# Monday, July 11, 2011

# POSTER PRESENTATIONS

## Animal Behavior and Well-Being

**M1 Validation of an automated method for recording the feeding behavior of dairy cows using a Calan Broadbent Feeding System.** L. M. Klaiber*, P. D. Krawczel, S. S. Thibeau, and H. M. Dann, *William H. Miner Agricultural Research Institute, Chazy, NY.*

Assessing feeding behavior is important in understanding the effects of nutrition and management on the well-being of dairy cows. Historically, collection of behavioral data from cows fed with a Calan Broadbent Feeding System required the labor-intensive practices of direct observation or video review. The objective of this study was to validate the output of a HOBO change-of-state datalogger, mounted to the door shell and latch plate, against video data summarized with continuous sampling. Data (number of feed bin visits per day and feeding time in minutes per day) were recorded with both methods from 26 lactating cows and 10 nonlactating cows for 3 d per cow (n = 108). The agreement (established by non-significant $R^2$) of the datalogger and video methods was evaluated using the REG procedure of SAS to compare the mean response of the methods against the difference between the methods. The maximum allowable difference (MAD) was set at ± 3 for bin visits and ± 20 min for feeding time. Ranges for feed bin visits (2 to 140 per d) and feeding time (28 to 267 min per d) were established from video data. Using all the data, agreement was established between the datalogger and video methods for feed bin visits ($P$ = 0.47; $R^2 < 0.005$), but was not established for feeding time ($P < 0.001$; $R^2 = 0.25$; $y = -0.64x + 92.5$). The complete data set was screened to remove visits of a duration ≤ 3 s reflecting a cow unable to enter a feed bin (7% of all data) and ≥ 5400 s reflecting a failure of the door to close properly (<1% of all data). Using the screened data set, agreement was established for feed bin visits ($P = 0.57$; $R^2 < 0.003$) and feeding time ($P = 0.13$; $R^2 = 0.01$). For bin visits, 4% of the data were outside of the MAD. For feeding time, 3% of the data were outside of the MAD and 83% of the data were within ± 3 min. The agreement between the 2 methods indicates that the use of a datalogger is a viable method for the assessment of feeding behavior for cows using the Calan Broadbent Feeding System. Use of the screening criteria before analyzing data resulting from the datalogger method is recommended.

**Key words:** validation, feeding behavior, Calan

**M2 Animal welfare assessment of intensive dairy farms from central zone of Chile under confinement with different housing systems.** M. J. Castro, C. Kobrich, and M. S. Morales*, *Departamento Fomento de la Produccion Animal, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, RM, Chile.*

The objective was to evaluate dairy welfare in 2 types of confinement systems in central Chile. Nineteen dairy farms were free stall (FS, n = 9) or California corral (CC, n = 10). Herd size ranged from 40 to 1100 lactating cows; animal welfare was assessed using the Welfare Quality® protocol for dairy cattle which considers animal based measures to evaluate the overall welfare (OW) at the farm, using 4 welfare principles: good feeding, good housing, good health and appropriate behavior, and 11 welfare criteria, giving a score (excellent, enhanced, acceptable and not classified) to each. Results from the scores by criteria, principles and OW were statistically described and analyzed by Kruskal-Wallis ANOVA using Minitab. No differences between housing systems for OW and the different principles were observed; while among the 11 welfare criteria considered in the evaluation; only absence of prolonged hunger, expression of social behavior (ESB) and good human-animal relationship (GHAR) showed statistical differences ($P \leq 0.05$) between FS and CC, where FS had higher scores for ESB and GHAR than observed for CC. The OW ranged between acceptable and enhanced, no farm showed an excellent level, and only one was nonclassified. The welfare principles good feeding and good housing among dairy farm systems ranged excellent to enhanced, while good health was acceptable and appropriate behavior ranged between acceptable and not classified. Results reflect that animal behavior generally is not considered a productive issue, whereas nutrition and feeding, housing and health management do receive more attention because of their direct effects on production. Confinement systems did not differ in measures of animal welfare quality and both systems had acceptable welfare quality. Funded by European Union-Latin American cooperative project (Nº FOOD-CT-2004–506508) and CONICYT.

**Key words:** animal welfare, dairy cows, housing systems

**M3 Effect of dietary starch on the behavior of early postpartum dairy cows.** P. D. Krawczel*[1], B. H. Nelson[1,2], H. M. Gauthier[1], L. M. Klaiber[1], R. E. Clark[1], R. J. Grant[1], and H. M. Dann[1], *[1]William H. Miner Agricultural Research Institute, Chazy, NY, [2]Department of Animal Science, The University of Vermont, Burlington.*

Propionate, a product of starch fermentation, may be the signal for satiety in ruminant species, which suggests that altering the starch content of a ration may alter feeding behavior. The objective of this study was to evaluate the feeding and lying behavior of multiparous dairy cows (n = 13/treatment) fed a total mixed ration containing L (21.0 ± 0.3% of DM), M (23.2 ± 0.3% of DM), or H (25.5 ± 0.3% of DM) dietary starch levels from 1 to 14 d in milk (DIM). Housing consisted of sand-bedded freestalls and a Calan Broadbent Feeding System. Following a completely randomized design, behavioral data from 8 to 14 DIM were captured using dataloggers (feeding recorded continuously and lying recorded at 1-min intervals). The bimodal distribution of intervals between visits to feed bins was used to calculate a meal criterion, which was used to establish the mean meals per day, the mean duration of each meal, and the meal time per day (active feeding time plus additional within-meal time). Lying behavior consisted of mean lying time per day and the mean daily bouts. Data were analyzed by ANOVA with the MIXED procedure of SAS using treatment and day as fixed factors and cow within treatment as a random factor. Dry matter intake increased from d 8 (19.7 ± 0.6 kg/d) to d 14 (20.7 ± 0.6 kg/d; $P < 0.001$), but no treatment or treatment by day interaction was evident ($P \geq 0.55$). Meals (10.4 ± 0.5 n/d), meal duration (17.1 ± 0.9 min/meal), and lying (696 ± 37 min/d) did not differ by treatment ($P \geq 0.36$), day ($P \geq 0.18$), or treatment by day interaction ($P \geq 0.31$). Feeding and meal times had treatment by day interactions ($P \leq 0.04$)

with the response of the L cows on d 14 (172 ± 10 min/d and 202 ± 12 min/d), relative to H (138 ± 10 min/d and 164 ± 12 min/d) and M (140 ± 10 min/d and 157 ± 12 min/d) cows, most likely responsible for this effect. A treatment by day interaction was evident ($P = 0.05$) for lying bouts, but the range of the mean of bouts (from 10 to 14) did not suggest a biologically meaningful effect. Treatment-by-day interactions suggest the possibility of behavioral responses in early postpartum dairy cows to dietary starch that merit further evaluation.

**Key words:** behavior, starch, transition cow

**M4 Effects of a high forage prepartum diet on feeding behavior of dairy cows.** L. A. Vickers*[1], D. M. Weary[1], D. M. Veira[2], and M. A. G. von Keyserlingk[1], *[1]Animal Welfare Program, University of British Columbia, Vancouver, BC, Vancouver, British Columbia, Canada, [2]Agriculture and Agri-Food Canada, Agassiz, British Columbia, Canada.*

Feeding higher forage diets prepartum is known to reduce energy intake before calving and improve postpartum health in dairy cows, but the effects of these diets on feeding behavior has not been described. The aim of this study was to compare the feeding behavior of cows fed either a traditional close up diet (NEL = 1.46 Mcal/kg; 24.3% concentrate, 76.8% forage) or a higher forage diet (NEL = 1.41 Mcal/kg; 13.4% concentrate, 86.6% forage) prepartum. Treatments were assigned to cow (n = 20 healthy multiparous Holsteins) within the same pen. Alternate electronic Insentec feeders provided access to feed and were programmed to allow access only to cows assigned to that diet. The number, duration and intake for each feeder visit was recorded electronically, and these data were used to calculate daily DMI, feeding time, and the number and duration of meals (with meals defined using the distribution of intervals between feeder visits). Time spent ruminating was measured using an electronic collar. All measures were recorded from 2 wk before calving until the day of calving. Cows fed the higher forage diet had lower DMI before calving (13.2 ± 0.6 vs. 16.0 ± 0.6 kg/d; $P = 0.003$), but spent more time ruminating (517 ± 12 vs. 411 ± 12min/d; $P < 0.0001$) compared with cows fed the traditional pre-calving diet. Cows on the higher forage diet ate fewer meals (9.4 ± 0.4 vs. 10.9 ± 0.4 meals/d; $P = 0.02$), but spent more time consuming meals (388.3 ± 13.8 vs. 324.3 ± 13.8 min/d; $P = 0.005$) than those on the traditional pre-calving diet. The number of separate visits to the assigned feeder (where cows were allowed access to feed) averaged (±SD) 70 ± 23 visits/d and did not differ between treatments. Cows also attempted to enter feeders assigned to the alternate treatment diet; these attempts were recorded but access to feed was denied. The number of attempted visits was higher for cows fed the higher forage vs. traditional diet (17.4; 95% CI = 17.0–22.9 vs. mean = 4.3; 95% CI = 3.5–5.2; $P = 0.02$). In conclusion, cows fed higher forage diets prepartum period consumed less DM, but ruminated more, consumed fewer and longer meals and made more attempts to access feed from the alternate treatment.

