
0059 Benefits of fly control in dairy heifers.

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This presentation discusses the role of the horn fly (*Haematobia irritans*) in the initiation and spread of staphylococcal mastitis among dairy heifers, how this insect vector can be managed, and the benefits of control for animal health and well-being, as well as producer profits. The horn fly is an irritant to livestock, and in response to the incessant painful biting, blood sucking, and stress, cattle expend a great deal of energy in defensive behavior, resulting in elevated heart and respiratory rates, reduced grazing time, decreased feeding efficiency and rate of gain, and reduced milk production. Additionally, the horn fly can serve as a disease vector, such as in the initiation and spread of mastitis in dairy heifers. As such, it is one of the most economically important pests of cattle worldwide. In the United States, \$700 M to \$1 B in losses are attributed to the horn fly each year, while additional \$60 M is spent annually on parasite control. Herd surveys have revealed that the prevalence of mastitis in heifers is markedly lower in dairy herds using some form of fly control compared with herds without a pest control program. The horn fly has a demonstrated role in the development of teat lesions on heifers that develop into chronic *Staphylococcus aureus* mastitis, which is then spread among heifers by these same insect vectors. Such infections, if left untreated, negatively affect the development of milk-producing tissues in the udder, resulting in less than optimal yield and quality during the first and subsequent lactations. The implementation of horn fly control measures such as aerosols, bait, strips, foggers, dust bags, traps, oilers, ear tags, pour-ons, natural predators, and insect growth regulators is instrumental in reducing the new infection rate, while existing mastitis cases can be eliminated with antibiotic therapy. Such management practices will promote animal health and well-being, as well as ensure that heifers calve with low SCC and the potential for maximum milk yield, thereby enhancing producer profits.

Key Words: horn fly, dairy heifer, staph mastitis

0060 Economic trade-offs between replacement rates and improved genetics. A. De Vries*, *Department of Animal Sciences, University of Florida, Gainesville.*

Genetic progress in sires used for AI is rapidly increasing. This means that replacement heifers are increasingly much better genetically than cows. Economically, this should lead to increased voluntary culling and thereby decrease cow longevity. On the other hand, lower culling rates are often viewed favorably because the costs and environmental impact to maintain herd size are generally lower. Thus, there is an economic trade-off between genetic progress and longevity in dairy cattle. Objective was to investigate these trade-offs. USDA results show that the annual increase in average predicted transmitting ability (PTA) of Net Merit dollars of

Holstein sires is accelerating from \$20/yr when the sire entered AI in 2000 to 2004, to \$52/yr in 2005 to 2009, to \$86/yr in 2010 to 2014. We expect that heifers born in 2015 are about \$50 more profitable per lactation than heifers born in 2014. An elegant but older study is from Allaire (1981). He found that the economically optimal cull rates were in the range of 25 to 27%, compared with the lowest possible cull rate of 20%. There was only a small effect of using the best surviving dams to generate the replacement heifer calves. Genetic progress from sires also had little effect. Using a spreadsheet model to determine genetic lag in Net Merit PTA between service sires and dams shows that increased cow cull rates reduce the genetic lag only marginally. The ratio of annual genetic trend in sires' PTA for Net Merit and genetic lag was 6.6, 7.7, 8.7, and 9.4% for the annual cull rates of 20, 30, 40, and 50%, independent of the magnitude in sire genetic trend. These results confirm the findings of Allaire (1981) that cow depreciation costs overwhelm the value of the genetic superiority of the replacement heifers. Van Arendonk (1985) showed that the effect of changes in genetic improvement in milk revenue minus feed cost on herd longevity was relatively small. Reduced involuntary cull rates improved profitability, but also increased optimal voluntary culling. Finally, an economic optimal culling model with prices from 2015 confirmed that optimal annual cull rates were insensitive to heifer prices and therefore insensitive to superior genetics in heifers. In conclusion, economic cow longevity depends more on the difference between heifer raising costs and cow cull prices than on genetic progress. This is confirmed by old and new studies.

