

## SYMPOSIA AND ORAL PRESENTATIONS

### Animal Behavior and Well-Being: Sow Housing, Management, and Stress

**409 Productivity and well being of pregnant sows in loose housing is affected by floor space allowance and dietary fiber content.** A. R. Hanson\*<sup>1</sup>, A. E. DeDecker<sup>2</sup>, J. L. Salak-Johnson<sup>2</sup>, P. M. Walker<sup>1</sup>, and J. P. Holt<sup>1</sup>, <sup>1</sup>*Illinois State University, Normal*, <sup>2</sup>*University of Illinois, Urbana*.

As government mandates and public perceptions encourage the adoption of group housing, appropriate management strategies must be evaluated to determine their effect on sow well being and performance. To evaluate the effects of floor space allowance (FSA) and dietary fiber, a 10 mo study was conducted involving 6 trials (n = 40 sows/trial). Pregnant, mixed parity sows were housed 10 per pen with either 2.32m<sup>2</sup> (B) or 1.67m<sup>2</sup> (S) of FSA per sow. Sows were floor fed either a traditional corn-soy based control (C) or higher fiber diet (F). Sows were evaluated for BCS, BW and 10th rib backfat (BF) at d34 (start of trial), d65, and d90 of gestation. Sows were weighed and BCS at d110 of gestation (end of trial), and were scored for lesions at d34 of gestation (before mixing sows), every 2nd day for 2 weeks, and at d65, d76, d90, d110 of gestation to assess skin injury. Farrowing data were collected for each litter, including total birth and weaning weight, piglet mortality, number of pigs born, born alive, born dead and weaned. Data were analyzed by GLM procedures or mixed models, using repeated measures analysis when appropriate to measure effects across gestation days (GD). Sows were assigned to 1 of 3 parity groups (PG) for gilts entering parity 1 (G), sows entering parities 2-3 (M), and sows entering parity 4 or higher (H), respectively. There were significant PG by diet interactions for BCS change, weight gain, and ADG. Gilts lost more BF over gestation compared with other PG ( $P < 0.05$ ). Sows in B pens tended to have higher ADG/period than those in S pens ( $P = 0.09$ ). The HF sows had higher ADG/period than the other diet by PG classifications ( $P < 0.05$ ). The FSA by GD interaction was significant, with S sows accruing lesions of higher severity compared with B sows at d36 ( $P = 0.002$ ) and d76 of gestation ( $P = 0.07$ ). Litter birth weight, and litter live birth weight were greater for higher parity sows ( $P < 0.05$ ). These results indicate that a diet high in fiber can be fed to sows without detrimentally impacting performance, and that FSA may affect lesion severity.

**Key Words:** sow group housing, fiber, floor space allowance

**410 Effects of fiber and floor space allowance on group kept dry sow well-being.** A. E. DeDecker\*<sup>1</sup>, A. R. Hanson<sup>2</sup>, P. M. Walker<sup>2</sup>, and J. L. Salak-Johnson<sup>1</sup>, <sup>1</sup>*University of Illinois, Urbana*, <sup>2</sup>*Illinois State University, Normal*.

Alternative housing systems for gestating sows is one of the most controversial welfare issues facing the swine industry, thus it is imperative that before implementing new systems that various components of group housing systems be fully evaluated. Therefore, the objective of this study was to evaluate the effects of dietary fiber (source of energy) and floor space allowance on immune and endocrine status, and behavior of sows during gestation. On d34 of gestation, 160 multiparous (parities 1-6) large white crossbred sows were randomly allotted to a dietary treatment (control or high-fiber supplemented diet) and a floor space allowance of

