day length; however, milk yield was improved. Since no physiological measurements were obtained it is not known what contributed to the increase in milk yield, but increased lighting is an effective management practice that can be used to improve milk production on high producing dairy herds in the San Joaquin Valley of California.

Key Words: Photperiod, Lactating, Dairy Cows

M227   Reasons and timing of cows leaving dairy herds in Florida and Georgia. B. L. Butler* and A. de Vries, *Department of Animal Sciences, University of Florida, Gainesville.*

Our objectives were to determine the reasons and timing of cows leaving dairy herds in Florida and Georgia. DHIA records for individual cows (n=61,532) culled on 257 Florida and Georgia dairy herds between 2000 and 2002 were used in the analyses. Producers using DHIA list a major reason for culling. Reasons for culling include voluntary reasons such as cows sold for dairy purposes (DHI code 2) and culled for low milk production (3). Involuntary reasons for culling include feet and legs (1), reproductive problems (4), injury (5), death (6), mastitis (7), disease (8) and udder problems (9). Frequency of the reasons for culling were calculated for the month of culling, herd size (small: 50 to 199 cows, medium: 200 to 699 and large: > 700) and days in last lactation. Values are expressed as average herd cull rates. Total cull rates in months January through December were respectively 3.27%, 3.13%, 3.50%, 2.56%, 3.06%, 2.73%, 3.00%, 3.20%, 3.13%, 3.40%, 3.30% and 3.82% (p<.0001). Frequency of death (6) ranged from a high in August (0.42%) to a low in May (0.27%). Most reproductive culls (4) were in January (0.41%), with the fewest in June (0.26%). Annual herd size culling rates for small, medium and large herds were 34.2%, 30.6% and 32.5% (p<.0001). Most feet and leg (1) culls were at large farms (4.04%) with the fewest in small herds (1.75%). By herd size, reproductive culls (4) were SM: 5.98%, MD: 4.43% and LG:3.12%. The median days in milk by culling reasons 1 to 9 were respectively 182, 138, 263, 412, 167, 90, 163, 129 and 186 days. Unlike other culling reasons, which occurred more frequently earlier in lactation (< 210 days), culling for reproductive problems (4) occurred more frequently later in lactation (>240 days). We concluded that the seasonality in the main reasons for culling were substantial.

Key Words: Culling Reasons, Herd Size, Seasonality

M228   Effect of automatic milking systems on milk yield in Italian conditions. M. Speroni, G. Pirlo*, and S. Lolli, *Animal Production Research Institute via Porcellasco, Cremona, Italy.*

Automatic milking systems (AMS) are expected to increase milk yield because of the higher number of daily milkings in comparison with the conventional milking systems. Many factors can influence the number of milking per day per cow. Two of them are parity and environmental conditions which affect animals activity. Most of the studies on AMS have been carried out in Northern Europe and they do not consider the extreme conditions of the Southern Europe, where the summer is very hot and humid. The aim of this experiment was to compare milk yield of cows reared in identical condition and milked by AMS or by milking parlour (MP) in a typical Italian dairy herd located in the Po Valley. From November 2002 to November 2003, 26 primiparous and 10 pluriparous cows were milked with an AMS (DeLaval VMS®), at the same time on the other side of the barn 31 primiparous and 10 pluriparous were milked twice a day in a MP (8+8 herring-bone). A selection gate allowed cows to access to the AMS only if interval from last milking was >5 h. Cows in the MP had milking intervals of 11 h and 13 h between morning and afternoon and between afternoon and morning respectively. Groups were fed the same TMR. Milk yield was recorded one day a week at each milking; temperature and humidity were recorded hourly and used to calculate temperature and humidity index (THI). Summer 2003 was particularly hot and THI constantly exceeded 72 between June and September. In the AMS, milking frequency (MF) was significantly higher (P< 0.001) in primiparous than in pluriparous cows. In winter and autumn, MF was 2.67±0.03 and in spring and summer it

was 2.51±0.05. Effect of season on MF (P<0.005) was higher in primiparous than in pluriparous. Pluriparous cows of AMS yielded 6.68±0,83 kg/d of milk more (P<0,001) than MP pluriparous cows. There was not difference in milk yield between AMS and MP primiparous cows. The negative effect of hot season (P<0,001) was higher for AMS cows than for MP cows. In conclusion AMS increased milk yield but primiparous cows had some difficulties adapting to AMS. Both primiparous and pluriparous milked with AMS were more sensitive to high THI than cows milked with MP