Key Words: genetics, longevity, economics

ANIMAL BEHAVIOR AND WELL-BEING

0061 Utility of an online learning module for teaching disbudding in dairy calves, including cornual nerve block application. C. B. Winder*¹,

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Although disbudding or dehorning dairy heifers is necessary for the safety of humans and other cattle, it has been identified as a key animal welfare issue when done without appropriate analgesia. Three-quarters of disbudding or dehorning is done by dairy producers or on-farm staff, the remainder is done by a veterinarian or veterinary technician. Reported use of pain control by dairy producers ranges from 15 to 60%. Cautery disbudding is the most commonly used method; best practices

include administration of a nonsteroidal noninflammatory drug (NSAID) and local anesthetic given as a cornual nerve block (CNB), which requires technical training. Teaching methods may involve one-on-one training with a veterinarian. As well, online training videos exist. To our knowledge, none of these methods have been studied for efficacy. Our objective was to determine if an interactive, online module could teach CNB application and cautery disbudding, as compared with hands-on training. Thirty-four student participants were assigned to either hands-on training or to self-directed online training. Assessments were performed by a blinded evaluator who examined knowledge, handling, CNB technique, disbudding technique, time taken, and self-confidence. Success of CNB was defined as a lack of pain-related behaviors during the first 5 s of disbudding iron application. The hands-on training group had no CNB failures, while online training had 25% CNB failures ($P = 0.13$). Online learners were significantly less confident ($P < 0.01$); had poorer handling ($P = 0.02$), CNB ($P = 0.05$), and disbudding ($P = 0.05$) technical skills; and took more time to perform all tasks ($P = 0.03$). Although online learning alone was surprisingly effective for a psychomotor skill, best practices should include hands-on training. Online learning alone may be appropriate for hard-to-reach populations, or as a preliminary step to hands-on training.

Key Words: calf, dehorn, pain control

0062 WS Grazing behavior and production characteristics among cows differing in residual feed intake while grazing late season Idaho rangeland.

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The objectives were to determine if cows classified as either low- or high-residual feed intake (LRFI or HRFI) differed in BW, BCS, and winter grazing activity over time. Thirty Hereford × Angus (LRFI = 16; HRFI = 14) 2-yr-old cows grazed sagebrush-steppe for 78 d beginning 29 Sept. 2016. Body weight and BCS were collected before and after grazing. Five cows of each RFI classification were fitted with global-positioning-system (GPS) collars on 16 Nov. 2015, with data collection commencing 3 d later and continuing for 25 d in a 323 ha pasture. The GPS units collected location coordinates every 2 min, from which total daily travel was calculated. Visual counts for bite rate were obtained from collared cows over 8 d. Coordinate data, daily bite rate, BW, and BCS were analyzed as repeated measures using a mixed model, which included RFI group, day, and RFI group × day as fixed effects, and cow within RFI group as the random effect. Change

in BW and BCS were analyzed by ANOVA, with RFI group as the main effect. Cow BCS and BW differed for both day ($P < 0.0001$) and day × RFI ($P < 0.05$). Body condition was less in LRFI cows at the beginning (5.8 ± 0.13 vs. 6.2 ± 0.14 BCS), but similar to HRFI at the end of the study (4.6 ± 0.13 vs. 4.6 ± 0.14). Body weight for the different RFI cows did not differ ($P = 0.1974$) before going to range. However, BW-change and BCS-change differed ($P = 0.05$) among RFI groups. Not only did the LRFI cows lose less BW (-50.0 ± 5.41 kg vs. -66.6 ± 5.78 kg) over the trial, they also were less variable with respect to BW loss. Cows did not differ ($P > 0.21$) by RFI for distance traveled or bite rate, but day was significant ($P < 0.0001$) with cows increasing bite rate as the season of year progressed (55.2 ± 5.63 bites/min for d 4 vs. 84.8 ± 5.32 bites/min for d 21) and increasing distance traveled as snow storms occurred. Although LRFI cows were leaner than HRFI cows at the commencement of the project, they lost less BW and functioned competitively in a late season rangeland environment.

