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## ANIMAL BEHAVIOR AND WELL-BEING II

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**0039 Evaluation of hair cortisol as a biomarker of chronic stress in beef cattle.** D. Moya\*, M. He, Y. Wang, T. A. McAllister, and K. S. Schwartzkopf-Genswein, *Agriculture and Agri-Food Canada, Lethbridge, AB.*

Three experiments were conducted to assess hair cortisol concentration as a biomarker of chronic stress in beef cattle. In Exp. 1, 24 calves ( $230.4 \pm 13.0$  kg BW) were randomly split into 2 groups immediately after weaning. Half of them remained at the ranch of origin (OR), whereas the other half were transported to a feedlot (TF). Weight and hair samples were collected from all calves at the time of weaning and for a period of 30 d postweaning to determine performance and cortisol concentration. In Exp. 2, 24 calves ( $299.1 \pm 28.2$  kg BW) were randomly split in 2 treatments: no castration (CT) or band castration (BA). Weight and hair samples were collected from all calves at d 0, 35, and 63 after castration to determine performance and cortisol concentration. In Exp. 3, 160 cross-bred steers ( $538 \pm 36$  kg BW) were used in a 84-d experiment, with a randomized block design, to study the effects of wheat (WH; 88.4% DM) or barley- (BA; 89% DM) based diets, or processing index (PI) of either 75% (PI75) or 85% (PI85) of their original volume-weight, on growth performance, stress, and behavior of finishing beef cattle. Cattle were allocated to 16 feedlot pens (10 animals per pen, 4 pens per treatment), 8 of which were equipped with an automatic feed monitoring system. Flight speed and hair and saliva samples were collected on d 1, 28, 56, and 84 to determine behavior and acute and chronic stress. The TF group had a greater ADG ( $P < 0.01$ ) and hair cortisol concentration ( $P = 0.05$ ) than OR. There was a castration  $\times$  time interaction ( $P < 0.05$ ), where BA calves had greater hair cortisol and lower ADG than CT only at d 35 after castration. The PI75 treatment reduced ( $P = 0.05$ ) DMI and increased ( $P = 0.04$ ) feed efficiency. Cattle fed WH had greater hair cortisol ( $P = 0.01$ ) and flight speed ( $P < 0.01$ ) than those fed BA. There was a trend ( $P = 0.07$ ) for a grain  $\times$  PI interaction, where heifers fed WH-PI85 had lower salivary cortisol than those fed other treatments. Results indicate that hair cortisol can be used to assess chronic stress in beef cattle related to conditions associated with calf management at weaning, band castration, or feeding management.

**Key Words:** feedlot, stress, welfare

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**0040 Maternal behavior in sheep production: Effects on lamb performance and economic indicators.** C. Raineri\*<sup>1,2</sup>, B. C. Nunes<sup>3</sup>, T. B. Bovo<sup>4</sup>, E. A. Titto<sup>4</sup>, E. R. Afonso<sup>1</sup>, and A. H. Gameiro<sup>1</sup>, <sup>1</sup>*Department of Animal Nutrition and Production, University of São Paulo School of Veterinary Science and Animal Science, Pirassununga, Brazil,* <sup>2</sup>*Federal University of Uberlândia. School of Veterinary Medicine, Uberlândia, Brazil,* <sup>3</sup>*Ministry of Science, Technology and Innovation, Brasilia, Brazil,* <sup>4</sup>*University of São Paulo. School of Animal Science and Food Engineering, Pirassununga, Brazil.*