**Key words:** forage, dairy cow, behavior

**M5 Diurnal grazing behavior of cattle fed a concentrate supplement during the dry-rainy transition season in tropical conditions.** H. J. Fernandes*[1], V. Siqueira[1], L. O. Tedeschi[2], G. C. Coelho[1], L. M. Paiva[1], C. Guaraldo[1], and J. C. Souza[3], *[1]State University of Mato Grosso do Sul, Aquidauana, MS, Brazil, [2]Texas A&M University, College Station, [3]Federal University of Mato Grosso do Sul, Aquidauana, MS, Brazil.*

The objective of this study was to evaluate the effect of a concentrate supplementation on the grazing behavior of cattle under tropical conditions. Twenty-four Nellore bulls, with average initial BW of 384 ± 28.8 kg were divided into 4 groups and grazed Mombaça grass (*P. maximum*, Jacq.) pastures in the beef cattle center of the State University of Mato Grosso do Sul, in Aquidauana, Brazil, at the beginning of the transition of the dry to the rainy season. Two groups received concentrate supplementation and other 2 received only mineral supplementation. After 28 d of adaptation, animals were individually identified and their grazing behavior was observed using binoculars from 0600 to 1800 h, every 5 min, during 6 consecutive day. At each observation, the animals' behavior was classified as standing in leisure, standing ruminating, lying in leisure, lying ruminating, walking, grazing, consuming supplement, or drinking water. The total time ruminating was calculated as the sum of time standing and lying while ruminating. The total time of leisure was calculated as the sum of time standing and lying in leisure. The daily time spent in each behavior was analyzed considering the effect of the type of the supplement. The diurnal time standing in leisure in animals receiving concentrate was greater than those receiving mineral supplement (Table 1). Also the time spent on diurnal period to consume supplement was greater for those animals. The diurnal grazing time was greater for animals that received mineral supplement. The other observed behaviors were not affected by the type of supplement provided.

**Table 1.** Means of diurnal behavior (min/d) of cattle during the dry-rainy transition season

| Behavior | Type of Mineral | Supplement Concentrate | SE | *P*-value |
|---|---|---|---|---|
| Standing in leisure | 51.3 | 59.6 | 3.00 | 0.054 |
| Standing ruminating | 4.35 | 4.38 | 0.88 | 0.976 |
| Lying in leisure | 191 | 191 | 11.3 | 0.982 |
| Lying ruminating | 43.7 | 42.7 | 5.90 | 0.901 |
| Total time ruminating | 48.0 | 47.1 | 6.31 | 0.918 |
| Total time of leisure | 242 | 251 | 12.6 | 0.628 |
| Walking | 20.8 | 22.8 | 1.70 | 0.423 |
| Grazing | 392 | 354 | 7.99 | 0.001 |
| Consuming supplement | 9.47 | 37.6 | 1.46 | <0.001 |
| Drinking water | 7.13 | 7.52 | 0.629 | 0.664 |

**Key words:** behavior, grazing animals, supplementation

**M6 Competition and feed restriction affect feeding and competitive behavior of group-housed dairy cows.** L. K. M. Collings*[1], D. M. Weary[1], N. Chapinal[1,2], and M. A. G. von Keyserlingk[1], *[1]University of British Columbia, Vancouver, BC, Canada, [2]University of Guelph, Guelph, ON, Canada.*

The effects of overstocking at the feed bunk are known, but no research has focused on the effects of restricting feed access time, or feeding to a slick bunk in group-housed cows. Our aim was to determine the effects of temporal and spatial competition on the feeding behavior of group-housed cows. Using a replicated Latin square design 48 Holstein cows were randomly assigned to groups of 6 cows; groups were assigned to either a competitive (2:1 cows:bin) or non-competitive (1:1 cow:bin) treatment and provided feed access for either 14 or 24 h/d. DMI, feeding time and rate were measured for 24 h and 2 h following fresh feed delivery for the last 4 d of the 7 d periods. Displacements were recorded for 2 h after the delivery of morning feed (peak

feeding period) and 2 h following afternoon milking. DMI tended to decline when feed access was restricted (27.0 vs. 25.7 ± 0.5 kg/d, $P$ = 0.06), but was not affected by competition (26.4 ± 1.9, mean ± SD). Feed restricted cows had lower daily feeding times (190.9 vs. 207.9 ± 6.1 min, $P$ = 0.005). When fed competitively restricted access cows had increased feeding rates during the day (136.9 vs. 155.6 ± 3.8 g/min, $P$ < 0.0001) and during the peak feeding period (146.5 vs. 175.2 ± 4.3 g/min, $P$ < 0.0001). In the peak feeding period, competitive cows had lower DMI (6.1 vs. 6.9 ± 0.3 kg/2 h, $P$ = 0.02) and feeding times (41.5 vs. 51.6 ± 2.1 min/2 h, $P$ = 0.0001) and increased feeding rates (160.9 vs. 137.8 ± 3.9 g/min, $P$ < 0.0001). In contrast, feed restricted cows had higher DMI (7.8 vs. 5.2 ± 0.3 kg/2 h, $P$ < 0.0001) and feeding time (54.7 vs. 38.5 ± 2.1 min/2 h, $P$ < 0.0001). Restricting feed access in conjunction with limited feed bunk access resulted in the greatest increase in daily displacements (15.0 vs. 7.4 ± 1.4, $P$ < 0.0001), with the majority of these occurring during the peak feeding period (11.2 vs. 4.8 ± 1.1, $P$ < 0.0001). Adequate space and time to access feed is essential to minimize the welfare concerns that can arise with indoor group housing systems.

**Key words:** feeding behavior, competition, dairy

**M7 Effect of residual feed intake in reactivity of Nellore heifers.** T. L. Sobrinho[1], L. T. Egawa[2], R. H. Branco[2], E. Magnani[2], S. F. M. Bonilha[2], and M. E. Z. Mercadante*[2], *[1]Faculdade de Ciências Agrárias e Veterinárias, Jaboticabal, São Paulo, Brazil, [2]Instituto de Zootecnia, Sertãozinho, São Paulo, Brazil.*

Residual feed intake (RFI) is the difference between DMI observed and predicted by regression equation as function of mid metabolic BW and ADG. This study aimed to evaluate reactivity of Nellore heifers classified as high, medium and low RFI. The experiment was conducted at Instituto de Zootecnia - Sertãozinho/São Paulo/Brazil. Fifty-six Nellore heifers with averages of 282 kg for BW and 9 mo for age were evaluated during 6 weighings. Reactivity score was obtained using qualitative behavioral measure (temperament score), based on movement, posture, breathing, stress level and presence or absence of kicks and vocalisation being classified on scale from 1 (docile) to 5 (aggressive). High RFI animals and the low RFI ones consumed, respectively, on average, 7.13 and 6.32 kg of DM/d, corresponding to a difference of 0.810 kg of DM/d between less and more efficient animals. There was no significant difference ($P$ = 0.4943) in reactivity among RFI levels. Docile animals when compared with the agitated ones use less energy, but the relationship between reactivity and ADG is not always antagonistic, depending of each animal. Reactivity not always defines temperament, that is a measure of complex expression, which justifies differences in physiological and productive traits.