either 1.7m<sup>2</sup>/sow or 2.3m<sup>2</sup>/sow. Group size was kept constant at 10 sows per pen. On d 34 and 90 of gestation both sow immune and endocrine statuses (n = 40 sows/treatment) were measured and for a 24h period between gestation d 75 and 105 sow behavior (n = 10 sows/treatment) was continuously observed using EZViewLog by Geovision. Data were analyzed using Proc MIXED with repeated measures and Chi-squared analysis (SAS). Both diet and days of gestation had an effect on sow immune status; with neutrophil phagocytosis and plasma cortisol being greater ( $P < 0.05$ ) for sows fed a control diet when compared with sows fed a high-fiber diet. Whereas, concanavalin-A induced lymphocyte proliferation was greater ( $P < 0.05$ ) for sows fed high-fiber compared with sows fed a control diet. On d90 of gestation, lymphocyte proliferation was greater ( $P < 0.01$ ) for sows fed a high-fiber diet than for sows fed a control diet. Sow behavior was also affected by diet; with sows fed the high-fiber diet being engaged in more ( $P < 0.001$ ) agonistic encounters than sows fed a control diet. Durations of oral-nasal-facial (ONF), standing, and eating behaviors were all greater ( $P < 0.05$ ) for sows fed the control diet compared with sows fed the high-fiber diet. Moreover, sow behavior was affected by floor space allowance; sows kept at 1.7m<sup>2</sup>/sow performed more ( $P < 0.05$ ) ONF, standing, and eating behaviors than did sows kept at 2.3m<sup>2</sup>/sow. These results indicate that fiber and floor space allowance can influence sow physiology and behavior which may ultimately impact sow well-being.

**Key Words:** fiber, well-being

**411 Effect of alternative individual and group housing on dry sow performance and physiology.** A. E. DeDecker\*<sup>1</sup>, A. R. Hanson<sup>2</sup>, P. M. Walker<sup>2</sup>, and J. L. Salak-Johnson<sup>1</sup>, <sup>1</sup>*University of Illinois, Urbana*, <sup>2</sup>*Illinois State University, Normal*.

Sow housing is one of the most controversial issues facing the swine industry, but before implementing alternative systems, we must fully understand the impact that various housing types have on the well-being of gestating sows. Therefore the objectives of this study were to evaluate the effects of individual standard and turn-around stalls on sow performance and physiology during gestation (Exp.1), and to determine the effects of keeping sows in one of the 2 types of stall for first 30d of gestation and then moving sows to group-pens for the rest of gestation (Exp.2). Forty multiparous crossbred sows were allocated, based on body weight and parity, to a standard stall (STS; n = 10) or a turn-around stall (TAS; n = 10) for all of gestation (Exp.1); or a standard stall (STS-G; n = 10) or turn-around stall (TAS-G; n = 10) for 30 d of gestation and then moved to group-pens of 10 sows/pen, at floor space allowance of 2.32m<sup>2</sup>/sow (floor fed; Exp. 2). On d 30 and 90 of gestation sow immune and endocrine statuses were measured. Performance measures and lesion scores (scale 1-7) were also assessed throughout gestation. Data were analyzed using Proc MIXED with repeated measures (SAS) and experimental unit was the sow. Fixed effects included parity, day of gestation, treatment and interactions. In Exp. 1, stall-type influenced sow performance and immune status; with lesion scores being greater ( $P < 0.05$ ) among sows kept in TAS than sows kept in STS. Sows kept in STS had greater ( $P < 0.05$ ) body condition score (BCS) than those

sows kept in TAS. Mitogen-induced lymphocyte proliferation was greater ( $P < 0.05$ ) for sows kept in TAS than for sows kept in STS. In Exp. 2, Treatment influenced both performance and immune status of sows; BCS, back fat, and lesion scores all tended to be greater ( $P < 0.10$ ) for sows kept in TAS-G than for sows kept in STS-G. Neutrophil phagocytosis and count, and total WBC count were all greater ( $P < 0.05$ ) for sows kept in STS-G than for sows in TAS-G. In conclusion, these data indicate that type of individual stall throughout gestation and before group-pens can affect performance and immune status of the sow, thus affecting sow well-being.

**Key Words:** group, stall

**412 Effect of alternative accommodations on sow behavior during gestation.** A. M. Visconti<sup>1</sup>, A. E. DeDecker<sup>1</sup>, A. R. Hanson<sup>2</sup>, P. M. Walker<sup>2</sup>, and J. L. Salak-Johnson<sup>1</sup>, <sup>1</sup>University of Illinois, Urbana, <sup>2</sup>Illinois State University, Normal.