Key Words: Automatic Milking System, Dairy Cows, Milk Yield

M229   Relationship between international body condition scoring systems. J. R. Roche*[1], P. G. Dillon[2], C. R. Stockdale[3], L. Baumgard[4], K. Macdonald[1], and M. VanBaale[4], [1]*Dexcel, Hamilton, New Zealand,* [2]*Teagasc Moorepark, Fermoy, Co. Cork, Ireland,* [3]*Primary Industries Research Victoria, Kyabram, Victoria, Australia,* [4]*The University of Arizona, Tucson.*

Managing body reserves is critical for farm management, and requires an accurate assessment of the cow's 'condition'. BW alone is not a good indicator of body reserves, as cows of a specific weight may be tall and thin or short and fat. Therefore measuring BCS and changes in BCS of dairy cattle have become essential tools in both farm management and research. The subjective appraisal of body fat stores has been rationalized into numerical BCS systems, but there are many scales in use. In the United States and Europe, 5-point scales are in operation, while an 8-point scale is utilized in Australia and New Zealand uses a 10-point scale. In New Zealand and Ireland, BCS is assessed by palpating individual body parts, while in Australia and the United States the same body parts are visually evaluated. Even though the anatomical regions considered most important are similar in all systems, to date no attempt has been made to relate and compare these systems, making extrapolation and transfer of research findings difficult between systems, and dependent on simple mathematical conversions. The New Zealand 10-point scale was compared to the scoring systems in the U.S., Ireland and Australia by trained assessors. Cows were assessed visually in the U.S. and Australia, and in Ireland by palpating key areas of the cow's body (n = 105, 112 and 120, respectively). Data were analyzed by regression. Positive linear relationships ($P < 0.001$) were found between the New Zealand 10-point and the U.S. 5-point BCS scale (USA = 1.5 + 0.32NZ; r^2 = 0.54; Residual S.D. = 0.34), the European 5-point scale (IRE = 0.81 + 0.40NZ; r^2 = 0.72; Residual S.D. = 0.16) and the Australian 8-point system of scoring (AUS = 2.2 + 0.54NZ; r^2 = 0.61; Residual S.D. = 0.48). The recorded scores converged as the degree of emaciation increased. Results are useful for extrapolating research findings from different countries.

Key Words: Body Condition Score, Dairy Cows

M230   Evaluation of alternative body measurements for growing heifers. D. M. Lefebvre*, B. Gosselin, and R. Lacroix, *PATLQ - Quebec DHI Ste-Anne-de-Bellevue, Quebec, Canada.*

The objective of this study was to validate the use of the Hipometer® and other body measurements to evaluate dairy replacement growth. Measurements were made on 969 heifers (898 Holsteins, 71 Ayrshires) from 27 Quebec dairy herds. Body weight (BW) was measured using a portable electronic scale. Body weight predictions from hip width (HW) were made using a Hipometer. Additional measurements included heart girth (HG) taken with a flexible metal tape, height at the withers (HW) and at the hip (HH) using a measuring stick with a crossbar, and body condition score BCS (1-5 scale). BW predictions from HG (HGW) were also calculated using a polynomial equation in use at PATLQ (559.18 - 22.841 * HG + 0.365 * HG^2 - 2.725 x 10^{-3} * HG^3 + 1.04 x 10^{-5} * HG^4 - 1.526 x 10^{-8} * HG^5). Age and breed of the heifer were also recorded. Average age of measured heifers was 11.75 ± 7.15 months (Mean ± SD), ranging from 0 to 30.5 months and BW was 334 ±176 kg, ranging from 29 to 769. HW was 120 ±18 cm (range 69-152 cm) and HH was 125 ±18 cm (range 75-156 cm). HW was closely associated with BW: HW = 0.9875 BW + 4.9795; r^2 = 0.9675, SD = 31.7 but yielded greater variation than HG-predicted weight: HGW = 1.0392 BW 2.3935 ; r^2 = 0.9834, SD = 23.7. A new second-degree polynomial equation for predicting BW from HG was developed but only yielded marginal improvement in precision (BW = 58.5 2.09 * HG + 0.024 * HG^2, r^2 = 0.9843, SD= 22.03). HW is the commonly used measurement to evaluate skeletal growth but HH is easier to obtain, is less subject to

be influenced by the posture of the heifer being measured and is used by breed associations to evaluate stature for type classification. HH was closely associated with HW, HH=7.13 + 0.9795 * HW, $r^2 = 0.984$, SD=2.3 cm. These results suggest that the Hipometer® is an acceptable method for evaluating BW but is less precise than HG. HH can be used to evaluate skeletal growth, but adjustments are required for comparisons to references.

