

Animal Behavior and Well-Being II

721 Effects of dietary fiber on the welfare of submissive multiparous sows. Eridia Pacheco*, Mayra Lopez, and Janeen Salak-Johnson, *University of Illinois at Urbana-Champaign, Urbana, IL.*

The effect of social rank, dietary fiber, and length of feeding stalls on the well-being of sows kept in groups was assessed on a sub population within the pens of the larger study. At gestational d 37, sows that were randomly assigned by BW and parity in a 2×2 factorial arrangement to a dietary treatment of either (a) soy hulls-wheat middlings diet (WM) or (b) DDGS-corn germ meal diet (DDGS); and feeding stall length of either (c) 2 ft. (short) or (d) 6 ft. (long) in groups of 9 sows/treatment (36/block), were put in a feed competition test to determine social rank ($n = 48$). Within each treatment pen, dominance value was calculated based on aggressive encounters among sows from the feeding test; with the 2 highest-ranking sows being dominant (DOM) and 2 lowest-ranking sows being submissive (SUB). Analysis of data was focused on this sub population of sows. Sow BW was recorded on gestational d 30, 70, 90, 104, and d 131 (end of lactation). Lesion scores and blood glucose levels were recorded every 3 d for 2-wks post mixing (Phase 1), and then bi-weekly until gestational d 104 (Phase 2). Live observations during feedings were performed at the first feeding, after mixing, and every 3-wk until gestational d 104, all aggressive encounters were recorded. Regardless of diet, SUB sows had greater ($P < 0.01$) blood glucose than DOM sows. Overall, lesion scores decreased in severity from phase 1 to phase 2, but in phase 2, DOM-sows had less severe scores compared with SUB-sows ($P < 0.01$). DOM-sows gained more ($P < 0.01$) BW from d 30 till d 70 of gestation, and then again from d 90 till d 104. Total number of aggressive encounters were lowest among DOM-sows fed DDGS-diet and in pens with long feeding stalls and these same sows made less aggressive encounters toward SUB-sows ($P < 0.01$). SUB-sows fed WM-diet had more ($P < 0.05$) total piglets born alive than DOM-sows fed the same diet. SUB-sows fed WM-diet and kept in pens with short feeding stalls had more ($P < 0.05$) total piglets born compared with SUB-sows on other treatments. These results indicate that dietary strategies and social status may serve as a management tool to improve sow well-being in small group pens.

Key Words: swine, social rank, welfare

722 Behavioral changes in steers supplemented with tryptophan and vitamin E. Paula R. Huenchullán² and Rafael E. Larrain^{*1}, ¹*Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile, Santiago, Chile,* ²*Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile.*

Tryptophan (TRP) and vitamin E (VITE) modulate the stress response in animals, so they may also induce changes in behavior. The goal of the study was to determine the effect of high TRP and VITE diets on steers behavior. Angus steers were used in 2 experiments (E1 and E2), with a 21-d washout period in-between. Steers were distributed in pairs in 16 pens and fed the experimental diets for 5 d before a stressful event (45 min in a single file chute for E1 and slaughter for E2). Diets were designed in a factorial arrangement, with TRP at 0 and 100 mg·kg BW⁻¹·d⁻¹ and VITE at 0 and 2000 IU·hd⁻¹·d⁻¹ ($n = 4$ pens). Steers were randomly assigned to diets in E1, and E1 diet was used as blocking factor for randomization in E2. Video cameras were used to record 24 h·d⁻¹ during supplementation, and also one day after stress in E1. Behavior was evaluated at d 2, 4, 5 and 6 of starting supplementation in E1, and at d -1, 0, 2 and 4 in E2. Behavior was observed every 10

min and compared as proportion of observations where animals were in standing or lying posture; and doing one of the following activities: defecating, drinking, eating, interacting, no detectable activity, ruminating, self-grooming, and stereotypic movements (bar licking, tongue rolling, etc.). Statistical analysis was made using repeated measures, with TRP, VITE, time and their interaction in the model. In E2, diet in E1 was used as blocking factor and d -1 was used as covariate. When ANOVA $P < 0.1$ for TRP, VITE or TRP \times VITE, comparisons with control were made using Dunnett adjustment. When ANOVA $P < 0.1$ for any interaction with time, comparisons were made within day. In E1, none of the diets including TRP or VITE was different to the control in any variables. In E2, animals receiving TRP tended to spend a higher proportion of their time eating ($P = 0.091$), while animals receiving VITE tended to spend a smaller part ($P = 0.076$) than their controls. Animals receiving TRP and TRP+VITE presented less stereotypic movements ($P = 0.008$ and 0.017 , respectively) than their controls, and animals receiving VITE spent a smaller proportion of their time interacting ($P = 0.032$). We concluded that TRP and VITE produced small changes in behavior in steers and no changes the day after a stressful event.