Currently there is a lack of scientifically-sound data to establish welfare-friendly guidelines on how to effectively manage gestating sows. Thus, to improve sow well-being, we must understand the impact that various housing systems have on the behavioral aspects of gestating sows. The objectives of this study were to determine the impact that keeping sows in either a standard or turn-around stall throughout gestation has on sow behavior (Exp. 1), and to evaluate the effects of keeping sows in either a standard or turn-around stall for first 30d of gestation and then moving sows to group-pens for remainder of gestation has on sow behavior (Exp.2). Post-mating, 30 multiparous white crossbred sows were randomly allotted to 2 treatments (TRT) either a standard traditional stall (STS;  $n = 5/\text{TRT}$ ) or a turn-around stall (TAS;  $n = 5/\text{TRT}$ ) for entire gestational period (Exp.1), or to a standard stall (STS-G;  $n = 10/\text{TRT}$ ) or turn-around stall (TAS-G;  $n = 10/\text{TRT}$ ) for 30 d and then moved to group-pen until d107 of gestation (Exp.2). Sow behavior was observed continuously from 0800 to 0900 h, 1200 to 1300 h, and 1600 to 1700 h on d6, 30, and 90 of gestation for Exp. 1 and on d30, 45, 65 and 90 for Exp. 2. Data were analyzed using Proc MIXED with repeated measures and Chi-squared (SAS). In Exp. 1, stall type and day of gestation affected behaviors. On d90, duration of standing and eating was greater ( $P < 0.01$ ) for sows in TAS than for sows kept in STS. Duration of eating was greater ( $P < 0.05$ ) for sows kept in STS on d30 than for sows in TAS. In Exp. 2, treatment and day of gestation both affected sow behavior. Duration of ONF was greater ( $P < 0.05$ ) for sows kept in TAS-G compared with sows kept in STS-G. Frequency of aggression was greater ( $P < 0.01$ ) for sows kept in TAS-G than sows in STS-G. Duration of lying on d45 and 90 was greater ( $P < 0.05$ ) for sows kept in TAS-G compared with sows kept in STS-G. These data indicate that individual stall design throughout gestation and type of stall before group-housing can influence sow behavior; therefore further assessment of alternative accommodations is needed before implementation of alternative systems.

**Key Words:** behavior, sow

**413 Effects of alternative housing systems on the well-being of gestating sows.** A. E. DeDecker\* and J. L. Salak-Johnson, University of Illinois, Urbana.

Housing systems for gestating sows is one of the most controversial welfare issues facing the swine industry. New systems are being implemented without scientifically evaluating the impact these alternative accommodations may have on sow well-being. The objectives were to evaluate the effects of 3 housing systems on sow physiology, performance, productivity and behavior. On d30 of gestation 36 multiparous

sows were allocated to a standard crate (CRATE; control), a width adjustable crate (FLEX), or free access stall-pen (FREE). Immune and endocrine status, body condition and lesion scores, body weight, and back-fat depth were measured at weaning (d 0), various time points throughout gestation, and again at d110. Behavior was observed for 24h on d29, 30, 66, and 87 of gestation for block 1. Data were analyzed using Proc MIXED with repeated measures (SAS). Sows in the FREE system had greater ( $P < 0.01$ ) body condition and lesion scores, body weight, and back fat depth than sows in either FLEX or CRATE systems. Sows in FLEX had greater litter size ( $P < 0.10$ ) and piglet mortality rate ( $P < 0.05$ ) than did sows in CRATE; while sows in FLEX had piglets with greater ( $P < 0.01$ ) wean weight and rate of gain than did sows kept in either FREE or CRATE systems. Sows in FREE had less ( $P < 0.05$ ) banded neutrophils than did sows in either FLEX or CRATE. On d31 (24 h later), all sows had greater ( $P < 0.05$ ) lymphocyte and neutrophil counts, neutrophil chemotaxis, and concanavalin A- and lipopolysaccharide-induced lymphocyte proliferative responses than any other day of gestation. Sows kept in CRATE engaged in more oral-nasal-facial (ONF) behaviors than sows kept in other systems ( $P < 0.05$ ). Sows in CRATE stood more ( $P < 0.05$ ) than sows in all other treatments. Also, as day of gestation increased ( $P < 0.05$ ), duration of ONF, sham-chewing, eating, and drinking behaviors all increased. These data indicate that alternative housing accommodations can affect immune status, physiology, performance, productivity and behavior of pregnant sows throughout gestation. Moreover, these data support the hypothesis that modifications of specific housing components within existing housing systems can affect sow well-being.