**Table 1.** Performance, DMI and reactivity of Nellore heifers classified for RFI

| Traits | High RFI | Medium RFI | Low RFI | $P$-value |
|---|---|---|---|---|
| n | 18 | 21 | 17 | |
| DMI, kg/d | 7.13[a] | 6.63[b] | 6.32[c] | <0.0001 |
| RFI, kg/d | 0.406[a] | 0.010[b] | −0.442[c] | <0.0001 |
| ADG, kg/d | 0.832[a] | 0.858[a] | 0.861[a] | 0.7508 |
| Reactivity | 2.06[a] | 2.47[a] | 2.29[a] | 0.4943 |

[a-c]Means within a row followed by the same letter do not differ ($P$ > 0.05) by Tukey test.

**Key words:** behavior, efficiency, temperament

**M8 Effect of different short- and long-term heat stress exposure periods and fescue toxicosis on the immune system.** P. A. Eichen*[1], D. K. Kishore[1], M. R. Waldron[1], T. J. Evans[2], K. L. Fritsche[1], and D. E. Spiers[1], *[1]University of Missouri, Division of Animal Sciences, Columbia, [2]University of Missouri, Department of Veterinary Pathobiology, Columbia.*

Fescue toxicosis and heat stress have each been shown to independently impact immune function of animals. The primary objective of this study was to investigate how heat stress, in combination with fescue toxicosis, affects the immune system. A secondary objective was to assess the effect of length of exposure to these stressors. Rats (n = 144) were housed at thermoneutrality (TN; 21°C) and fed diets containing ergopeptine alkaloids (E+), no alkaloids (E-), or pair-fed (PF to E+) for one week. They were then divided into TN or heat stress (HS; 33°C) groups and exposed for a 3-d short-term (ST) or 21-d long-term (LT) period. Blood samples, collected at the end of the trial, were analyzed by flow cytometry for various lymphocyte subpopulations, including: T cells, natural killer (NK) cells, B cells, CD4+ and CD8+ T cell subsets. In both ST and LT, daily food intake (FI) was reduced as a result of consumption of E+ diet (50% and 40%, respectively) with additional decrease during HS. During LT HS, there was partial recovery of FI by Day 4. Individually, neither E+ nor HS in ST affected proportions of NK, T- or B-lymphocytes present in the circulation. However, acute exposure to both stressors elevated NK cells % ($P$ < 0.05), while diminishing B-cell % in turn ($P$ < 0.05). These changes in lymphocyte subpopulations were clearly not a consequence of FI reduction from E+ and HS, because PF to E+ rats fed to the same intake failed to show these immune cell profile shifts. In contrast to ST effects, LT exposure to HS alone elevated NK cells % ($P$ < 0.05). However, it took the combination of LT HS and E+ exposures to reduce T-lymphocyte % in the blood ($P$ < 0.05). In summary, acute- and long-term exposures to HS and/or E+ can lead to alterations in circulating immune cell subpopulations. Additional studies are needed to determine if such shifts in circulating lymphocytes might affect host response to infection.

**Key words:** heat stress, immune, fescue toxicosis

**M9 Intake and feeding behavior in growing heifers fed a high concentrate diet and offered a total mixed ration or dietary components separately.** S. P. Iraira, M. Rodríguez-Prado, X. Manteca, J. L. Ruíz de la Torre, S. Calsamiglia*, and A. Ferret, *Universitat Autònoma Barcelona, Bellaterra, Barcelona, Spain.*

Calves fed high concentrate diets consume low amounts of forage when dietary components are offered separately. Total mixed ration could be a good approach to promote a greater intake of roughage. Eight Simmental heifers (118 ± 3.8 kg initial BW) were used to study the effects of feeding method on intake and animal behavior in a cross-over design experiment. Treatments consisted of feeding concentrate and chopped barley straw as: 1) choice (CH; concentrate and straw in separate feed bunks), or 2) as total mixed ration (TMR; concentrate and straw mixed in one feed bunk). Feeds were offered on an ad libitum basis, but always maintaining a concentrate to straw ratio of 90 to 10. The experiment was performed in 2 21-d periods, and sampling was carried out in the last week of each period. At the end of each period, heifers changed treatment, so the final number of animals per treatment was 8. Intake was recorded over 7 consecutive days. Barley straw was coarsely chopped with a chopping machine. Animal behavior was video-recorded for 24-h on d 2 and d 6 of each sampling week. Differences were analyzed by using the MIXED procedure of SAS, for

intake variables, and the GLIMMIX procedure of SAS, for behavior variables. Concentrate intake and total DMI of heifers fed with the CH feeding method were higher than when fed with the TMR (5.1 and 5.3 kg vs. 4.7 and 5.0 kg, for CH and TMR; $P = 0.002$ and $P = 0.021$, respectively). Conversely, intake of barley straw was higher in heifers fed with the TMR feeding method than in heifers fed CH (0.21 vs. 0.31 kg, for CH and TMR; $P = 0.001$). Total NDF intake was similar in both treatments. In contrast, NDF intake from barley straw was higher in heifers fed with the TMR feeding method than in heifers fed with CH (0.16 vs. 0.23 kg, for CH and TMR; $P = 0.001$). Feeding method did not affect eating and drinking behaviors but it did affect ruminating behavior and heifers fed TMR spent more time ruminating than heifers fed concentrate and barley straw separately (287 vs. 376 min, for CH and TMR; $P = 0.007$).

**Key words:** feeding behavior, feeding method, high-concentrate diet

**M10 Validation and cross-prediction of a single or dual accelerometers for the prediction of grazing, standing/walking, and lying behavior of beef cattle using linear discriminant analysis.** M. S. Gadberry[1], W. Whitworth*[2], G. Montgomery[2], and K. Simon[1], *[1]University of Arkansas, Cooperative Extension Service, Little Rock, [2]University of Arkansas, Southeast Research and Extension Center, Monticello.*

The objective of this study was to evaluate Hoboware's Pendant G 3-axis accelerometer data logger for the prediction of grazing (G), standing/walking (SW), and lying (L) behavior in beef cattle. Three mature, nonlactating Beefmaster cows (C1, C2, and C3) of mild temperament were monitored. On Jun 28, accelerometers were halter mounted, aligned posterior to the poll (P1) or placed within a patch and adhered to the hide, caudal to the shoulder and centered over the thoracic vertebrae (P2). Data logging was programmed to begin Jun 30 at 0700 for 1 s intervals. Cattle behavior was recorded by 3 observers using a spreadsheet with a timestamp script, recording the change in cow behavior from G, SW, and L. Linear discriminant analysis (LDA) was used to predict behavior within cow using a 50% random sample as the training data set and the remaining observations as a test data set. The prediction of one cow's behavior using another cow's prediction coefficients was also examined. At 1 s intervals, logger capacity (16,270 obs) was reached at 1130. Observed time G, SW, and L differed among cows ($P < 0.001$). Among cows, the percentage of accurate predictions for G tended to differ ($P = 0.06$) for P1, P2 and combined position (P1P2), 85.5%, 81.9%, and 93.1%, respectively. Percent accuracy for L activity differed ($P < 0.001$) for P1, P2 and (P1P2), 76.4%, 97.6%, and 98.1%, respectively. Percent accuracy for SW activity differed ($P = 0.002$) for P1, P2 and (P1P2), 63.5%, 84.0%, and 91.9%, respectively. For C1 and C2, G and L could be cross-predicted with >90% accuracy. However, SW was less predictable at 36% and 67% accuracy when C1 was used as the predictor of activity for C2 and vice versa, respectively. C3 coefficients could not predict C1 or C2 and vice versa for G and SW (less than 10% accuracy). These results indicate LDA, based on 2 positions of a 3-axis accelerometer, can predict G, SW, and L with greater than 90% accuracy, however, prediction of one cow's behavior from another cow's prediction coefficients does not appear viable.