This study assessed the economic impact of inadequate maternal behavior of sheep between birth and first suckle of lambs in a commercial flock of meat sheep. We observed 222 pregnant Santa Ines ewes and their 327 lambs. Behavioral observations were performed, by direct method with focal samplings every 5 min. Maternal activities considered negative were preventing suckling, withdrawing, and butting. Statistical analyses were conducted by multiple linear and logistic regression models, using functions PROC REG and PROC LOGISTIC of the software SAS 9.3. In economic analysis, we simulated the ratios for production costs and revenues in case of manifestation or not of negative maternal activities. We investigated connections between maternal behavior, incidence of dystocia, need for artificial rearing, birth weight, preweaning mortality, prolificacy rate, and weaning weight. Negative maternal behaviors were displayed by 19.37% of the ewes. Lamb weaning weight was influenced by birth weight ( $P < 0.001$ ) and litter size ( $P < 0.01$ ), but not by maternal behavior, artificial rearing, or dystocia. Preweaning mortality was probably affected by maternal behavior ( $P = 0.10$ ) and litter size ( $P < 0.05$ ), but not by artificial rearing. Lambs from dams that did not display negative behavior had 82% higher chances of surviving until weaning. Probability of surviving until weaning fell 50% with the increase of each additional lamb in the litter. Maternal behavior was significantly influenced by birth weight ( $P < 0.01$ ) and dystocia ( $P < 0.05$ ), but not by litter size. The chance of ewes not displaying negative maternal behavior increased 105% for each 1-kg increase on birth weight of lambs. On the other hand, dystocia incidence increased in 79% the chances of negative behavior to occur. In the studied flock, dystocia incidence was not related to lamb birth weight. Economic analysis demonstrated that production cost would be higher for lambs whose mothers displayed negative behaviors, mainly due to greater need for artificial rearing, whereas sale income would be similar between groups. Negative maternal behavior was related to increases in preweaning mortality rate and need of artificial rearing. Thus, negative maternal behavior resulted in economic impact, represented by the increase of production cost and the decrease in 7% of revenues. These results are important to guide viability evaluation of investments that aim to improve maternal-offspring relation in

sheep. Reasons for displays of negative behavior by important portions of that flock are not clearly elucidated, although data suggest relations with higher prolificacy and dystocia.

**Key Words:** economic evaluation, ewe, production cost

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**0041 Effect of rest-stop duration during long-distance transport on indicators of animal welfare in weaned beef calves.** S. Marti\* and K. S. Schwartzkopf-Genswein, *Agriculture and Agri-Food Canada, Lethbridge, AB.*

Forty newly weaned Angus beef calves ( $260 \pm 32.6$  kg) were transported 15 h in a livestock trailer ( $7.3 \times 2.1$  m) on 2 separate days (20 calves per day) to evaluate the effect of rest-stop duration on indicators of calf welfare. Immediately following the 15-h journey, all calves were unloaded at a feedlot and randomly assigned to 1 of the 4 treatments. Treatments included: 0- (Control; C), 5- (RS5), 10- (RS10), or 15- (RS15) h rest periods in pens containing ad libitum access to water and long-stem hay. Following each rest period, calves were reloaded onto the same trailer and taken on another 5-h journey for a total transport event lasting 20 h. Control calves did not have access to feed or water until the end of the 20-h transit event. Behavioral measurements included: loading and unloading scores (fall, aggression, mount, slip, trip, balk and walk, trot, or run), animal condition (non-ambulatory, lame, injured, fatigued, wet coat, and dirty), number of steps (steps per day), feeding behavior (minutes per day), standing and lying frequency (number per day), and duration (minutes per day) during rest periods and at the end of the 20-h transport event. Physiological measurements included: saliva and hair cortisol, total blood cell count, and substance P concentrations. All measurements were taken immediately before loading and after unloading at the rest stop and the end of the 20-h event. Salivary cortisol was greater ( $P < 0.01$ ) in C and RS15 than in RS5 and RS10 calves at the end of each rest stop period and the 20-h event. The RS15 calves had greater ( $P = 0.02$ ) salivary cortisol concentrations before and after the last 5 h of transport compared with RS5 and RS10 calves. The RS10 calves spent more ( $P < 0.01$ ) time lying than any other treatment. No treatment differences ( $P = 0.14$ ) were observed for feeding duration, although it was numerically less in RS10 calves. Meal duration following 20 h of transport was less ( $P = 0.05$ ) in C calves than all other treatments. The results of this study indicate that provision of a rest stop  $< 10$  h reduces stress in weaned calves as witnessed by reduced salivary cortisol concentration and less time spent lying.