**Key Words:** behavior, immune

**414 The effect of a repeated prenatal stressor and low-dose Ketamine on the anxiety and social behavior of pigs.** B. L. Davis\*<sup>1</sup> and M. A. Sutherland<sup>2</sup>, <sup>1</sup>Texas Tech University, Lubbock, <sup>2</sup>Ruakura Research Centre, AgResearch, Hamilton, New Zealand.

The fetal programming hypothesis states that exposure to elevated glucocorticoid concentrations in utero can alter offspring development. Animals exposed to stress prenatally have been shown to display increased anxiety-like behavior coupled with a reduced ability to cope with stress. The objective of this research was to determine if exposure to stress prenatally would affect the social and anxiety-like behavior of pigs and whether an anxiolytic drug (Ketamine) would reverse these behavioral changes. Sows were allocated to one of 2 treatments; 1) Sows were given an injection of adrenocorticotrophic hormone (ACTH; 100 IU i.m.) 3 times a wk during the last 5 wk of gestation (ACTH;  $n = 10$ ), and 2) Sows were control handled (HAN;  $n = 10$ ). At 6 mo of age, the female offspring from the ACTH (PNS;  $n = 20$ ) and HAN (CON;  $n = 20$ ) sows were tested for 10 min in an open-field test (OFT) to measure anxiety and for 30 min in a social test (ST) to measure social interactions. The ST involved observing the interactions between 2 pigs; the experimental pig and a naïve non-experimental pig. Pigs were tested in each behavioral test twice; 1 wk apart. Two h before testing, pigs were given either Ketamine (KET; 0.5mg/kg, i.m.) or saline (SAL) at the same dose. Videos from behavior tests were analyzed using Observer 7.0. Data were analyzed using the MIXED procedure of SAS. At 6 mo of age, PNS pigs tended ( $P = 0.075$ ) to weigh less than CON pigs. In the OFT, PNS pigs spent more ( $P < 0.05$ ) time in the middle squares and pigs given KET spent less ( $P < 0.05$ ) time displaying escape behaviors compared with SAL pigs. In the ST, PNS pigs given KET tended to spend less time ( $P = 0.065$ ) fighting and more time ( $P < 0.05$ ) performing non-aggressive social touching than CON pigs given KET. In conclusion, exposure to elevated glucocorticoid concentrations in utero may affect

offspring growth and anxiety-like behaviors. Furthermore, low-dose KET appeared to have anxiolytic effects on pig behavior, especially among prenatally stressed pigs.

**Key Words:** stress, pigs, anxiety

**415 Heart rate variability—A tool to differentiate positive and negative affective states in pigs?** R. Poletto\*<sup>1</sup>, R. M. Marchant-Forde<sup>1</sup>, J. N. Marchant-Forde<sup>1</sup>, J. L. Rault<sup>1,2</sup>, D. F. Hogan<sup>3</sup>, and D. C. Lay Jr.<sup>1</sup>, <sup>1</sup>USDA-ARS-Livestock Behavior Research Unit, West Lafayette, IN, <sup>2</sup>Department of Animal Sciences, Purdue University, West Lafayette, IN, <sup>3</sup>Veterinary Clinical Sciences, Purdue University, West Lafayette, IN.

Neurophysiological processes, such as autonomic nervous system activity, that mediate behavioral and physiological reactivity to an environment have largely been ignored in farm animal research. Heart rate variability (HRV) analysis is a clinical diagnostic tool used to assess affective states (stressful and pleasant) in humans, but its application is limited in farm animals. This experiment aimed to determine if HRV may be used to differentiate affective states in swine. Ten 4-mo-old barrows and gilts underwent surgery to place an intracardiac ECG lead attached to a biotelemetry device; pigs had a 3-wk recovery period before data collection. A negative state was induced by restraining pigs for 1 h in metabolism crates located in the same room, while a positive state was induced by allowing pigs' access to the hallway for 10 min. Behavior and ECG data were recorded. For data analyses, a 512-beat section of HR inter-beat intervals was selected per pig while behaviorally inactive during restraint; or while performing a combination of play- and exploratory-like behaviors in the hallway. Data were analyzed using time and frequency domain analysis followed by a factorial analysis of test  $\times$  sex with mixed models and Tukey's post hoc test. Average HR was lower for restraint than the hallway test (121.7 vs. 162.4  $\pm$  4.4 bpm;  $P < 0.01$ ), while RMSSD, index of vagal cardiac control, was higher for restraint than for hallway test (11.0 vs. 7.0  $\pm$  1.0 msec;  $P < 0.05$ ). Gilts had higher low frequency (LF) power than barrows (65.1 vs. 43.9  $\pm$  4.0 msec<sup>2</sup>/Hz;  $P < 0.01$ ). High frequency (HF) power was lower in hallway than in restraint (4.2 vs. 14.1  $\pm$  1.9 msec<sup>2</sup>/Hz;  $P < 0.01$ ). Sympathovagal balance (LF/HF) was higher during hallway test compared with restraint ( $P < 0.01$ ). Gilts showed primarily sympathetic modulation of HR; while over both sexes, restraint resulted in greater parasympathetic control of cardiac function. Results indicate that HRV can be used to distinguish different degrees of activity/states in pigs. Further research will assist to identify distinct autonomic response patterns to different well-being states in farm animals.