**Key words:** accelerometer, beef cattle, behavior

**M11 Comparison of logging intervals for accelerometer predicted grazing, standing/walking, and lying behavior of beef cattle.** M. S. Gadberry*[1], W. Whitworth[2], G. Montgomery[2], and K. Simon[1], *[1]University of Arkansas, Cooperative Extension Service, Little Rock, [2]University of Arkansas, Southeast Research and Extension Center, Monticello.*

Because extending logging interval for a fixed capacity data logger increases the total observation time, the objective of this study was to evaluate logging interval of Hoboware's Pendant G 3-axis accelerometer data logger for the prediction of grazing (G), standing/walking (SW), and lying (L) behavior in beef cattle. One mature, nonlactating Beefmaster cow (C1) of mild temperament was monitored. On Jun 28, an accelerometer was halter mounted and aligned posterior to the poll and another placed within a patch and adhered to the hide, caudal to the shoulder and centered over the thoracic vertebrae. Data logging began Jun 30 at 0700 for 1 s intervals. Logger capacity was reached at 1130. Cattle behavior was recorded by a single observer using a spreadsheet with a timestamp script, recording the change in behavior from G, SW, and L. Using the C1 data set, linear discriminant analysis (LDA) was used to predict behavior using separate training and test observations. Five replications of training and test samples were drawn at 60, 30, or 15 s intervals and a t-test was used to determine if the percentage of predicted time differed from actual. Training sets were >90% accurate at predicting G and L at all 3 intervals. Training sets were 83%, 91%, and 88% accurate for predicting SW using 60, 30, and 15 s intervals, respectively. Actual percentage time G, SW, and L was 27, 22.5, and 50.5%. Percentage of time predicted G at 60, 30, and 15 s intervals was 29.8 ($P = 0.03$), 23.4 ($P = 0.002$), and 31% ($P = 0.001$), respectively. Percentage of time predicted SW using 60, 30, and 15 s intervals was 25.2 ($P = 0.04$), 24 ($P = 0.05$), and 22.4% ($P = 0.88$), respectively. Percentage of time predicted L using 60, 30, and 15 s intervals was 45 ($P = 0.002$), 52.6 ($P = 0.001$), and 46.4% ($P = 0.001$), respectively. No interval produced a best match to the actual observed G and L activity. As a result, prediction inaccuracies resulting from extended logging intervals must be considered in using this technology for estimating behavior on pasture.

**Key words:** accelerometer, beef cattle, behavior

**M12 A comparison of lipopolysaccharide-induced febrile responses across heat-tolerant and -sensitive *Bos taurus* cattle in different thermal environments.** R. E. Chaffin*[1], B. Scharf[1], J. S. Johnson[1], J. K. Bryant[1], D. K. Kishore[1], P. A. Eichen[1], J. A. Carroll[2], C. C. Chase[3], S. W. Coleman[3], N. C. Burdick[2], R. L. Weaber[1], and D. E. Spiers[1], *[1]University of Missouri, Columbia, [2]USDA-ARS, Livestock Issues Research Unit, Lubbock, TX, [3]USDA-ARS, SubTropical Agricultural Research Station, Brooksville, FL.*

Accurate detection of fever in cattle is an important step in maintaining health of a herd. There is little information on several fronts regarding the differences in febrile response to a lipopolysaccharide (LPS) challenge. These include differences in hot (HS) and thermoneutral (TN) environments and between heat-tolerant and -sensitive cattle. Likewise, there has been no comparison of febrile responses across different regions of the body. Eighteen–month–old Angus (ANG; n = 11; 306.7 ± 25.87 Kg BW) and Romosinuano (RO; n = 10; 312.9 ± 31.96 Kg BW) heifers, all derived from Florida, were fitted with ruminal telemetric transmitters (Tru; SmartStock, Pawnee, OK), rectal temperature dataloggers (Tre; Reuter et al., JAS 88:3291), and vaginal temperature dataloggers (Tvg; iButton, Maxim, Sunnyvale, CA). Animals were housed in separate stanchions in 4 temperature-controlled environmental chambers (Brody Environmental Center, University of Missouri). Ambient temperature was within cycling thermoneutral

range (TN; 18.5–23.5°C) for a one wk adjustment period, followed by an increase in 2 chambers to cycling heat stress level (HS; 18.5–38°C) for another 2 wks. On Day 20 of study, an *Escherichia coli* (O111:B4; Sigma-Aldrich, St Louis, MO) LPS (0.5 µg/Kg BW) was administered intravenously to all heifers at approximately 1000 h. Although LPS effect on Tru showed no differences ($P > 0.05$) across breed or environment, there was an approximate 1°C increase in HS animals within 5 h following injection. Tre increased by over 2.0°C within 5 h of injection, with higher values (~0.4°C; $P < 0.05$) for ANG versus RO and HS versus TN. During HS, RO heifers appeared to exhibit the largest increase in Tre. Although Tvg increased by over 2°C 6 h post-LPS injection ($P < 0.05$), there were no general breed or environment differences. These results show that there are regional differences in thermal response to LPS injection, with Tre providing the greater separation across breed and environment. Additional studies are needed to verify a heat-induced increase in the febrile response following an LPS challenge.

**Key words:** heat stress, cattle, LPS

**M13 Effects of alternative housing and feeding systems on the performance of dairy heifer calves.** J. A. Pempek*, M. L. Eastridge, N. A. Botheras, C. C. Croney, and W. S. Bowen, *The Ohio State University, Columbus.*

This study investigated the effects of housing and milk feeding method on the production performance of dairy calves. Eighty-two female Holstein calves were allocated to treatments at 6 ± 3 d of age and monitored for approximately 9 wk. Treatments were as follows: individual housing fed with a bucket, individual housing fed with a bottle, paired housing fed with a bucket, or paired housing fed with a bottle. Two experimental sites were utilized. Calves were housed in hutches (non-tethered, wire pen) at Site 1 (n = 34) and in wire-panel pens in a feed commodity shed at Site 2 (n = 48). Calves allocated to the individual treatment were housed in a single hutch at Site 1, whereas calves assigned to the paired treatment were housed by joining 2 adjacent hutches with doubling of the pen size. Pasteurized whole milk was fed via bucket or bottle twice a day (6 L/d). Calves had ad libitum access to calf-starter (same at both sites) and water. Gradual weaning commenced at wk 6 by reducing the calves' milk allowance by 2 L/wk. Calves were weaned at the beginning of wk 8. Grain consumption and body weight were monitored on a weekly basis and wither height measured at the beginning and end of the experiment. Data were analyzed using the MIXED model procedure of SAS. Total DM intake (grain and milk solids) was higher for calves housed in pairs compared with those housed individually (1764 ± 28 versus 1686 ± 27 g/d; $P = 0.04$). Average daily gain (ADG) was higher for Site 1 compared with Site 2 (1.6 ± 0.05 versus 1.4 ± 0.05 kg/d; $P = 0.001$). Bottle feeding also increased ADG compared with bucket feeding (1.6 ± 0.04 versus 1.4 ± 0.05 kg/d; $P = 0.01$). Change in wither height was greater at Site 1 (13.5 ± 0.5 versus 9.5 ± 0.4 cm; $P < 0.0001$) and for calves housed individually (12.2 ± 0.4 versus 10.8 ± 0.5 cm; $P = 0.03$). In conclusion, housing young calves in pairs may enhance performance due to social facilitation.

**Key words:** dairy calves, paired housing, performance

**M14 Environmental enrichment influence on feedlot cattle performance.** B. J. Howell*[1], J. R. Brethour[2], and J. R. Jaeger[2], *[1]Fort Hays State University, Hays, KS, [2]Kansas State University, Hays.*

Feedlot cattle are able to consume feedstuffs rapidly, quickly meeting DM intake requirements, and therefore have much more idle time in a confined space compared with grazing animals. The objective of 2 experiments was to investigate the effects of providing an environmental enrichment device consisting of a large brush on live and carcass performance in steers in a feed yard environment. In Exp. 1, yearling crossbred steers (n = 156) were allotted by weight to 2 treatments, no brush (control) or access to a brush (brush). Steers were fed for 73 d using 3 replications per treatment (n = 26 hd/replication). Steers were implanted with Synovex Plus and were not treated for parasites. In Exp. 2, yearling crossbred steers (n = 165) were blocked by weight and projected harvest date to 3 replications per treatment (n = 25 to 33 hd/replication). Steers had been previously implanted with Synovex-S, and were treated with Atroban for lice. Replication 1 was harvested (48 d), replication 2 (80 d), and replication 3 (110 d). All cattle were fed a high-energy finishing ration comprised primarily of dry-rolled milo and included sorghum silage, soybean meal, urea, ammonium sulfate and 300 mg Rumensin, 90 mg Tylan, and 30,000 IU Vitamin A per head. The brush treatment increased 12th rib fat thickness in Exp. 1 ($P < 0.05$), but not in Exp. 2 ($P > 0.05$). No differences ($P > 0.05$) were observed between treatments for average daily gain, dressing percentage, calculated yield grade, marbling, proportion grading Choice, kidney, or pelvic and heart fat. Daily dry matter intake was not different between treatments in Exp. 1 ($P > 0.10$), but was greater ($P = 0.03$) in Exp. 2 for steers housed with a brush compared with control steers (13.02 vs. 12.73 kg, respectively). Continual interaction occurred with the brush device in all brush replications throughout both trials, indicating it did provide a stimulus for the cattle.