Key Words: Dairy Heifer Growth

M231   Effect of bedding materials and modified rubber free-stall bases on stall usage by lactating dairy cows. R. Panivivat*[1], E. B. Kegley[1], D. W. Kellogg[1], J. A. Pennington[2], and Z. B. Johnson[1], [1]*Department of Animal Science, University of Arkansas, Fayetteville,* [2]*University of Arkansas Cooperative Extension Service, Little Rock, AR.*

Two studies were conducted to observe cow preference for using stalls bedded with different materials. In the first experiment, a 2 x 3 factorial arrangement of treatments, commercially available rubber free-stall bases that filled the entire stall were compared to handmade modified rubber bases that filled only the rear half of the stalls, in conjunction with three types of bedding materials (rice hulls, sand, or a base of sand covered with rice hulls [combination]). Thirty-six stalls were equipped with either the full base or the modified base and stalls were filled with the three types of bedding from August 8 to 29, 2001. Cows were observed beginning 3-h post-milking, four times at 30 min intervals on d 7, 14, 21, and 31. Cows used the stalls equipped with the full bases (56% usage) more than the modified bases (44%; frequency procedure [P < 0.05]). Cows preferred the combination (61%) to the sand (52%), or the rice hulls (41%; P < 0.01). Using the GENMOD procedure, there was a type of base by material interaction (P < 0.05); stalls bedded with the combination were used 4.6 times more likely (P < 0.01) with the full base than with the modified base. In the second study, 36 stalls were equipped with the full bases and were bedded with the same three types of material from November 19 to December 19. Cows preferred the sand (72%) to the combination (69%), or the rice hulls (60%; P < 0.001). Bacterial counts in the bedding were determined on d 30, 31, and 38. There were material by day interactions (P < 0.05) for gram-negative, coliform, and *Streptococci* bacteria counts. Bacterial counts were greatest initially in rice hulls and lowest in sand; by d 38 counts were similar for all materials. Cows preferred stalls equipped with the commercially available free-stall bases that filled the entire stall. Cows also preferred stalls bedded with sand or the combination of materials rather than with rice hulls.

Key Words: Cow Preference, Bedding Material, Free-Stall Base

M232   Use of ambient and physiological markers to predict production changes in dairy cows resulting from acute heat challenge. J. D. Sampson*, D. E. Spiers, J. N. Spain, R. P. Rhoads, and M. Ellersieck, *University of Missouri, Columbia.*

It is well known that cows reduce production during summer months with either acute or chronic exposure to heat stress (HS). An ambient indicator of heat stress (i.e., temperature-humidity index; THI) is traditionally used to predict milk yield (MY) of heat-stressed cows. More recently, a strain index (PSI) has been developed for humans using physiological markers (i.e., rectal temperature , heart rate) to determine HS impact (Moran et al., Am. J. Physiol. 275: R129-134, 1998). The objective of this study was to measure effects of acute HS on lactating dairy cows to identify ambient and physiological parameters that could be used to develop a similar strain index. Multiparous Holsteins (61±8 d postpartum) were acclimated to thermoneutral (TN) conditions (19°C, 55% RH) for 1 week, followed by TN or HS (29°C, 50% RH) exposure for 24 (n=6), 48 (n=4) or 96 (n=2) hrs. Individual daily milk yield (MY; 0400 and 1600 hr) and feed intake (FI) were recorded. Respiration rate (RR), skin temperature (Tsk)and rectal temperature (Tre) were measured every four hrs. Both MY and FI of HS cows decreased (P<.05) within 48 hrs from 34.5 to 28.2 kg and 40.2 to 24.5 kg, respectively. Likewise, Tre increased 0.5°C at 24 hrs and 1.7°C at 96 hrs of HS (P<.05). Multivariate linear analyses were performed to determine best predictors of production and thermal status. Only correlation coefficients (r) for HS alone were used for comparisons since these values were higher than for a combination TN and HS values. MY was linearly correlated with FI (r = 0.79), followed by Tre and change in Tre (r = -0.73). Likewise, best physiological predictors of FI included Tre and

change in Tre (r = -0.75). There was a close relationship between RR and Tre using either actual values (r = 0.89) or change from baseline (r = 0.91). Skin temperature was a reliable predictor of RR (r=0.91) and Tre (r=0.88). These data suggest that thermal status is a reliable predictor of production and should be used in different combinations when developing a PSI for the dairy cow.