**Key Words:** calves, resting stop, transport, welfare

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**0042 Monitoring stress behavior in grazing beef cows with a long range pedometric system.** R. Gabrieli\*, *Ministry of Agriculture and Rural Development, Extension Service, Beit Dagan, Israel, Beit Dagan.*

Beef breeding is an extensive operation performed in vast pastures. Hierarchy within the herd is an important factor that determines priority of access to limited resources and level of feed intake, resulting in stress to the subordinate animals. Hierarchy is mainly passive, thus difficult to detect in conventional breeding systems. Most of the cows that are culled due to low production are subordinate cows. Identifying subordinate cows may enable the breeder to improve grouping management and thereby minimize stress. This will lead to improved production and lower replacement costs. A newly developed long range pedometric system, based on RF transmission, providing on-line activity monitoring, was installed in a crossbred Simmental beef herd of 250 cows, grazing in a 300-ha pasture in the Upper Galilee, Israel. The hypothesis was that the average cow will maintain a daily activity routine, whereas stress will result in deviations of activity expressed in the graph. Thirty transmitting tags were mounted on front legs of randomly selected cows. Analysis of data showed 17 cows with regular activity graphs (i.e., lower than average values of activity with lower values of standard deviation,  $161 + 105$  steps per hour) and 13 expressed irregular activity graphs (higher than average values of activity with higher values of standard deviation,  $209 + 128$  steps per hour). Observations near the food trough were conducted during feeding time to rank cows according to their social status. A cow that reached the trough and wasn't rejected was ranked "dominant." Order was established thereafter by number of rejections from the trough each cow received. The lowest ranking cows did not approach the trough during feeding at all. Comparison between activity graphs and observations showed that dominant cows expressed regular activity graphs and subordinate cows expressed irregular activity graphs. Cortisol levels in hair samples were taken to validate activity results ( $0.1975 + 0.039$  and  $0.2862 + 0.0423$   $\mu\text{g/dL}$  for dominant and subordinate, respectively;  $P = 0.018$ ). Cortisol level in hair reflects the stress status over a fortnight, thus the effect of sampling-related stress is minimal. The activity pattern expressed while measuring hourly activity online, we believe, reflects the measure of freedom each cow has to choose for her ongoing activity within the herd. Assuming that establishing an individual routine is beneficial for cows, detecting those that are unable to do so and grouping them by social order will minimize stress and improve production.

**Key Words:** beef breeding, stress

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**0043 Effect of 4 different reflective barriers on black-globe temperatures in calf hutches and on calf**

**ADG.** T. H. Friend\*, W. Binion, and J. Haberman,  
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Polyethylene hutches are a popular method of housing dairy calves from birth to  $\pm 60$  d of age, although these hutches get hot when in full sun. Shading the hutches and yard has been effective, but shade increases concerns about increased pathogens and moisture from the lack of sunlight. This study characterized the relative differences in the ability of 4 different types of radiant barriers to reduce black globe (BG) temperature within these hutches during hot weather and reports the results from some field trials. Treatments for the BG trials included 3 different types of covers [2 types of reflective laminates (Cadpak P and Cadpak ESD) and an aluminized 3.0-mL white low-density polyethylene (LDPE)], and a reflective paint (LO/MIT-1). The reflective covers were 1.8-  $\times$  3-m finished size and covered the top and sides of the hutch down to 0.15 m above the ground, leaving the front and back exposed. The LO/MIT-1 paint covered the entire sides and roof of the hutch. Two 24-h trials, 1 wk apart, were conducted during relatively hot and clear days in early August. Black globe temperatures were recorded at 20-min intervals in duplicate, using blackened table tennis balls mounted 0.3 m above the floor in the center of each hutch. Ambient temperature (shade) during the hottest 2-h period for both trials averaged 39.9°C, whereas the uncovered control averaged 41.1°C and LO/MIT-1 39.9°C, both of which were significantly higher (ANOVA followed by LSD,  $P < 0.01$ ) than the Cadpak P (38.9), Cadpak ESD (38.6), and aluminized LDPE (38.7°C). Twelve to 24 of the covers were field tested on 3 collaborating dairy farms in the Panhandle Region of Texas from June to September 2013. Despite having a relatively cool summer, the farms reported increased ADG ranging from 0.018 to 0.045 kg/d. A statistical analysis was not possible because the calves in each treatment were weighed as a group on the farms ( $n = 3$ ). Both the Cadpak P and Cadpak ESD were starting to delaminate at the end of the trials. The reflective covers evaluated in this study can be expected to improve calf comfort and most likely gain, but additional field testing is needed to refine the design and determine cost effectiveness of the covers.