Key Words: tryptophan, vitamin E, behavior

723 Rumen and cecum expression of genes related to inflammation and behavior in Holstein bulls fed high-concentrate diets with different concentrate presentation forms and with or without straw supplementation. Maria Devant^{*1}, Greg Penner², Bruna Quintana¹, Francesc Fábregas¹, Alex Bach^{3,1}, and Anna Arís¹, ¹*IRTA-Ruminant Production, Animal Nutrition, Management, and Welfare Research Group, Caldes Montbui, Spain,* ²*University of Saskatchewan, Saskatoon, Saskatchewan, Canada,* ³*ICREA, Barcelona, Spain.*

Twenty-four individually housed Holstein bulls (395 ± 7.3 kg BW and 252 ± 3.1 d age) were exposed to a 2×2 factorial design (meal vs. pellet and with vs. without straw) to evaluate the effect of concentrate form and provision of straw in finishing diets. Concentrate and straw consumption were recorded monthly, and behavior by scan sampling biweekly. Bulls were slaughtered after 64 d. Rumen and liver lesions were recorded and tissue samples were collected. Data were analyzed using an ANOVA. Straw supplementation increased ($P < 0.01$) percentage of rumination observations (9.4 vs. $3.1 \pm 1.02\%$), and decreased ($P < 0.01$) oral non-nutritive behaviors (0.74 vs. 1.68 ± 0.12 times/15 min) relative to bulls not provided straw. Provision of straw increased rumen pH, but the magnitude was greater when meal was provided compared with pellet (interaction $P < 0.05$). When straw was not supplemented, all rumens had papillae fusion, whereas only 16.7% of bulls fed pellet and straw had papillae fusions ($P < 0.05$). In the rumen straw provision numerically increased expression of free fatty acid receptor 2 (stimulates PYY and serotonin secretion, $P = 0.06$), α -2C adrenergic receptor (modulates immune reactions and behavior, $P = 0.09$), and increased occludin and claudin-4 (tight junction proteins, $P < 0.05$), along with IL-1 β , TNF α (pro-inflammatory cytokines, $P < 0.01$) and toll-like receptor-4 ($P < 0.01$); moreover, it also numerically increased β -defensin1 (antimicrobial peptide, $P = 0.10$), and intestinal alkaline phosphatase ($P = 0.10$), and increased CASP3 (pro-apoptotic gene, $P < 0.05$) and numerically increase SPC25 (proliferative marker, $P = 0.06$). Pellet decreased rumen gene expression of α -2C adrenergic receptor ($P < 0.05$) and increased occludin ($P = 0.06$) and monocarboxylate transporter 1 ($P < 0.05$). Bulls without straw had increased expression of IL-1 β in the cecum. In conclusion, the lack of straw supplementation in bulls fed

high-concentrate diets modifies behavior, affects rumen macroscopic morphology, and expression of epithelial genes related to inflammation.

Key Words: bull, gut-brain axis, nutrition and behavior

724 Immunological castration of gilts changes behavior, weight gain, and reproductive development. Guilherme Picinin* and John J. McGlone, *Texas Tech University, Lubbock, TX.*

Physical castration is a current practice on commercial farms used to reduce boar taint and aggressive behavior. Immunological castration (IC) using a GnRF conjugate is an alternative to physical castration. IC males eat more, grow faster and are easier to handle than intact males. The objective of this study was to evaluate the effect of IC on gilt behavior, handling during loading and unloading, weight gain, reproductive function, and physiological responses. Gilts were given a first immunization at wk 3 of the finishing period (about 12 weeks of age) followed by a second immunization at wk 7 of the finishing period. Gilts were marketed when they were 143.6 kg on average. Behaviors of immunized gilts (IG) (n = 48) and control gilts (CG) (n = 48) were assessed 2 times through the finishing period, one before (second week of grower-finisher phase) and one after effective immunization (eleventh week of grower-finisher phase). Handling during loading and unloading a livestock trailer was also recorded during a simulated transport experience. Weight gain was assessed weekly. Physiological response was assessed via heart rate, plasma cortisol and ovarian weights. IG spent more time feeding (4.17%) ($P = 0.04$) than CG (3.43%). However, CG spent 1.41% more time standing ($P = 0.002$) and 0.17% more time drinking ($P = 0.01$) than IG. No difference was found in transport and handling measures between treatments. At the last week of grower-finisher phase IC were 5.15 kg heavier than CG ($P = 0.04$). Control gilts had 225% heavier ovaries than IG ($P < 0.001$). No differences were found in plasma cortisol and heart rate between CG and IG. Immunological castration does not induce a stress response or cause behavioral problems in the home pen or during handling and transport compared with intact gilts. IC is an effective tool to increased gilt feeding behavior, feed intake, and weight gain with no identified animal welfare concerns.