Key Words: Heat Stress, Performance, Index

M233   Investigating effects of heat stress on milk production and composition of Iranian Holstein dairy cattle. A. Naserian*, B. Saremi, and F. Karavan, *Animal Science Department, Ferdowsi University of Mashhad.*

Dairy farms are developing so fast in recent years at north of Iran. This area has a special climate condition (High temperature and humidity during May-October). It's so important to investigate effects of this climate on the performance of cows. The objective of this study was to investigate the effects of temperature and humidity of the weather via an Index (THI), which it is calculated from the following equation: [Temperature°f- (0.55-0.55×Humidity%)×(Temperature°f-58)] on milk production and composition of Iranian Holstein dairy cattle in this area. Treatments consider as T1) THI<52 T2) THI between 52-62 T3) THI between 62-72 T4) THI between 72-82 T5) THI>82. Data were obtained from Gorgan dairy farm (700 heads), which is located at line coast of Caspian Sea at north of Iran (Golestan state). Cows were kept in open shed system and milked three times a day and rations were offered as a TMR. Study was conducted between years 2000-2004 and cows were fed according to NRC 1989 and 2001. Measured data were: 1) Mean daily milk for each cow adjusted to Fat 4% (MDM4), 2) Total milk production (TM), 3) Total milk production adjusted to fat 4% (TM4), 4) Fat% (Fat), 5) Maximum daily temperature (MaxT), 6) Daily humidity (Humid). Data were analyzed using General Linear Model procedures of SAS v6.12 to evaluate differences among experimental groups. The design was completely randomized. Means were compared with Duncan test. Data showed that there is a significant difference between MDM4, TM, TM4 and Fat by year and month of recording; at 2003-2004 and between December-May all of milk production and composition were improved (p≤0.01), which are because of improvement at management of the herd and lack existence of heat stress between mentioned months, respectively. Results showed that all measured factors were reduced significantly by increase in THI (P≤0.05) (Table1). The results of this study showed that investment for dairy industry in this area is possibly unaccepted.

Table 1: Effect of heat stress on milk production and composition of Holstein dairy cattle

THI	MDM4 Kg	TM Kg	TM4 Kg	Fat%
<52	17. 91[a]	4803[b]	4451[b]	3.53[a]
52-62	18.10[a]	5046[a]	4663[a]	3.52[a]
62-72	17.17[b]	4773[b]	4376[b]	3.45[b]
72-82	15.80[c]	4546[c]	4090[c]	3.33[c]
>82	13.81[d]	3961[d]	3529[d]	3.28[d]
SEM	0.044	14.75	12.69	0.004

Different words at columns show significant differences between treatments.

Key Words: Heat Stress, Dairy Cattle, Milk Production

M234   Effects of different bone preparation methods (fresh, dry, and fat-free dry) on bone parameters and the correlations between bone-breaking strength and the other bone parameters. W.K. Kim*[1], L.M. Donalson[1], P. Herrera[1], C.L. Woodward[1], L.F. Kubena[2], D.J. Nisbet[2], and S.C. Ricke[1], [1]*Texas A & M University, Collete Station,* [2]*USDA-ARS, Southern Plains Agricultural Research Center, College Station, TX.*