**Key Words:** calf, hutch heat stress

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**0044 Effects of 3 tail painting formulations on behavior of dairy heifers.** C. S. Skenandore\* and F. C. Cardoso, *University of Illinois, Urbana.*

Studies have shown that the correct use of tail paint can identify almost 90% of cows in standing heat. To investigate the potential relationship among the use of different formulations of commercially available tail paint and their effectiveness in heifers, 18 Holstein heifers at breeding age were selected, balanced by age ( $13.7 \pm 1.2$  mo), body weight ( $394 \pm 32$  kg), and

BCS ( $3.43 \pm 0.1$  on a 1 to 5 scale), and randomly assigned to 1 of 3 treatment groups. Experimental treatments were: Control (CON), orange color, tail chalk, commercial formulation; Treatment A (TRTA), orange color, tail chalk, new formulation; and Treatment B (SPRAY), orange color, spray formulation. Experimental design was a replicated  $3 \times 3$  Latin square design with 6 total squares, 3 animals per square. Each period was 14 d. Visual observations were performed for tail paint licking (LICK; being licked at the tail paint), social licking (SOCLICK; being licked at the head, neck, or leg areas), rump licking (RUMPLICK; being licked at the rump area), and product disappearance (TPREMOVED; score from 0 to 2, according to the degree of tail paint removal) in 30-min segments every 2 h from 0600 to 1800 h. Video recordings were used to confirm observations. The outcome variables of interest, LICK, SOCLICK, and RUMPLICK, were summarized to daily counts of interactions. Assessment of TPREMOVED was done once daily before subsequent treatment application. A synchronization protocol (Ovsynch: 100 mg GnRH, then 25 mg PGF<sub>2 $\alpha$</sub>  7d later, and 100 mg GnRH 2d after PGF<sub>2 $\alpha$</sub> ) was used to stimulate high and low social interactions. Statistical analyses were performed using the GLIMMIX procedure of SAS (SAS v9.3 Institute Inc., Cary, NC, USA). Half of the heifers (51.4%) received at least 1 SOCLICK, but only 10.1% of the heifers received a RUMPLICK. There were no treatment differences for SOCLICK ( $P > 0.88$ ) or RUMPLICK ( $P > 0.42$ ). The majority (75.3%) of heifers did not receive LICK and < 2% of the heifers received < 1 LICK. Heifers receiving SPRAY had a lower number of LICK per day ( $P = 0.005$ ) when compared with CON or TRTA. Heifers that received SPRAY had less TPREMOVED ( $P = 0.0001$ ) when compared with CON or TRTA, and TRTA heifers had less TPREMOVED ( $P = 0.01$ ) when compared with CON. In conclusion, SPRAY had a lower number of LICK and lower TPREMOVED. Licking behavior seen on commercial dairy farms may be primarily from social licking rather than tail paint licking.

**Key Words:** dairy heifers, licking behavior, tail paint

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**0045 Balking behavior incidence in cattle at the processing plant and carcass implications.**

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Balking behavior in the cattle processing line can pose welfare issues as electric prod use to coerce forward movement is implemented. Temperament differences have been shown among breed-type categories, within breed-type categories,