Key Words: GnRF immunization of gilts, heavy market weight, behavior-handling

725 Behavioral responses of livestock exposed to unmanned aerial systems. Phil Urso, Marcy Beverly*, Stanley Kelley, John Wilson, Jessica Leatherwood, Mark Anderson, and Kyle Stutts, *Sam Houston State University, Huntsville, TX.*

Unmanned aerial systems (UAS) have been gaining popularity in several fields. Their uses in agriculture provide major management benefits while assessing production conditions. This study utilized an UAS to determine the flight zone upon approach and while hovering over different livestock species: cattle, goats, and horses. Barometric pressure, temperature, wind speed, and noise levels were all recorded to eliminate environmental variables affecting behavior. Selected animals were held in pens several days before the UAS flight to allow for the animals to acclimate and become familiar to the test area. Test areas were spacious so animals could flee and not feel confined during UAS approach and hover. Groups were tested with the UAS 3 times on separate days. Horses were tested in 2 independent groups: outdoor round pens and indoor arena. Cattle were split into 3 groups: cows with calves (CWC), cows without calves (COC), and weaned heifers (WH). Goats were tested as a group in their home pasture. With each test group, the UAS began at a height of 75 feet above the group and descended at 5 feet

increments when hovering. Environmental measurements were similar for each flight. All groups were acoustically signaled before seeing the UAS. The animal flight zone varied by test group at different hovering heights. The COC and WH allowed the system to hover at 15 feet above ground before they casually moved from the UAS. CWC, did not flee from under the drone, but huddled closer together around their offspring responding in a protective behavior. The goats allowed the UAS to hover at 10 feet before moving. Horses tested indoors expressed a startled, frightened behavior at 25 feet. The outdoor tested horses were calm and showed unstartled behaviors consistent with other test groups. The geldings were much more relaxed and calm with the approach of the UAS than the mares, which had a higher flight zone. Though foals were not present, this difference could be attributed to their protective instinct. Understanding these behavioral responses could help producers utilize UAS for herd observations without disturbing animals in their natural environments.

Key Words: unmanned aerial system (UAS), flight zone, behavior

726 ADSA®-EAAP Speaker Exchange Presentation: REM sleep time varies during the lactation cycle. Emma Ternman¹, Emma Nilsson¹, Per Peetz Nielsen^{1,2}, Laura Hänninen³, and Sigrid Agenäs*¹, ¹*Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences, Uppsala, Sweden,* ²*Department of Large Animal Sciences, University of Copenhagen, Copenhagen, Denmark,* ³*Department of Production Animal Medicine and Research Centre for Animal Welfare, University of Helsinki, Helsinki, Finland.*

Little is known about sleep in dairy cows. This study investigated the influence of stage of lactation on total lying time, rumination time and rapid eye movement (REM) sleep in dairy cows. Data on rumination and REM sleep was obtained by electrophysiological recordings in 19 high yielding dairy cows during 7 24-h recording sessions; late dry period, lactation week (wk) 2, 7, 13, 21, 37 and early in the next dry period. In addition, standing and lying was recorded using IceTag data loggers. During recordings cows were kept in individual pens with ad lib access to silage and water. Data analysis included total time and duration of bouts and was separated for daytime (05.00–21.00 h) and night (21.00–05.00 h). Effect of stage of lactation cycle and day/night distribution of activity was tested with a linear mixed model (SAS 9.4). In total, cows were lying down for $50 \pm 4\%$ of the time in the study, distributed as lying half of the night in early lactation (wk 2 and 13) and up to 2/3rds of the night in other stages of the lactation cycle. During daytime more time was spent standing than lying in all stages of lactation. Overall, lying bouts were longer at night than at daytime (51.7 ± 3 vs. 43.3 ± 3 min, $P < 0.005$) and standing bouts were shorter at night than at daytime (33.1 ± 3 vs. 58.8 ± 3 min, $P < 0.001$). Rumination time was longest in wk 7 (573 ± 23 min) and shortest in late dry period (458 ± 23 min) ($P < 0.01$) and bouts were longer at night than day (36.3 ± 1.2 vs. 29.7 ± 1.1 min, $P < 0.001$). REM sleep time was affected by stage of lactation ($P < 0.05$) with the longest time (52 ± 4 min) in late lactation (wk 37) and shortest in early lactation (34 ± 4 min). The main part of REM sleep was found at night and REM sleep bouts were longer at night than day (4.6 ± 0.1 vs. 4.1 ± 0.2 min, $P < 0.001$). Total lying time and rumination time found in this study was in accordance with previous findings. Cows rest lying down and even if total lying time during 24 h does not vary during the lactation cycle there is a variation in the distribution of the lying time between day and night and in the amount of REM sleep.