A study was conducted to evaluate effects of different bone preparation methods on bone parameters and the correlations between bone-breaking strength and the other bone parameters. Bone-breaking strength is dramatically altered depending on bone preparation methods whereas the other bone parameters such as ash content and ash concentration are not significantly influenced by bone preparation methods. Thus, the objective of this study was to evaluate the effects of three bone preparations (fresh, dry, and fat-free dry) on bone parameters. A

total of 60 Single Comb White Leghorn hens were used for this study. At the end of the 2nd laying cycle (approximately 120 wk of age), hens were euthanized using carbon dioxide gas, and the right tibia and femur were collected. The bones were divided into three treatment groups: fresh, dry, and fat-free dry. Fresh weight, bone volume, dried weight, ash weight, ash concentration, and bone-breaking strength were evaluated. There were no significant differences in fresh weight, bone volume, dried weight, ash weight, and ash concentration of tibia and femur among the treatments. However, fresh tibia (24.13 kg) had a greater bone-breaking strength compared to the dried (9.90 kg) and fat-free dried bones (7.41 kg) ($P<0.05$). The bone-breaking strength (20.97 kg) of fresh femur was also significantly higher than the dried (9.22 kg) and fat-free dried femurs (6.94 kg). The bone-breaking strength of the fresh bone was highly correlated with dried weight, ash weight, and ash concentration whereas that of the fat-free dried bone was poorly correlated with the other bone parameters. The results indicate that fresh bone gives better bone-breaking strength correlated to the other bone parameters than dry or fat-free dry preparation.

Key Words: Bone-Breaking Strength, Bone Parameters, Bone Preparation

M235   Interrelationships of traits measured on male Angora goats during a central performance test. F. A. Pfeiffer*, C. J. Lupton, and D. F. Waldron, *Texas Agricultural Experiment Station, College Station, TX, Texas A&M University System, San Angelo.*

A pooled correlation analysis was conducted to estimate the phenotypic relationships between traits measured, calculated, or scored on yearling Angora male goats (n = 462) that had participated in a central performance test (1997-2003). These annual tests were initiated in 1967 to evaluate goats from different herds at a central location for growth, mohair production, and fiber characteristics, and to help breeders identify genetically superior animals. Correlation analyses had been reported earlier (1981 to 1984 data) when selection emphasis was primarily on mohair production. With changes in economic emphasis and the size and structure of the Angora goat industry over the past ten years, it is of interest to re-estimate these correlations. Characteristics measured or scored included initial and final body weights (IW and FW), average daily gain (ADG), scrotal circumference, grease fleece weight (GFW), clean fleece weight (CFW), average fiber diameter (AFD) and variability (SDFD), clean yield (CY), med (M), kemp (K), average staple length, face cover score, neck cover score, and fleece character score. Previously reported significant correlations (r = 0.3, P < 0.01) between FW and the fleece weights were not present (r < 0.1, P > 0.05) in this analysis. Conversely, significant but antagonistic correlations (r = -0.15, P < 0.01) between ADG and the fleece weights and CY and AFD (r = 0.18, P < 0.01) were present in the current analysis but had not been reported previously (r < 0.05). The magnitude of the favorable correlation between FW and ADG (r = 0.47) and the antagonistic relationships between GFW and CY (r = -0.23), GFW and AFD (r = 0.50), and CFW and AFD (r = 0.57) were similar in both studies. Three previously unreported correlations are noteworthy: AFD and M (r = 0.40), M and K (r = 0.60), and ADG and SDFD (r = 0.16). The newly calculated correlation coefficients are expected to assist breeders to better understand the consequences of selecting for individual traits.

Key Words: Angora Goat, Mohair, Central Performance Test

M236   Factors affecting performance and carcass characteristics of beef cattle: a meta-analysis. M. J. McPhee*, J. W. Oltjen, T. R. Famula, and R. D. Sainz, *Department of Animal Science, University of California, Davis.*

A meta-analysis of the main factors affecting finishing average daily gain (FADG; kg/day), intramuscular fat percentage (IMF), 12/13th rib fat (BF; cm), longissimus muscle area (REA; cm2) and kidney, pelvic and heart fat percentage (KPH) at harvest were assessed. Twenty-six papers from 1990 to 2003 were evaluated where consistent IMF data was a key selection criterion. Twenty experiments from 16 papers were selected and used in the analysis. Over 80 variables were entered into a data base and additional variables were created as the data were coded for analysis. In total 93 variables were available for analysis, e.g. sample sizes (n), pen numbers and s.d. for each carcass characteristic. Three categories were developed to distinguish: (1) end point at harvest (i.e.