**Key words:** environmental enrichment, beef cattle, feedlot

**M15 Lack of the expressive associations between temperament, aggression and weight gain in finishing weight feedlot cattle.** D. R. Soares*[1], K. Schwartzkopf-Genswein[2], A. C. Sant'anna[1], T. da Silva Valente[1], P. M. Rueda[1], J. N. dos Santos Gonçalves Cyrilo[3], and M. J. R. P. da Costa[4], *[1]Sao Paulo State University, Animal Science Posgraduation, Jaboticabal, Sao Paulo, Brazil, [2]Agriculture and Agri–Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada, [3]Animal Science Institut of Sertaozinho, Sertaozinho, Sao Paulo, Brazil, [4]Animal Science Department, Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil.*

The aim of this study was to determine the relationship between temperament, aggressive behavior and average daily gain (ADG), in feedlot cattle. Behavioral observations were conducted for 10 d (0700 to 1800) using a continuous sampling method. Fifty–3 bulls (35 Nelore and 18 Nelore cross with an average age of 30 ± 3 mo.) were observed in one feedlot pen. The frequencies of 2 types of aggressive behavior were recorded: displacement (DISP; physical contact where the initiator pushed with his head, horn or body resulting in a change in the receivers position) and non-displacement (NDISP; as described above, without any change of the receivers position). Temperament was assessed, in the pen during at weights registers on d 1, d 29 and d 54 at the end of fattening period, using flight distance (FD: proximity (m) to which a stock person could come to an individual animal before it would move away) and flight speed (FS: speed (m/s) at which the animal exited a handling chute). Average daily gain was calculated using animal weights obtained on d 1 and d 54 at the end of the fattening period and Pearson correlation coefficients were estimated for all variables. There were significant positive correlations ($P < 0.05$) between FD and FS (r = 0.58), DISP and NDISP (r = 0.74) and negative correlations between NDISP and FS (r = –0.29). No correlations

($P > 0.05$) were observed between NDISP and FD (r = –0.17), DISP and FD (r = –0.06), DISP and FS (r = –0.13), or between ADG and any of the other variables (NDISP: r = 0.07, DISP: r = 0.03, FD: r = 0.09 and FS: r = –0.03). Based on these results we conclude that there is no expressive association between temperament, intra-specific aggression, or ADG. Financial support: CNPq and ETCO Group.

**Key words:** behavior, confinement, reactivity

**M16 Relationship between temperament, blood flow and area in the external jugular vein, and body temperature in crossbred beef calves.** H. L. Sanchez-Rodriguez*, R. C. Vann, E. Baravik-Munsell, S. T. Willard, and P. L. Ryan, *Mississippi State University, Mississippi State, MS.*

The relationship between temperament, blood flow and dimension of the external jugular vein, and body temperature was assessed in Angus crossbred calves [223.4 ± 33.2 kg BW; 262.72 ± 24.94 d old (mean ± SD)] during December, 2010. An average between exit velocity and pen score was used to classify the calves according to their temperament (calm, intermediate, and temperamental). Calves (n = 91) were weighed and the hair of the neck over the jugular vein was clipped. Pulsatility Index (PI) and area of the lumen of the external jugular vein were measured via Duplex Doppler and B mode ultrasound, respectively. The luminal area of the jugular vein was standardized by body weight. Rectal and superficial temperatures of the neck region (over the hair and over the skin) were also recorded. Blood samples were collected for future plasma cortisol analysis. There was a tendency for higher PI values ($P = 0.09$) in temperamental than in calm calves [1.78 ± 0.16, 1.87 ± 0.15, and 2.28 ± 0.18 for the calm (n = 31), intermediate (n = 32), and temperamental (n = 28) groups, respectively]. Luminal areas of the jugular vein were not affected by temperament ($P = 0.65$; 0.254 ± 0.016, 0.242 ± 0.015, and 0.263 ± 0.018 $mm^2$/kg BW for the calm, intermediate, and temperamental groups, respectively). Rectal temperatures were greatest ($P = 0.01$) in temperamental than in calm and intermediate calves (39.38 ± 0.13, 38.92 ± 0.12, and 38.90 ± 0.11°C, respectively). There was no effect of temperament on the superficial temperature of the hair ($P = 0.10$; 24.08 ± 0.65, 26.00 ± 0.61, and 25.15 ± 0.72°C) or the skin ($P = 0.84$; 33.23 ± 0.55, 33.59 ± 0.51, and 33.17 ± 0.61°C) in the neck region for the calm, intermediate, and temperamental calves, respectively. In this study there was a relationship between temperament and some important indicators of the animal′s physiological status (internal body temperature and Pulsatility Index). The effect of these physiological changes can influence the performance of beef cattle and therefore these markers may be beneficial in developing better tools for selection of beef cattle.

**Key words:** beef calves, temperament, blood flow

**M17 Pre-separation behavior of calves being weaned by different methods.** H. T. Boland*[1,5], S. T. Willard[2], K. Umemura[3], G. Scaglia[4], J. A. Parish[5], and T. F. Best[1], *[1]Mississippi State University, Prairie Research Unit, Prairie, [2]Mississippi State University, Department of Biochemistry and Molecular Biology, Mississippi State, [3]National Agricultural Research Center for Hokkaido Region, Toyohira, Sapporo, Japan, [4]Louisiana State University Agricultural Center, Iberia Research Station, Jeanerette, [5]Mississippi State University, Department of Animal and Dairy Sciences, Mississippi State.*

Two-stage weaning can potentially reduce stress associated with abrupt weaning of calves. British crossbred beef cattle (n = 96 cow-calf pairs) were used to evaluate 3 weaning methods: "one-size fits all" nose-clips (ONE), adjustable size nose-clips (ADJ), and fence-line weaning (FL). In a fourth control treatment group (CTRL) calves remained in pastures with their dams. Nose-clips were placed on ONE and ADJ calves on d −4 and FL calves were placed in pastures adjacent to their dams on d −4. All calves were completely separated from cows the morning of d 0. Calves wore bite counters and IceTag sensors to evaluate pre-separation grazing behavior and locomotor activity. Three trial periods were conducted in sequential weeks in Fall 2010. There were 2 replicate groups (4 cow-calf pairs per group) of each treatment per wk and each group grazed an area of 2.0 ha. Pasture assignment was randomized for treatment each week to minimize effects of differently shaped paddocks on behavior. A standard stride length of 65 cm was used to estimate distance traveled. Data were analyzed using PROC MIXED of SAS. There was no effect of weaning method on number of bites and steps, distance traveled, and time spent standing or lying per day ($P > 0.05$). On d −4, bites/d were less while steps/d and distance traveled/d were greater compared with d −3, −2, and −1 ($P < 0.05$). This was likely due to cattle being handled the morning of d −4 to start the experimental treatments and being introduced to new pastures. Unseasonably high ambient temperatures during wk 1 may have led to an effect of wk ($P < 0.05$) on bites/d with values being less in wk 1 than wk 2. Average high temperatures during wk 1, 2, and 3 were 36, 27, and 25°C, respectively. Time spent standing was greater, and consequently time spent lying was less in wk 1 compared with wk 3 ($P < 0.05$). On d −4 FL calves spent more time standing ($P < 0.05$) than CTRL calves, but only tended ($P = 0.07$) to stand more than ONE calves. The data indicate that use of these gradual weaning methods did not greatly alter behavior of calves during the first stage of the weaning process compared with calves that continued to nurse.