**Key Words:** swine, heart rate variability, behavior

**416 A combination of head/heart electric stunning is more effective than the head-only method in pigs.** K. D. Vogel\*<sup>1</sup>, G. Badtram<sup>2,3</sup>, J. R. Claus<sup>3</sup>, T. Grandin<sup>1</sup>, S. Turpin<sup>3</sup>, R. E. Weyker<sup>3</sup>, and E. Voogd<sup>4</sup>, <sup>1</sup>Department of Animal Sciences, Colorado State University, Fort Collins, <sup>2</sup>Wisconsin Department of Agriculture, Trade, and Consumer Protection, Division of Food Safety, Madison, <sup>3</sup>Department of Animal Sciences, University of Wisconsin-Madison, Madison, <sup>4</sup>Voogd Consulting, Inc., West Chicago, IL.

Head-only electrical stunning is a reversible procedure that is effective for approximately 15 s. Shackle to bleed time in small slaughter facilities may exceed 30 s, primarily due to slow hoist speed. A 2-stage stunning method was proposed where head-only stunning for 3 s was followed by application of the same stunning apparatus to the cardiac region of the animal for 3 s while lying in lateral recumbency (head/heart). A paired-comparison study was performed on 89 pigs in a small

Wisconsin slaughter facility to compare the head-only method applied for 6 s to the head/heart method. The study objective was to evaluate signs of return to sensibility, shackle to bleed time, blood lactate concentration, muscle pH, drip loss, and fresh meat color to validate the head/heart electrical stunning method for small slaughter plants. Incidence of corneal reflex was not different ( $P > 0.05$ ) between head/heart (93.8%) and head only (85%) stunning. Nose twitching was more common ( $P < 0.05$ ) in head only (26.5%) than head/heart (5%) stunning. The head/heart method eliminated rhythmic breathing, natural blinking, eye tracking to a moving object, and righting reflex, which were all observed in head-only stunned pigs. Blood lactate was not different ( $P > 0.05$ ) between stunning methods (head only: 8.8  $\pm$  0.7 mmol/L, head/heart: 7.8  $\pm$  0.7 mmol/L). Shackle to bleed time did not differ ( $P > 0.05$ ) between stunning methods (head only: 32  $\pm$  1 s, head/heart: 33  $\pm$  1 s). Mean time to loss of detectable heartbeat with the head-only method was 121  $\pm$  5 s. No detectable heartbeat was observed with the head/heart method. Longissimus thoracis pH, color, and drip loss were not different ( $P > 0.05$ ) between stunning methods. Farm of origin effects were observed in blood lactate, meat color, and drip loss. Farm effects can be generated by differences in genetics and management, which were not investigated in this study. This study determined that the head/heart electrical stunning method reduces the incidence of signs of return to sensibility without significant effect on meat quality, speed of plant operation, and blood lactate concentration.

**Key Words:** swine, stunning, welfare

**417 Effects of pen size on the stress response of market weight pigs during loading and unloading.** L. M. Gesing\*<sup>1</sup>, A. K. Johnson<sup>1</sup>, K. J. Stalder<sup>1</sup>, J. T. Selsby<sup>1</sup>, M. Faga<sup>2</sup>, A. Whiley<sup>2</sup>, S. Abrams<sup>2</sup>, H. Hill<sup>2</sup>, R. Bailey<sup>3</sup>, and M. J. Ritter<sup>4</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>Iowa Select Farms, Iowa Falls, <sup>3</sup>JBS Swift and Co., Marshalltown, IA, <sup>4</sup>Elanco Animal Health, Greenfield, IN.