age, weight or fat depth); (2) experimental unit pen or individual animal (ExpUnit); and (3) weight class (WtClass) (e.g. adjusted for carcass weight). The data were analyzed using the mixed model procedure in SAS with n as the weighting variable. The terms in the model were paper, system (feedlot or pasture), implant (Yes or No), breed (8 categories), End Point, ExpUnit, WtClass, Weaning age, Days on feed before harvest (DOF), Final Age and Carcass wt. All terms were fitted as fixed effects except for paper which was fitted as random; weaning age, days on feed, final age and carcass weight were covariates. Non-significant terms were deleted from the model and the three most significant, determined by the F statistic, are reported. Residual variances of papers were 12, 4, 5, 6 and 4 % for FADG, IMF, BF, KPH and REA respectively. The most significant variables in order were: system, DOF and Carcass wt for FADG; System, Carcass wt and End Point for IMF; Carcass wt, Breed and WtClass for BF; Carcass wt, WtClass and End Point for KPH; and Carcass wt, Breed and Weaning age for REA. These analyses will provide valuable inputs to an ongoing program for modeling beef cattle growth and carcass quality.

Key Words: Cattle, Meta-Analysis, Carcass Characteristics

M237   Cow and calf performance in a management system including twinning and early weaning. R. Wasson*[1], J. E. Larson[2], D. R. Brown[1], A. DiCostanzo[2], J. D. Arthington[3], and G. C. Lamb[1], [1]*North Central Research and Outreach Center, University of Minnesota, Grand Rapids,* [2]*Department of Animal Science, University of Minnesota, St. Paul,* [3]*Range Cattle Research and Education Center, University of Florida, Ona.*

We evaluated the effects of early weaning calves from cows that had twins on cow and calf performance, compared to a system of early-weaned single calves or normal weaned single calves. During the spring of 2003, cows that gave birth to twins simultaneous to cows calving to a single calf were assigned based on days postpartum and calf sex to one of three management systems: 1) cows with twins were maintained together until both calves were early-weaned from the cow at 81 ± 2.5 d (TWIN; n = 7); 2) cows with a single calf were maintained together until the calf was early-weaned at 76 ± 3.4 d (SE; n = 8); 3) cows with a single calf were maintained together until the calf was weaned at 202 ± 3.4 d (SL; n = 8). At early-weaning calves assigned to the TWIN and SE systems were exposed to a step-up feeding procedure until they consumed an 85% concentrate diet consisting of corn and soybean meal, with access to grass hay. Body weight (BW) and body condition score (BCS) of cows and BW of calves were recorded every 28 d. The MIXED model of SAS was used to analyze all data as repeated measures. At 60 d prior to calving BW and BCS of cows did not differ. At Calving the percentage change in BW and BCS was greater (P < 0.05) for SE (0% and 5.2 ± 0.2 for BW change and BCS, respectively) and SL (-3% and 5.6 ± .2 for BW change and BCS, respectively) than TWIN (-12% and 4.0 ± .2 for BW change and BCS, respectively) cows. At d 44, 72, and 100 BW and BCS was greater (P < 0.05) for SE and SL than TWIN cows, whereas at d 128 to 204 BW and BCS for TWIN cows was similar to SE and SL. Average BW of calves at birth was greater (P < 0.01) for SE (42.3 ± 8.6 kg) and SL (42.2 ± 8.1 kg) calves than individual TWIN (30.8 ± 6.5 kg) calves. From birth to d 204 ADG was greater (P < 0.05) for SE (0.98 ± .06 kg) and SL (1.05 ± 0.06 kg) than individual TWIN (0.83 ± 0.04) calves; however, total weight per cow weaned was greater (P < 0.05) for TWIN (406 ± 13 kg) than SL (253 ± 12 kg) and SE (241 ± 12) systems. We conclude that weaning cows by 80 d with twins influenced BW change and BCS in cows. In addition, TWIN cows weaned more total calf-weight per cow than their single counterparts.

Key Words: Beef Cows, Twinning, Early Weaning

M238   Acute phase protein response to weaning and transport in calves produced by matings of Romosinuano, Angus, and Brahman. J. D. Arthington*[1], D. G. Riley[2], C. C. Chase, Jr.[2], W. A. Phillips[3], and S. W. Coleman[2], [1]*Univ. of Florida, Gainesville,* [2]*USDA, ARS, Brooksville, FL,* [3]*USDA, ARS, El Reno, OK.*