**Key words:** weaning methods, grazing behavior, pedometers

**M18 Predictors of body thermal status in heat-tolerant and -sensitive *Bos taurus* cattle exposed to different temperature loads under controlled conditions.** D. E. Spiers*, H. L. Vellios, P. A. Eichen, B. Scharf, J. S. Johnson, D. K. Kishore, and R. L. Weaber, *University of Missouri, Columbia.*

There have been attempts to derive predictors of thermal status for cattle, with the ultimate goal of developing practical models. There have been few studies under controlled conditions that have compared cattle with different sensitivities to thermal stress. There has been little attempt to identify shifts in predictors of thermal strain that occur with adaptation to heat stress. The present study evaluated multiple potential determinants of thermal status over repeated exposures to heat stress to determine shifts in correlation coefficients (R). Heat-sensitive Angus steers from Oklahoma (n = 6 per trial) and Missouri (n = 6 per trial) were compared against heat-tolerant Romosinuano steers (n = 5 per trial) from Florida in the Brody Environmental Center (University of Missouri). Air temperature (Ta), rectal temperature (Tre) and respiration rate (RR), as well as skin temperatures for ear, shoulder, rump, upper tail and lower tail were measured hourly for 24 h during one day midway through each temperature interval. Two different groups of animals were used in 2 separate trials. Cattle were exposed to a constant 20–22°C (TN) for 8 d, followed by 2 separate 7 d cyclic heat stress (HS) periods. Ta in Trial 1 cycled 26–36 then 28–37°C for the 2 cycles, and in Trial 2 cycled 28–38 then 30–40°C. In no case was Ta a reliable predictor of Tre or RR. Likewise, there was no skin temperature or Tre that served as a reliable determinant ($P > 0.05$) of RR. All additional comparisons examined skin temperature predictions of Tre. Trunk sites were closely related ($P < 0.05$) across breed and environment (TN and HS), with lower R between extremities. Rump and

shoulder sites were better Tre predictors under all conditions. Shift from TN to HS environments generally increased R from ~0.50 to 0.60. Use of only times when daily Ta increased (0500 to 1500) further improved R (~0.70) for many sites. Trial 2 with higher Ta did not increase R. Trunk temperature, and not RR or Ta, during the daily temperature rise is the best predictor of rectal temperature across heat-tolerant and -sensitive breeds.

**Key words:** cattle, heat stress, model

**M19 Sexual behavior of Nellore cattle in the Pantanal.** J. C. DeSouza*[1], U. G. P. Abreu[2], J. R. B. Sereno[3], C. H. M. Malhado[4], J. A. Freitas[5], P. B. Ferraz Filho[6], H. J. Fernandes[7], R. L. Weaber[8], and W. R. Lamberson[8], *[1]Mato Grosso do Sul Federal University – UFMS/ Animal Science, Aquidauana, Brazil, [2]Empresa Brasileira de Pesquisa Agropecuária - CPAP-EMBRAPA, Corumbá, Brazil, [3]Empresa Brasileira de Pesquisa Agropecuária - CPAC - EMBRAPA, Brasília, DF, Brazil, [4]South of Bahia State University - UESB, Bahia, Brazil, [5]Parana Federal University - UFPR, Palotina, Brazil, [6]Mato Grosso do Sul Federal University - UFMS, Tres Lagoas, Brazil, [7]State University of Mato Grosso do Sul, Aquidauana, Brazil, [8]Animal Sciences, University of Missouri, Columbia.*

The objective of this study was to evaluate the sexual behavior of Nellore bulls and cows by observing the duration of courtship, the hierarchy of bulls, the distance maintained between bulls, and the behavior of Nellore cows with respect to the choice of bull in a natural service mating system in the Pantanal Region of Mato Grosso do Sul, Brazil. Behavior was observed between 6:00 a.m. to 7:00 p.m. for a total of 380 h over 2 years. Thirty-six bulls were observed, of which 9 were more than 60 mo old, (GE5); 15 were 24 to 30 mo in year one (GE2_3) with 12 of these retained for a second year (GE2_4). The bull to cow ratio was 1:20 (average). All bulls from GE5 group maintained 10 M separation from each other, with one being the leader in a clear hierarchy. When GE2_3 bulls, in lots of 3, were exposed to cows, they spent the first days together, interacting through touching, licking and smelling each others' testicles. From the third day on, they started to exhibit the Flehmen response and mounting cows, but without completing sexual intercourse. The first service was observed on d 5. The hierarchical ranking among GE2_3 bulls was established only in the second year. Bulls from GE2_4 group were more precocious, completing sexual intercourse by the third day. A total of 32 matings were observed with 6 being repeated. Only 5 of the 26 serviced cows were observed to choose the male to mate. Among the 26 first matings, 11 took place before 10:00 a.m., 8 occurred from 10:00 a.m. to 4:00 p.m., and 13 occurred after 4:00 p.m. The mean duration of courtship was 68.45 min; and ranged from 17 to 186 min. Of the observation courtship, 75.76% lasted 60 min or less, 15.15% lasted between 60 and 120 min, and 3.0% lasted more than 120 min (Chi-Square = 26.91; $P < 0.0001$). It was observed in many cases that the bull and cows copulation once and then part with no further courtship or copulation. The presence of hierarchical (dominant) bulls may hinder fertility rate since it results in uneven distribution of matings among bulls.

**Key words:** courtship, ethology, Nellore

**M20 Behavioral reactivity to psychosocial stress determines the effects of lavender oil on anxiety in sheep.** P. Hawken[1], C. Fiol*[2], and D. B. Blache[1], *[1]UWA Institute of Agriculture (Animal Production), The University of Western Australia, Perth, Western Australia, Australia, [2]Departamento de Bovinos, Facultad de Veterinaria, Universidad de la República, Montevideo, Uruguay.*

The aim was to determine the effects of lavender (*Lavendula augustofolia*) oil on individuals that innately differ in their reactivity to stress. Merino ewes (n = 24) selected for high (nervous) and low (calm) expression of behavioral reactivity to isolation were allocated to 1 of 4 groups: Calm Lav; Calm Con; Nerv Lav; Nerv Con. Ewes were fitted with a mask that contained wool scented with 10% lavender (Lav) or peanut (Con) oil for 30 min before entering an isolation box for 5 min. Agitation score and activity in the box were recorded using a video camera and calibrated agitation meter. Blood was sampled before fitting the mask; before entering and after exiting the box, and 30 min after exiting the box. Behavioral and cortisol data were analyzed with 2-way and repeated measures ANOVA, respectively. Agitation score, central line crosses, vocalizations, and cortisol after exiting the box were lower for calm than nervous ewes, irrespective of exposure to Lav (Table 1; $P < 0.001$). Exposure of calm ewes to Lav decreased vocalizations, central line crosses (Table 1; $P < 0.05$), and cortisol before entering the box compared with calm control (14.6 ± 0.9 vs. 24.4 ± 3.4 ng/mL; $P < 0.05$). Among the nervous ewes, exposure to Lav increased vocalizations, escape attempts (Table 1; $P < 0.05$), and cortisol 30 min after exiting the box (37.1 ± 5.8 vs. 14.8 ± 3.0 ng/mL; $P < 0.05$). In conclusion, lavender decreased anxiety in sheep selected for calm temperament but increased some measures of anxiety in sheep selected for nervous temperament. Differences in behavioral reactivity to psychosocial stress appear to determine the effect of lavender oil on anxiety in sheep.

**Table 1.**

| | Calm Con | Calm Lav | Nerv Con | Nerv Lav |
|---|---|---|---|---|
| Agitation score | 67.8±20.0$^{a}$ | 28.1±7.46$^{a}$ | 299±43.8$^{b}$ | 374±72.0$^{b}$ |
| Central line crosses | 16.6±4.23$^{a}$ | 3.42±0.81$^{b}$ | 53.8±4.38$^{c}$ | 57.2±6.18$^{c}$ |
| Vocalizations (bleats/min) | 1.95±0.86$^{a}$ | 0.34±0.19$^{b}$ | 5.60±1.01$^{c}$ | 9.2±1.13$^{d}$ |
| Escape attempts | 1$^{ab}$ | 0$^{ac}$ | 0$^{ac}$ | 4$^{b}$ |
| Mean cortisol after exiting box (ng/mL) | 32.0±2.8$^{a}$ | 34.6±1.0$^{a}$ | 58.5±4.2$^{b}$ | 53.3±1.5$^{b}$ |

$^{a-d}$Different superscripts indicate significant differences between treatments (at least $P < 0.05$).