Key Words: lying, REM, sleep

727 Assessment of cognitive ability and memory retention in neonatal goats. Isabelle C. Withrock*, Paul J. Plummer, Timothy A. Shephard, John Stinn, Hongwei Xin, Johann F. Coetzee, and Suzanne T. Millman, *Iowa State University, Ames, IA.*

Our research team is exploring the suitability of inhalant methods for euthanasia of neonatal livestock. A key component of this project is examining the aversiveness of carbon dioxide and argon gases by preference tests and conditioned place avoidance. However, little is known about the cognitive ability of neonatal livestock. The objective of this study was to determine the problem-solving ability of goat kids by using a conditioned place preference paradigm. A secondary objective was to determine if the presence of a novel odor disrupts previous learning. A preference-testing box was custom built with 2 connected chambers divided by a sliding door. One chamber was vacant while the second chamber held a 32oz milk reward. Twelve mixed breed dairy kids were enrolled in the study. Kids were given a 5 min acclimatization period in the control chamber before the sliding door was opened. Kids were then given 5 min to travel through the doorway to access the milk, after which kids were physically assisted through the doorway. Kids were allotted 10 min in the treatment chamber to consume their milk meal. After 5 d of testing, kids were not tested for 3 to 6 d. Kids were then tested with a novel odor (<1 oz peppermint oil) present in the treatment chamber. The following behaviors were collected using live observation: frequency of vocalizations and defecation, latency to enter treatment chamber, latency to suckle and volume of milk consumed. A mixed effect Poisson regression model showed that vocalizations were reduced from d 1 to all other days ($P < 0.0001$). Mixed effect logistic regression models showed defecation behavior did not differ ($P = 0.3064$). Mixed effect Cox models showed that latency to enter the treatment chamber and latency to suckle also decreased from d 1 ($P < 0.0001$). Milk consumption increased from d 1 to d 6 based on a linear mixed model ($P < 0.0001$). These results suggest neonatal kids have the ability to problem solve, and a novel odor did not disrupt learning. Hence, approach-avoidance and conditioned place associations using a milk reward are relevant paradigms for asking kids about aversiveness of inhalants used for stunning and euthanasia.

Key Words: goat, learning, memory

728 Development of a novel automated method of measuring tail-flick behavior in beef cattle. Diego Moya*^{1,3}, Carollyne E. J. Kehler², Sonia Marti³, Kim H. Ominski², Christy Goldhawk¹, and Karen S. Schwartzkopf-Genswein³, ¹*University of Calgary, Calgary, AB, Canada*, ²*University of Manitoba, Winnipeg, MB, Canada*, ³*Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.*

Tail-flicking behavior is a reliable indicator of pain in cattle, however visual observation is challenging and time-consuming. Two trials were conducted to validate the use of tri-axial accelerometers to assess tail-flicking behavior in beef cattle. In Exp. 1 (proof of concept), accelerometers (HOBO, Onset Computer Corp., Pocasset, MA) were affixed with vet wrap to the tail of 5 Angus heifers at 3 different positions: 8 cm below the base, 26 cm below the base, and above the tail switch. The HOBOS were set to measure acceleration at 20 readings \times s⁻¹ for a 10-min period, with a total of 49 periods of data collection. The heifers were videotaped concurrently, and viewed by the same observer to determine the number of tail movement events. Data obtained from the vector sum of the acceleration of the X, Y and Z axes was cleaned using either 2 standard deviations, the 80th percentile or the mean as the threshold below which tail movement was considered unintentional, and therefore removed from the data set. Data were then pooled into movement events using either a 1- or 2-s criteria as the time between 2 tail

movements to be considered separate movement events. The resulting data sets were summarized for each 10-min period as total acceleration, maximum acceleration, average acceleration per movement event, and percentage of time in motion. Data from HOBOS located at the tail switch, and processed with the 80th percentile threshold and the 2-s criteria, resulted in the greatest ($P < 0.01$) correlation with the number of tail movement events observed via video ($r = 0.9217$; $P < 0.01$). In Exp. 2 (biological validation), accelerometers were affixed above the tail switch of 14 bulls to measure movement of the tail during 2 20-min periods that took place from 3 to 6 h before and immediately after castration. Total acceleration was greater ($P = 0.03$) after than before castration (805.0 vs. 409.7 ± 18.27 g-force, respectively), suggesting that HOBOS captured the tail-flicking behavior caused by the discomfort of the procedure. Accelerometers provide an objective and efficient method of measuring tail-flick behavior in beef cattle.