Objectives were to assess acute phase protein (APP) response in calves due to weaning and transport, and to evaluate breed influence on any detected response. Straightbred and crossbred calves (n = 297) were produced from all possible matings of Romosinuano (R; tropically adapted breed native to Colombia), Angus (A), and Brahman (B) in central Florida. Calves were weaned at approximately 7 mo of age (September, 2002) and provided a commercial preconditioning concentrate and

free-choice grass hay. Approximately 28 d after weaning, steers (n = 143) were transported 2,200 km to central Oklahoma. As an estimate of inflammation, concentrations of ceruloplasmin, fibrinogen, and haptoglobin were measured in blood samples collected at weaning, 24 and 72 h post-weaning, and on the day of shipping, 24 and 72 h after arrival. Fixed effects were breed type (n = 9 levels: straightbreds [RR, AA, BB], and crossbreds [RA, AR, RB, BR, AB, BA] where letters indicate breed of calfs sire then dam, respectively), herd, sex (weaning only), and sampling time. Animal was a random effect. Following weaning, the concentration of each APP increased (P < 0.01; 15, 17, and 19% in the interval from weaning to 72 h for ceruloplasmin, fibrinogen, and haptoglobin, respectively). Irrespective of breed of sire, concentration of each APP was lesser (P < 0.01) in calves derived from B dams (average APP concentration = 21.7 and 23.2 mg/dL, 102 and 124 mg/dL, and 2.9 and 3.3 mg HbB for ceruloplasmin, fibrinogen, and haptoglobin, respectively). Following transportation, concentrations of ceruloplasmin and fibrinogen decreased (P < 0.05; 10 and 17% in the interval from pre-shipping to 72 h after arrival for ceruloplasmin and fibrinogen, respectively). In contrast, average haptoglobin concentration increased 78% for all calves by 24 h following arrival. Increased haptoglobin concentration was most evident as heterotic effects for AR; i.e., crossbred (AR and RA) concentration (2.71 mg HbB) was greater (P < 0.01) than straightbred (AA and RR) concentration (1.41 mg HbB). These data suggest that certain breed effects impact the APP response to calf weaning and shipping.

Key Words: Acute Phase Proteins, Romosinuano, Brahman

M239 Effects of fasting and handling stress of market pigs on plasma concentrations of stress-associated enzymes and carcass quality. D. H. Kim*, J. T. Seo, D. M. Ha, and C. Y. Lee, *Regional Animal Industry Research Center, Jinju National University, 150 Chilamdong, Jinju, Korea.*

One hundred and forty-four cross-bred market pigs weighing approximately 110 kg were randomly divided into six groups in a 3 (duration of fasting prior to loading; 0, 12 and 24 h) x 2 (handling stress; minimal vs stimulated handling stress) factorial arrangement of treatments. The stimulated handling stress group received overall rough handling including electric prod stimulation during loading, transport and lairage at least once at each step. All the animals received 3-h lairage prior to slaughter. Blood and longissimus dorsi muscle (LM) samples were taken at slaughter and after overnight chilling of the carcass, respectively. Mean plasma glucose concentration, as expected, was less in the 12 h- or 24 h-fasting group than in the 0 h-fasting, whereas cortisol concentration was greater (P<0.05) in the 24 h- vs 0 h-fasting group. Plasma concentrations of stress indicators glucose, cortisol, creatine kinase and lactate dehydrogenase were greater in the stimulated vs minimal handling stress group. There were no interactions between the duration of fasting and handling stress in their effects on these blood

variables. The incidence of pale, soft and exudative (PSE) carcass and drip loss of LM were reduced in the 12 h- or 24 h- vs 0 h-fasting group, whereas the 24-h postmortem LM pH and color including the lightness and redness were not affected by the duration of fasting. The incidence of PSE carcass and physico-chemical characteristics of LM, however, were not changed by the stimulated vs minimal handling stress. In conclusion, results suggest that fasting the market pig overnight prior to transport is desirable in terms of reducing the incidence of PSE carcass. Rough handling of market pigs may not affect the carcass quality of the animals when an enough lairage time is provided. However, rough handling inflicts a stimulated stress on the animal, which is manifested by increased blood concentrations of stress indicators, and therefore should be avoided for animal welfare.