The objective of this trial was to determine the effects of pen size on the stress response and transport losses in market weight pigs. Twenty-six loads (~174 pigs/load) of pigs (n = 4522) were used in a complete randomized block design. Three commercial grow-finish sites were used over July and August. Each site had 2 rooms with both treatments represented in each room. The small pen (SP) treatment had 36 pigs/pen (0.59 m<sup>2</sup>·pig<sup>-1</sup>). The large pen (LP) treatment had 324 pigs/pen (0.59 m<sup>2</sup>·pig<sup>-1</sup>). To achieve large pens, 8 consecutive swing gates were kept open. During loading, all swing gates were closed in LP pens. Pigs from both treatments were sorted from pen mates at the time of loading, moved in groups of 4–6 using sort boards and electric prods if necessary, and loaded onto straight deck trailers. Treatments were randomly assigned to a deck, pigs were provided with ~0.42 m<sup>2</sup>·pig<sup>-1</sup>, and transported ~1 h to a commercial harvest facility. During loading and unloading, the number of pigs displaying open mouth breathing (OMB), skin discoloration (SD) and muscle tremors (MT) were recorded. At the plant, dead and non-ambulatory pigs (fatigued and injured) were recorded during unloading and total losses were defined as the sum of dead and non-ambulatory pigs. Data were analyzed using Proc Glimmix of SAS. MT at loading and injured and DOA at plant could not be run and will be presented descriptively. SP had lower incidences of OMB ( $P = 0.0015$ ) and SD ( $P = 0.0120$ ) during loading than LP. At loading MT was 0.04% SP vs. 0% LP. At the plant, LP had a lower incidence of SD ( $P < 0.0001$ ) than SP; however, there were no ( $P > 0.05$ ) differences between treatments for OMB, MT, fatigued, total non-ambulatory, or total losses. Incidence of injured pigs was 0% SP vs. 0.04% LP and there were no DOAs. In summary, pen size did not impact the incidence of transport losses.

**Key Words:** pen size, pig, transport loss

**418 Effects of vehicle design on blood stress indicators and meat quality in pigs of three genotypes for two different travel distances.** A. Vanelli Weschenfelder<sup>\*1,2</sup>, S. Torrey<sup>3</sup>, N. Devillers<sup>2</sup>, L. Saucier<sup>1</sup>, and L. Faucitano<sup>2</sup>, <sup>1</sup>Université Laval, Sainte-Foy, Québec, Canada, <sup>2</sup>Agriculture and Agri-Food Canada, Lennoxville, Québec, Canada, <sup>3</sup>University of Guelph, Guelph, ON, Canada.

This study aimed at evaluating the effects of vehicle design on stress response and meat quality traits of 3 different pig genotypes; namely Piétrain HALNn (A), Piétrain HALNN (B) and Duroc crossbreds (control; C). A total of 360 pigs (120 pigs/genotype) were transported either for a short or long distance (45 min and 7h, respectively) over a 6 weeks period. The vehicles were a 3-decked Pot-Belly (PB) trailer equipped with 2 internal ramps and a 3-decked Flat-Deck (FD) trailer equipped with moving decks and no internal ramps. For each group, blood samples were collected at exsanguination from a sub-sample of 144 pigs (4 pigs/genotype/vehicle/week) for the analysis of lactate and creatine phospho-kinase (CPK) concentrations, while meat quality was assessed in the Longissimus dorsi (LD) and Semimembranosus (SM) muscles of all 360 pigs (10 pigs/genotype/vehicle/week). Data were analyzed using the mixed model procedure of SAS. In the short distance journeys, CPK levels were higher ( $P = 0.021$ ) in A pigs transported on the PB trailer compared with those transported on the FD trailer. Pigs transported on the PB trailer had higher ( $P = 0.02$ ) pHu values in the SM muscle than those transported on the FD trailer. Yet, in the short distance study group, A pigs had lower ( $P = 0.008$ ) pHu and higher ( $P < 0.001$ ) drip loss in the LD muscle compared with B and C pigs. Concurrently, the LD muscle of A and B pigs was paler (higher  $L^*$  value;  $P = 0.002$ ) than that of C pigs. A pigs also had higher  $L^*$  and drip loss values ( $P = 0.04$  and  $P < 0.001$ , respectively) in the SM muscle. In the long distance transportation, no effect of vehicle type was found on blood stress indicators ( $P > 0.05$ ). Nonetheless, A and B pigs had higher lactate ( $P = 0.003$ ) and CPK levels ( $P < 0.001$ ) than C pigs. Regarding meat quality parameters, differences between genotypes were similar to those found in the short distance travel study. Overall, the use of PB trailer for short distance transportation and of HALN carrier pigs are not recommended from an animal welfare and meat quality improvement perspective.