among crossbreds, and between genders. Objectives in this study were to determine if breed-type predominance, based on coat color or gender, had an effect on balking behavior and if that behavior affects carcass economics. A total of 6510 balking observations over 7 random dates in 1 yr were recorded at the entrance to the restrainer in a high-capacity processing plant. Balking scores were assigned on a scale of 1 to 5 by a trained, consistent observer. Thirteen color combinations and 16 feedlot sources were represented at random collection dates and times. Holstein cattle barked more ( $P < 0.0001$ ) than all other colors, which were similar. Gender differed in balking incidence with heifers balking more ( $P = 0.05$ ) than steers and pens containing both steers and heifers barked intermediately. The feedlot source affected ( $P < 0.0001$ ) balking behavior, with balking score means ranging from the lowest at 1.1 to 2.3 as the highest mean. Balking behavior was negatively correlated ( $r = -0.18$ ,  $P < 0.0001$ ) with dressing percentage. Mean pen weight and dressing percentage were also affected ( $P < 0.0001$ ) by feedlot source. Mean pen weight was affected by color. Holstein cattle had greater ( $P < 0.0001$ ) pen weights than all other colors, which were similar. Steers had heavier ( $P < 0.0001$ ) pen weights than mixed pens, with heifers having the lowest pen weight ( $602.8 \pm 15.4$ ,  $546.1 \pm 0.59$ , and  $541.1 \pm 0.36$  kg, respectively). Dressing percentage was affected ( $P < 0.0001$ ) by coat color and gender ( $P = 0.01$ ). Steers had the greatest ( $P = 0.01$ ) dressing percentage at  $64.8 \pm 0.1$  vs. heifers at  $64.3 \pm 0.3$ , with mixed pens being intermediate at  $63.4 \pm 0.5$ . Our results suggest an association with dressing percentage and balking behavior, and dressing percentage is affected by coat color and gender.

**Key Words:** balking, behavior, welfare

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#### 0046 Effects of ractopamine or zilpaterol on physiologic and metabolic parameters in feedlot steers.

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The feeding of  $\beta$  adrenergic agonists has recently been implicated as a potential animal welfare concern. The objective of this study was to determine the effects of ractopamine hydro-

chloride or zilpaterol hydrochloride on physiologic and metabolic blood parameters indicative of stress. Thirty crossbred steers (BW =  $573 \pm 27.4$  kg) were used in a randomized complete block design. Steers were grouped into 2 blocks based on harvest date, stratified by BW within block, assigned randomly to treatment, and then placed into individual pens. A basal finishing ration was delivered to each steer twice daily. Treatments were applied via premix containing 20 g ground corn at each feeding and consisted of: 1) no  $\beta$  agonist (CON), 2) 300 mg/d ractopamine hydrochloride (RH), or 3) 90 mg/d zilpaterol hydrochloride (ZH). Blood samples were collected via jugular venipuncture on d -7, -1, 0, 0.25, 0.5, 1, 3, 7, 14, and 21, relative to initial delivery of treatment. Whole blood (excluding d 21) was analyzed for complete blood count using an automated hemocytometer. Serum was analyzed for cortisol and haptoglobin via ELISA, and an array of blood metabolites were evaluated using an automated analyzer. Overall, the total leukocyte concentration was greater ( $P = 0.01$ ) in steers that received RH compared with CON; whereas ZH did not differ ( $P \geq 0.43$ ). On d 1, total leukocytes were greater for both RH and ZH vs. CON (treatment  $\times$  d;  $P \leq 0.046$ ). Overall, neutrophil concentration was greater in RH ( $P = 0.01$ ) and ZH ( $P < 0.01$ ) compared with CON. Neutrophils were greater for ZH on d 1 and 3, and RH on d 7 compared with CON (treatment  $\times$  d;  $P \leq 0.045$ ). Although RH did not alter ( $P = 0.36$ ) the neutrophil to lymphocyte ratio (NLR), NLR was greater ( $P = 0.03$ ) in steers fed ZH vs. CON. Treatment did not affect any other complete blood count variables ( $P \geq 0.10$ ) and cortisol and haptoglobin were not different ( $P \geq 0.19$ ). Serum urea nitrogen was decreased ( $P < 0.02$ ) and potassium and chloride were increased ( $P < 0.01$ ) for both RH and ZH. Creatine kinase was increased for ZH on d 14 and 21 ( $P \leq 0.017$ ). Serum albumin, globulins, NEFA, creatinine, calcium, phosphorus, and magnesium were not different ( $P \geq 0.57$ ). Under conditions of this study, feeding of either  $\beta$ -agonist did not clearly affect blood parameters indicative of physiological stress.

**Key Words:**  $\beta$ -agonists, stress