Key Words: Pig, Stress, Carcass

M240 Economic evaluation of gestation crates versus loose-housing systems for gestating sows. M. Ellis, M. E. Kocher*, and G. D. Schnitkey, *University of Illinois, Urbana.*

The objective of this study was to model the economics of a change from confinement to loose-housing of gestating sows using an economic engineering approach. Analysis was conducted with the base case of a 2,200 sow breeding to weaning operation with gestating sows housed in two alternative systems (crates or loose-housing/fed from electronic sow feeders). Annual total costs for each system were estimated on the basis of the following assumptions. Building and equipment costs were depreciated over 15 and 10 years, respectively, assuming an interest rate of 7%. Total fixed costs of $1,184,348 and $1,236,786 for a crate and loose-housed system, respectively, which consisted of costs of building ($656,613 and $623,996, respectively), equipment ($299,480 and $375,615, respectively), and ownership (i.e., depreciation, interest, repairs, taxes, and insurance) ($228,255 and $237,175, respectively). Operating costs (i.e., labor, genetics, feed, utilities, transportation, and veterinary and medicine) and sow productivity levels were assumed to be the same for both systems. Total cost for the system based on gestation crates was $1,311/sow/year (at a total floor space allowance of 1.67 m^2/sow). The costs of the loose-housed system varied with the floor space allowed per sow. At the same floor space assumed for the conventional crate system (i.e. 1.67 m^2/sow), the costs for the two systems were similar ($1,311 vs. $1,334 /sow/year, respectively.) However, costs per sow increased with increasing floor space in the loose-housed system (e.g. 2.04 m^2/sow = $1,521; 2.42 m^2/sow = $1,701; 2.79 m^2/sow = $1,875). In conclusion, the cost to the industry of a move from gestation crates to loose-housed systems will depend on the floor space necessary for successful operation of the loose-housed system.

Key Words: Sows, Housing, Economics

Horse Species

M241 Handling method influences equine urinary calcium and nitrogen. C. I. O'Connor*, B. D. Nielsen, and M. Mayack, *Michigan State University, East Lansing.*

Four mature geldings were used to study the effects of urine handling prior to analysis on Ca and N values. Urine was collected into a clean bucket and then poured through three layers of cheesecloth to remove any hair or debris. The urine was stirred to suspend any precipitate and 5 ml of urine was pipetted into 7-ml vials and the vials were tightly capped. An additional 500 ml of urine was poured into a total collection device (TCD) for later sampling. Urine from each of the 4 horses was blocked by horse and evaluated with twenty-one treatments. Seven combinations of holding time and temperature were examined (frozen immediately, 6 h at 30 C, 6 h at 10 C, 12 h at 30 C, 12 h at 10 C, TCD for 6 h, TCD for 12 h). There were 3 acidification methods evaluated for each combination (no acid, acid added just before freezing, or acid added after urine was thawed). Sample processing was completed within 45 min of collection. Acid was added at a rate of 20 μl of 12 M HCl/ml urine. All samples were frozen at -4 C until analyzed. Differences between treatments were determined by orthogonal contrasts using the mixed model procedure in SAS 8.2. Urinary Ca was higher when acid was added compared to when no acid was added (1.52 mg/ml $\pm$ 0.18 vs. 0.59 $\pm$ 0.18) regardless of holding time, temperature, or location (P<0.01). The addition of acid prior to freezing tended to result in

samples having higher Ca than samples in which acid was added after urine was thawed (P=0.07), though no other variables had an effect. Urine N was unaffected by the addition of acid to the sample (1.04% $\pm$ .26 vs. 1.05 $\pm$ .26; P=0.22). There was a trend for urine placed in the TCD for either 6 or 12 h to have lower N than urine not placed in the TCD (P=0.06) and urinary N was higher when acid was added after thawing compared to before freezing (1.05% $\pm$ 0.01 vs. 1.01 $\pm$ 0.01; P<0.01). There was no difference in N based upon holding time (P=0.77). Vials were tightly capped and N was not able to volatilize, which may explain why other differences were not seen. These data suggest that urinary Ca is more sensitive to the addition of acid than urinary N but that urine handling methods do influence results.

Key Words: Horse, Urine Nitrogen, Calcium

M242 The effects of FEB-200 on serum progesterone and cortisol levels of pregnant mares in early gestation grazing on endophyte-infected tall fescue pastures. V. Akay*[1], R. Stepp[2], and P. Karnezos[1], [1]*Alltech, Inc., Nicholasville, KY,* [2]*Southern States Cooperative, Inc., Richmond, VA.*

Fifty pregnant mares in early gestation from a commercial horse farm in Lexington, KY were used to evaluate the effects of modified gluco-