**Key words:** stress, lavender, temperament

**M21 Characteristics and welfare of horses used for transportation in northeast Ohio.** K. Bennett-Wimbush*, M. Amstutz, and D. Willoughby, *Ohio State University Agricultural Technical Institute, Wooster.*

Horse transportation is common in some geographical locations, often dictated by cultural beliefs and practices. However, little information is available on welfare issues concerning this sub-segment of the US equine population. The purpose of this study is to characterize factors that influence travel speed and document welfare and safety concerns of horses used as primary modes of transportation. Horse drawn vehicles/riders (n = 306) were observed at 8 different locations, representing 3 distinct communities in northeast Ohio during summer 2010. Environmental conditions (slope, heat index), gait characteristics (hitch, gait, speed, lameness) and driver/rider factors (gender, vehicle type, safety equipment) were recorded. Differences between variables

were determined by Least Square Means, GLM and Fisher's Exact Test, SAS. Travel speed was correlated with terrain slope ($P < 0.01$), community ($P < 0.001$), heat index ($P < 0.05$), gait ($P < 0.001$) and lameness grade ($P < 0.05$). Most notably, horses traveled slower uphill (slope > 1.0), during periods of high (>25°C.) heat index and when exhibiting a grade 3 lameness, using the AAEP 0–5 lameness scale. Overall, there was a trend ($P = 0.10$) for double hitches to travel slower than single hitches. Travel speed within vehicle type was observed. Wagons (4.63 ± 0.25 m/sec) traveled slower ($P < 0.01$) than buggies (5.00 ± 0.10 m/sec) which traveled slower ($P < 0.05$) than open buggies (5.35 ± 0.13 m/sec). This was most likely due to the vehicle and cargo weight. Pacing accounted for 2.6% of the observations at 5.14 ± 0.38 m/sec while 92.8% of the horses trotted (5.14 ± 0.07 m/sec), although speeds were not different. Grade 3 lameness was observed in 4.1% of the horses which slowed ($P < 0.05$) travel speed to 4.23 ± 0.35 m/sec compared with non-lame horses (5.07 ± 0.07 m/sec). Youth drivers were more likely to drive lame horses than women or adult men. The frequency of displayed slow-moving vehicle signs on horse drawn vehicles varied by community from 41.3 to 94.6%. This is a safety concern for both the occupants and animals. In this study, lameness was minimal and appropriate animal welfare allowances were observed.

**Key words:** equine, welfare

**M22 Female mate choice in the domesticated goat (*Capra hircus*).** K. M. Longpre* and L. S. Katz, *Rutgers University, New Brunswick, NJ.*

Female mate choice is the tendency for females to distinguish among and mate selectively with one specific phenotype. In promiscuous species such as the goat, in which males contribute genes only, females should choose to mate with high quality males. This sexual selection can account for the display of dimorphic characteristics not attributed to Darwin′s theory of natural selection. Female mate choice has not been studied in most domesticated species, in part due to single-male breeding programs and the use of artificial insemination. Both of these practices inhibit the opportunity for mate choice. Therefore, the appearance of mate choice in a domesticated species, when the environment or management system allows it to be expressed, suggests that the underlying mechanisms of mate choice are robust. We find that female goats are able to distinguish among and show preference for males with higher serum testosterone (T) concentrations ($P < 0.05$). Our studies indicate that morphological cues, specifically T-dependent neck and shoulder musculature are not used to distinguish among males. Instead, females use T-dependent physiological and/or behavioral cues, which increase in frequency and intensity during the breeding season, to assess potential mates. Specifically, males that emit potent chemical cues ($P < 0.001$) and high frequency courtship cues ($P < 0.001$) are preferred by estrous females. It is males with higher circulating T concentrations that emit more potent chemical cues ($P < 0.05$), and display higher frequency courtship cues ($P < 0.01$). Furthermore, high circulating T concentrations impose high energetic costs as males with higher T concentrations lose more body weight during the breeding season ($P < 0.05$), likely due to the increased frequency of T-dependent behavior expression. We conclude that female mate choice exists in the domestic goat, and circulating T concentrations and the resulting T-dependent behaviors in males may serve as an honest indicator of a male′s overall quality.

**Key words:** goats, sexual selection, mate choice

**M23 Effects of spray-dried porcine plasma (SDPP) administered as an oral gavage on indicators of health, welfare, and performance in pigs transported after weaning.** L. M. Wittish* and M. J. Estienne, *Virginia Polytechnic Institute and State University, Blacksburg.*

Transportation of swine is an emerging welfare issue, especially for pigs weaned and then transported to other farms for grow-finish. Weaned pigs fed starter diets containing SDPP show improved growth performance. The objective of this study was to determine the effects of SDPP, administered as an oral gavage during suckling, on indicators of health, welfare, and performance in transported weaned pigs. At weaning (4 wk of age), pigs were assigned to one of 4 treatments: I. SDPP (0.375 g/mL) + transport, II. Water + transport, III. SDPP + no transport, and IV. Water + no transport (n = 10 barrows and 10 gilts per treatment). Pigs received 25 mL of the assigned gavage 2x/d for 5 d before weaning. Pigs were moved from the farrowing barn, loaded on a livestock trailer and transported on a 5-h roundtrip or were moved directly to the on-site wean-to-finish barn. Rectal temperatures and blood samples were obtained at weaning and after relocation. Pig BW was determined at weaning, after relocation and at weekly intervals for 5 wk thereafter. Rectal temperature increased in all groups, but the magnitude of increase was greatest for groups I and II (treatment x time, $P < 0.01$). Effects of treatment x time ($P < 0.01$) were detected for several blood measures. Creatinine levels increased in all groups, but the magnitude was greatest for groups I, II, and III. Circulating concentrations of cortisol, urea nitrogen, and chloride increased, and calcium decreased, in groups I and II only. Potassium increased in group I only. That levels of phosphorous and sodium increased in group II only suggests a protective effect of prior treatment with SDPP in transported pigs. There was a trend ($P = 0.08$) for an effect of treatment x time for BW, and BW were greater at wk 4 and 5 after weaning for group I compared with group IV. In summary, transportation impacted physiological indicators of health and welfare in weaned pigs. Providing SDPP before weaning prevented transportation-induced changes in blood levels of phosphorous and sodium.

**Key words:** pig, spray-dried porcine plasma, transportation

**M24 Castration is no laughing matter, nitrous oxide can′t even help.** J. L. Rault*[1] and D. C. Lay[2], [1]*Department of Animal Sciences, Purdue University, West Lafayette, IN,* [2]*USDA-ARS-Livestock Behavior Research Unit, West Lafayette, IN.*

Surgical castration is performed on all male pigs in the United States. However, castration is painful and analgesics are being considered to relieve pain. Inhalant gases with analgesic properties allow for a fast induction, short-term and reversible effects, and are a needle-free option. Isofluorane, halothane and carbon dioxide have been tested to alleviate castration-induced pain in pigs with variable success. The use of those gases also raises practical or ethical concerns. Nitrous oxide ($N_2O$) or "laughing gas" has been widely used in human surgery and dental offices as an analgesic, sedative and anxiolytic drug. Yet, $N_2O$ has not been thoroughly investigated for use in farm animals. $N_2O$ possesses appealing features for the animal industry: It is not regulated as a drug, it is widely available, relatively inexpensive, and harmless. We hypothesized that the analgesic effect of $N_2O$ may reduce the pain induced by castration. We used 24 piglets from 12 litters, one piglet receiving $N_2O$ (N) and a littermate receiving air as a control (C). After 150 s under the gas, castration was performed while the piglet remained under the gas. Behaviors and squeal lengths were recorded during castration. Behavioral observations were continued for 3 d

using a scan-sampling interval recording method, and weight gain was measured. Data were analyzed using a mixed model in SAS. $N_2O$ successfully induced anesthesia in all N pigs, as validated by a skin pinch test and the loss of palpebral reflex. Squeal length was shorter in N pigs during the induction phase ($P < 0.001$) but not different during castration itself as N pigs awoke and squealed as much as C pigs. Agitation scores during the whole procedure were reduced in N pigs, in both frequency ($P = 0.02$) and intensity ($P = 0.02$). For 2 h following castration, N pigs displayed less huddling behavior than C pigs ($P < 0.05$). Over the 3 d, N pigs performed more tail wagging ($P < 0.01$) and slept less ($P < 0.05$) than C pigs. $N_2O$ was effective in inducing anesthesia in neonatal pigs. Nonetheless, its anesthetic effect seemed ineffective in preventing castration-induced pain.