**Key Words:** transport, pigs, stress

**419 Effects of pasture versus stall housing on cortisol and DHEA concentrations in young Quarter Horses.** S. M. Garey<sup>\*</sup>, T. H. Friend, L. R. Berghman, A. L. Adams, and C. L. Terrill, Texas A&M University, College Station.

Adaptation of horses to long-term stall housing has not been thoroughly investigated. The objective of this study was to determine if cortisol or dehydroepiandrosterone (DHEA) differed among groups of young horses when housed in individual stalls versus in a group on pasture. Eighteen 2- to 3-yr-old Quarter Horses were randomly assigned to either stall or pasture housing for 21 d. The 3.05 × 3.05 m stalls had solid concrete side and rear walls with a small ventilation window, while the front allowed horses to view the alley of the barn. The stalled horses were allowed 15 min of exercise 3 d per week. The 9 pasture horses were on a novel 0.2 km<sup>2</sup> pasture. All horses were fed concentrate 2 times per day, pastured horses had coastal grass, and stalled horses had coastal hay. After 21 d, all horses were combined on pasture and observed for 7 d. Jugular blood samples were drawn at 24 h and 0.5 h before treatment, then every 12 h for 3 d, every 24 h for 5 d, and every 48 h for the final 13 d. On d 22, blood samples were collected at 0.5 h before combining the horses, 12 h and 24 h post-combination, then every 24 h for the remaining 6 d. Plasma was analyzed by ELISA to determine

cortisol and DHEA concentrations. A mixed model repeated measures ANOVA with unstructured covariance determined treatment and time of sampling effects. Overall, stalled horses had significantly higher cortisol concentrations (5.11 ng/mL) than pastured horses (3.62 ng/mL,  $P < 0.0001$ ), although no significant differences were observed in DHEA ( $P = 0.08$ ). No significant differences were observed in cortisol concentrations between treatment groups during the pre-treatment sample periods ( $P = 0.29$ ), however, average cortisol concentration of stalled horses during the treatment period ( $4.73 \pm 1.08$  ng/mL) was significantly higher ( $P < 0.0001$ ) than pastured horses ( $3.23 \pm 1.08$  ng/mL). In conclusion, differences between the treatment groups were initially slight, and became more exaggerated over the treatment period. These results suggest that isolation in an individual stall over an extended period of time causes changes in cortisol that merit further investigation.

**Key Words:** housing, stall, cortisol

**420 Use of infrared thermography to measure inflammation associated with castration and anti-inflammatory drugs.** L. A. González<sup>\*1</sup>, K. S. Schwartzkopf-Genswein<sup>2</sup>, E. Fierheller<sup>3</sup>, E. Janzen<sup>3</sup>, N. Caulkett<sup>3</sup>, and T. A. McAllister<sup>2</sup>, <sup>1</sup>University of Manitoba, Winnipeg, Manitoba, Canada, <sup>2</sup>Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada, <sup>3</sup>University of Calgary, Calgary, Alberta, Canada.