Key Words: welfare, behavior, pain

729 Relationships between maternal defensiveness behavior and pre-calving flight speed in primiparous Nellore cows. Mateus J. R. Paranhos da Costa*^{1,2}, Tiago S. Valente², and Aline C. Sant'Anna¹, ¹*Departamento de Zootecnia, Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal-SP, Brazil*, ²*Programa de Pós-Graduação em Genética e Melhoramento Animal, Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal-SP, Brazil.*

Defensiveness is an important aspect of maternal temperament, which can be defined as the set of cow's behavior in response to disturbance of their relationship with newborn calf. The aim of this study was to evaluate the relationship between 2 temperament traits, flight speed (FS) measured 6 mo before calving and maternal defensiveness in primiparous Nellore beef cows. The FS was performed for 196 heifers measuring the speed (in m/s) at which each animal exited the cattle crush after weighting. The females calved around 24 mo of age and had their maternal temperament assessed 24h after birth, during the handling for calf ear-marking and weighing. We assessed the reactions of cows when their newborns were caught in a corral pen, using a maternal defensiveness score (MD), which ranged from 1 (cow exhibited no attention to the calf and remained indifferent to the procedure) to 6 (cow displayed aggressive behaviors toward the handler, trying to attack them). The latency to each cows touch the calf (LT, s) after finishing the handling procedure and the calf be released to the pen was also recorded. Pearson's coefficients of correlation were calculated among the MD, LT and FS. A significant correlation was found between MD and LT ($r = -0.62$, $P < 0.01$), indicating that the shortest latency was related to a more defensive behavior toward the calf. The FS had significant, but low correlation with LT ($r = 0.16$, $P = 0.04$), and it was not correlated with MD ($r = -0.10$, $P = 1.79$), suggesting that an indicator of fear/excitability is not associated with an indicator of MD. There is a belief among the Brazilian farmers that the calmer Nellore cows during handling are likely to be less defensive toward their calves. However, according to the present results the cows' temperament assessed during handling in the corral is not related with cows' MD, providing clear evidence that cows with more excitable yearling temperament (faster FS) would not present more defensive behavior toward their calves compared with the calmer ones.

Key Words: maternal behavior, temperament, beef cattle

730 Relationship between quantitative measures of temperament and observed behaviors in receiving cattle. Kelsey A. Bruno*, Eric S. Vanzant, Alex W. Altman, Monoj Kudupoje, and Kyle R. McLeod, *University of Kentucky, Lexington, KY.*

Temperament has been related to gain and intake in beef cattle; more temperamental animals often have decreased gain and intake. Intake effects may be partially mediated through social interactions in that some temperament measures may directly relate to social dominance behavior. To examine the relationships between temperament, growth, and social dominance behavior, 32 crossbred steers were used in a 56-d RCBD experiment with a 2×2 factorial treatment structure. Temperament treatments (assigned on d -7) were chute exit velocity (EV; slow vs. fast) and objective chute score (OCS; low vs. high), a novel temperament measure, the CV of weights collected at 5 Hz for 10 s while an animal's head was restrained in a chute. Electronic ear tags with accelerometers were used to continuously measure animal activity. Social dominance behaviors were quantified using video records of 2-h intervals directly following feeding for d 1–13. Dominance was calculated as average dominance index and David's score. Jugular blood samples were collected to analyze antibody response to leptospirosis vaccines. There were

no EV by OCS interactions ($P \geq 0.23$) for average daily gain (ADG) or antibody titers. High OCS steers had higher ADG than low OCS steers ($P < 0.01$) and slow EV steers had higher ADG than fast EV steers ($P = 0.02$). Slow EV animals had an increased antibody response compared with fast EV animals ($P = 0.05$). Ranking in the dominance hierarchy was influenced by an EV x OCS interaction ($P \leq 0.02$), but there was not a linear relationship between dominance ranking and ADG. Low OCS steers tended to have higher daily activity counts than high OCS steers ($P = 0.11$), and fast EV steers had higher ($P = 0.08$) activity counts than slow EV steers. EV and OCS were independently related to differences in ADG. Although dominance ranking was significantly related to these 2 independent temperament measures, it was not linearly related to ADG. Alternatively, differences in accelerometer-based activity counts among temperament groups did correspond with trends in growth responses.

Key Words: temperament, dominance, beef cattle