**Key words:** castration, analgesic

**M25 The effect of using carbon dioxide gas and/or a NSAID to reduce the pain associated with castration in pigs.** B. L. Davis*[1] and M. A. Sutherland[1,2], *[1]Texas Tech University, Lubbock, [2]Ruakura Research Centre, AgResearch, Hamiliton, New Zealand.*

Surgical castration is routinely conducted on commercial swine farms to prevent boar taint and reduce aggressive behaviors. However, the procedure of castration causes acute pain which is an animal welfare concern. The objective of this study was to evaluate the effect of general anesthesia (carbon dioxide: CO2) and a non-steroidal anti-inflammatory drug (NSAID) either singularly or combined on the pain caused by castration in pigs. Pigs were allocated to one of 7 treatments (n = 10 pigs per treatment): 1) sham castration (CON), 2) administration of CO2 only (CO2), 3) administration of NSAID only (NSAID), 4) castration (CAS), 5) castration while the pig was anaesthetized with CO2 gas (CAS+CO2), 6) castration plus NSAID administered at the time of castration (CAS+N), and 7) castration conducted while the pig was anesthetized with CO2 plus NSAID administered at the time of castration (BOTH). Blood samples were collected before (0), and 30, 60, 120, 180 min after administration of treatments for analysis of cortisol concentrations. Behavior was recorded (live observations) in the farrowing crates using 1-min scan sampling for up to 180 min after castration. Body weight was measured before and 24 h after experiment. Data were analyzed using the MIXED procedures of SAS. Cortisol concentrations were elevated ($P < 0.005$) in all castrated pigs 30 min after castration regardless of pain relief treatment. Cortisol concentrations remained elevated ($P < 0.05$) in CAS pigs for up to 180 min after castration, but were lower in CAS-CO2 pigs at 60, 120, and 180 min after castration as compared with pigs castrated without pain relief. Pigs castrated without pain relief spent more ($P < 0.05$) time lying without contact compared with non-castrated pigs and CAS+N and BOTH pigs spent less ($P < 0.06$) lying without contact compared with CAS pigs. Change in body weight did not differ ($P > 0.05$) among treatments 24 h after castration. Pain relief in the form CO2 and/or a NSAID appeared to have some beneficial effects on the physiological and behavioral response to castration in pigs.

**Key words:** pigs, castration, welfare

**M26 The effects of group size on aggression when mixing unacquainted sows in outdoor paddocks.** J. N. Marchant-Forde*[1], J. P. Garner[2], A. K. Johnson[3], R. M. Marchant-Forde[2], and D. C. Lay[1], *[1]USDA-ARS, West Lafayette, IN, [2]Purdue University, West Lafayette, IN, [3]Iowa State University, Ames.*

Aggression is a challenge when pigs are kept in groups. Sows fight at mixing when space is limited but this project sought to determine the amount and type of aggression observed when unacquainted Berkshire sows were mixed in pairs or in 2 established sub-groups of 3 in outdoor paddocks. Treatment 1 (PR) used 16 pairs of sows mixed into a 5000 $m^2$ paddock. Treatment 2 (GP) used 28 unacquainted groups of 3 sows, with 2 groups mixed into a 5000 $m^2$ pen. Behavior was recorded continuously for 60 min post-mixing and all-occurrences sampling was used to extract social interactions. The data were analyzed to determine the number of social interactions that did or did not contain aggressive components (i.e., pushing, knocking or biting) and fighting defined as interactions that contained 10 or more reciprocated, aggressive component actions. Within each interaction, data were analyzed to determine the number of component actions and the number of aggressive component actions. The data were compared using a GLM, with treatment as a fixed effect. The number of social interactions was similar in GP (15.7 ± 2.7) and in PR (14.4 ± 2.5, $P < 0.001$) The number of interactions that contained aggression was also similar (6.9 ± 1.4 v. 5.6 ± 1.2, $P > 0.05$), but GP interactions contained more aggressive components (26.8 ± 2.5) than PR interactions (16.6 ± 1.4, $P < 0.05$). Twelve of the 16 PR pairs fought and aggression occurred quickly, beginning with biting after 2.1 ± 0.4 interactions and 17.3 ± 6.9 components. In GP mixing, 8.5 ± 0.3 of the 15 possible pair combinations per group interacted, of which 5.6 ± 0.4 interacted aggressively and 1.5 ± 0.4 fought. A higher proportion of unacquainted pairs interacted aggressively (0.57 ± 0.07) and fought (0.17 ± 0.05) than acquainted pairs (0.10 ± 0.04 and 0 respectively, $P < 0.01$). Bites were delivered quickly after 2.2 ± 1.7 interactions and 9.2 ± 2.6 components. Mixing pairs or groups of sows in paddocks did not prevent aggression. Aggression occurred quickly but reduced rapidly, with sows using space for avoidance. The results further our understanding of aggression at mixing and will help to identify best practice for producers.

**Key words:** aggression, pigs, mixing

**M27 Association of sow fear with prolactin and cortisol concentrations pre- and post-farrowing.** C. E. Phillips*[1], Y. Z. Li[2], L. J. Johnston[2], G. C. Shurson[1], J. Deen[4], and C. Farmer[5], *[1]University of Minnesota, St. Paul, [2]West Central Research and Outreach Center, Morris, MN, [3]University of Minnesota-Morris, Morris, [4]College of Veterinary Medicine, St. Paul, MN, [5]Agriculture and Agri-Food Canada, Dairy and Swine R & D Centre, Sherbrooke, Quebec, Canada.*

A study was conducted to investigate associations among sow fear and circulating concentrations of prolactin and cortisol peripartum. Multiparous sows (n = 63) were subjected to human approach and novel object fear tests on wk 12 post-breeding. A fear score for each sow was calculated using Principal Component Analysis. Fear scores ranged from 0 to 7.88. Sows were classified as fearful (n = 31, scores = 7.32 ± 0.42) or less fearful (n = 32, scores = 4.36 ± 1.83). A subset of sows (7 fearful; 7 less fearful) from 2 winter farrowing groups were chosen to collect blood samples. Two days before the expected farrowing date of the first sow, sows were moved into the farrowing facility, anesthetized, and had an indwelling ear vein catheter inserted. The farrowing facility housed 8 sows, where sows shared a communal area and farrowed in individual pens. A blood sample was collected from each sow 2 d pre-farrowing, the day of farrowing, and 2 d post-farrowing between 1000 and 1100h. Catheters in 11 sows (5 fearful and 6 less fearful) remained functional for the sampling period. Serum samples were analyzed for prolactin and cortisol concentrations using RIA. Data were analyzed using repeated measures for day with the Glimmix

Procedure of SAS. There was no association ($P > 0.60$) of sow fear with prolactin (fearful 37.7 ± 3.8 ng/ml, less fearful 37.8 ± 3.7 ng/ml) or cortisol (fearful 4.2 ± 0.5 ug/dL, less fearful 4.5 ± 0.5 ug/dL) concentrations on any day. Prolactin concentrations 2 d before farrowing were lower ($P < 0.01$) than on all other days. Cortisol concentrations 1 d before farrowing and the day of farrowing were greater than 1 d post-farrowing ($P < 0.05$) and 2 d post-farrowing ($P < 0.01$). Results corroborate an increase in prolactin concentrations in sows on the day before farrowing to initiate the lactogenic process. They also suggest that cortisol concentrations are indicative of a greater stress level closest to the time of farrowing. Nevertheless, sow fearfulness as measured in this study, was not related to circulating concentrations of prolactin or cortisol pre- and post-farrowing.

**Key words:** sow, fear, parturition