Angus bulls ( $n = 48$ ; initial BW  $301 \pm 3$  kg) were randomly assigned to 1 of 6 treatments according to a  $3 \times 2$  factorial design to study the effect of castration method and pain medication on eye (ET) and scrotal area temperature (ST). Castration (Cast) treatments consisted of sham (C), band (B), and surgical (S) castration. Pain medication (Med) treatments consisted of either lactated ringer solutions (NM) or pain mitigation drugs (M). Drugs used were 2% lidocaine with epinephrine injected at 10 mL into each testicle plus 10 mL subcutaneously at the scrotal base, and a subcutaneous injection of flunixin meglumine (2.2 mg/kg BW) in the neck of calves. Maximum ET and ST were measured with an infrared camera on day -1, 0, 2, 5, 7, 14, 21, and 35 relative to castrations. Data were analyzed with a mixed-effects regression model considering the fixed effects of covariate (d -1), Cast, Med, and Day as repeated measure, the random effect of Pen, and all possible interactions. Maximum temperature of the scrotal area was affected by Cast ( $P < 0.001$ ), Cast × Med ( $P < 0.05$ ), and Cast × Day ( $P < 0.001$ ). S calves had greater temperature than C and B at d 2, 5, and 7 after castration ( $P < 0.05$ ). In contrast, B had greater temperature than S and C at d 21 and 28, and greater than C at d 14 and 35 ( $P < 0.05$ ). MB calves had lower ( $P < 0.05$ ) ST compared with NMB but this was not the case in S and C ( $P > 0.10$ ), values being 36.0, 35.3, 35.2, 35.5, 34.2, and  $34.7 \pm 0.32^\circ\text{C}$  for BNM, BM, SNM, SM, CNM, and SM, respectively. Cast and Med did not significantly influence ET ( $P > 0.10$ ). Based on ST, S produces inflammation during the first week whereas B produced inflammation during wk 3 and 4 after castration. However, neither Cast nor Med resulted in systemic inflammation because no differences in ET were observed. The medication protocol used in the present study reduced local inflammation in band castration only.

**Key Words:** bull inflammation, castration method, pain medication

**421 Influence of cattle temperament on stress hormones and IgG concentrations in Angus-cross calves.** R. C. Vann<sup>\*1</sup>, N. C. Burdick<sup>2</sup>, J. G. Lyons<sup>2</sup>, T. H. Welsh, Jr.<sup>2</sup>, and R. D. Randel<sup>3</sup>, <sup>1</sup>MAFES-Brown Loam Research Station, Raymond, MS, <sup>2</sup>Texas AgriLife Research, College Station, <sup>3</sup>Texas AgriLife Research, Overton.

The objective of this study was to determine the influence of temperament on concentrations of cortisol, epinephrine, norepinephrine, and

IgG in Angus-cross calves. Calves from 2005 and 2006 were selected based on temperament score measured 28 d before weaning and at weaning. Based on temperament score the 10 calm, 10 intermediate and 10 temperamental calves from each sex (steers and heifers in 2005, bulls and heifers in 2006) were selected from each calf crop ( $n = 120$ ). Blood was collected 28 d before weaning, weaning, 28 and 56 d post-weaning to determine serum cortisol and IgG, and plasma epinephrine (EPI) and norepinephrine (NE) concentrations. Data were analyzed using the MIXED procedure of SAS specific for repeated measures. Sources of variation included temperament, sex, day and year. Concentrations of EPI and NE were greater in 2005 than 2006 ( $P = 0.004$ ). Cortisol concentrations were lower in calm ( $25.9 \pm 0.9$  ng/mL,  $P < 0.001$ ) compared with intermediate or temperamental calves ( $35.5 \pm 0.7$  and  $32.7 \pm 0.9$  ng/mL, respectively). Heifers had greater ( $P < 0.001$ ) cortisol concentrations ( $37.2 \pm 0.7$  mg/mL) with steers being

intermediate ( $34.2 \pm 1.2$  ng/mL) and bulls having lower concentrations ( $22.7 \pm 1.3$  ng/mL). Calm had lower ( $P < 0.001$ ) EPI concentrations ( $389 \pm 65$  pg/mL) than intermediate ( $613 \pm 64$  pg/mL) and temperamental calves ( $788 \pm 64$  pg/mL). Concentrations of EPI declined over the 4 collection times ( $P < 0.002$ ). Temperamental had greater concentrations ( $P < 0.001$ ) of NE ( $754 \pm 53$  pg/mL) and NE did not differ between calm and intermediate calves ( $461 \pm 53$  and  $470 \pm 53$  pg/mL, respectively). Concentrations of NE differed ( $P = 0.012$ ) over the 4 collection times and were not influenced by sex. Concentrations of IgG were influenced by the following interactions: temperament  $\times$  sex ( $P < 0.002$ ) and sex  $\times$  day ( $P < 0.02$ ). In summary, there appears to be a relationship between temperament and concentrations of stress hormones. In addition, sex influenced concentrations of cortisol and EPI whereas, both temperament and sex influenced IgG.

**Key Words:** cattle, temperament, stress hormones