Key Words: beef cattle, grazing behavior, rangeland, residual feed intake

0063 Variability in feeding behavior between individual dairy cows fed under different levels of competition.

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The objective of this study was to investigate the effects of differing levels of competition for feed access on group-housed dairy cows and on the variation in feeding behavior between individuals within the group. We hypothesized that, as competition increases, (1) cows will consume feed faster and in larger meals, and (2) individuals within the group will experience greater variability in feed consumption patterns. Eighteen lactating Holstein dairy cows with average DIM of 77 ± 20 d and production of 46 ± 7 kg/d at the start of the trial, were divided into groups of three, and fed three times per day. Groups were exposed to each of three competition levels: high (3 cows: 1 feed bin), moderate (3 cows: 2 feed bins), and low (3 cows: 3 feed bins). Treatments were assigned in random order according to a modified Latin Square design and applied for 10 d. DMI and feeding behavior (feeding time, feeding rate, and meal patterns) for each cow were recorded using an automated feed intake system on d 6 to 10 of each period. Data were summarized by group and treatment period, and analyzed in a general linear mixed model. DMI (29.1 kg/d) was found to be similar ($P = 0.63$) across treatments. Increased competition resulted in a reduction in feeding time (low = 202.6 , moderate = 194.9 , high = 83.6 min/d; SED = 4.49 ; $P = 0.015$), especially following fresh feed delivery and milking. Rate of feed intake increased with greater competition (low = 0.16 ; moderate = 0.18 ; high = 0.20 kg DM/min; SED = 0.01 ; $P = 0.01$). Meal frequency (8 meals/d) and size (4.0 kg DM/meal) were unaffected by treatment ($P > 0.40$), while meal length increased

Table 0064.

Table 1. Probabilities of being lame for variables measured by precision dairy farming technologies.

Variable	Odds ratio	Standard Error	P - value
Lying time (increase by one hour) ¹	1.56	0.14	0.01
Rumination time (decrease by 30 minutes) ²	1.25	0.04	0.02
Neck activity (decrease by 150 units) ³	3.87	1.35	0.01
Reticulorumen temperature (increase by one degree) ⁴	1.00	0.00	0.01
Milk yield (decrease by five kg) ⁵	0.88	0.08	0.16

¹Lying time was measured by an IceQube (IceRobotics, Edinburgh, Scotland)

²Rumination time was measured by an HR tag (SCR Engineers Ltd., Netanya, Israel)

³Neck activity was measured by an HR tag (SCR Engineers Ltd., Netanya, Israel)

⁴Reticulorumen temperature was measured by a DVM bolus (DVM Systems, LLC Boulder, CO)

⁵Milk yield was recorded by the Milkline Milpro P4C (Gariga di Podenzano, Italy) milking system

under high competition (low = 37.0; moderate = 36.6; high = 47.3 min/meal; SED = 3.7; $P = 0.046$). This was due to greater within-meal nonfeeding time, which at the high competition level, was approximately double that of the other treatment levels (low = 10.0; moderate = 10.8; high = 20.3 min/meal; SED = 2.3; $P = 0.008$). Analysis of individual within group variability, calculated as the daily SD of each group averaged across d 6 to 10, revealed treatment differences in variability of meal length (low = 12.0; moderate = 13.9; high = 29.0 min/meal; SED = 5.56; $P = 0.04$) and within-meal nonfeeding time (low = 6.4; moderate = 8.3; high = 21.5 min/meal; SED = 4.57; $P = 0.03$). These results suggest that at elevated competition levels, cows modify their feeding behavior to consume more feed in a shorter period of time and devote a large portion of their meal time toward waiting to gain feed access. Further, there is greater variability in meal patterns within groups at higher levels of competition for feed access.

Key Words: dairy cow, feeding behavior, competition, meal patterns

0064 Identification of lameness using lying time, rumination time, neck activity, reticulorumen temperature, and milk yield. B. A. Wadsworth*, A. Stone, J. D. Clark, and J. M. Bewley, *University of Kentucky, Lexington.*

Early identification and treatment of lameness can reduce pain and negative performance related to the disease. However, producers frequently misidentify lame cows; therefore,

automatic identification of lame cows is needed. The objective of this study was to identify lame cows using precision dairy monitoring technologies. Cows ($n = 98$) were housed at the University of Kentucky Coldstream Dairy from 11 Jan. 2012 to 3 May 2013. Cows were equipped with an IceQube (IceRobotics, Edinburgh, Scotland) on their left rear leg, which measured daily lying time (LT), an HR tag (SCR Engineers Ltd., Netanya, Israel) around their neck, which recorded daily rumination time (RUM) and neck activity (ACT), and a DVM bolus (DVM Systems, LLC Boulder, CO) that measured reticulorumen temperature (RETT). Milkline Milpro P4C (Gariga di Podenzano, Italy) milking system recorded daily milk yield (MY). Seasons were categorized as Season 1 (December, January, and February), Season 2 (March, April, and May), Season 3 (June, July, and August), and Season 4 (September, October, and November). Cow gait was assessed weekly using a one (sound cow) to five (severely lame cow) scale. General symmetry, tracking, spine curvature, head bob, speed, and abduction/adduction were scored individually. Final gait score was calculated as a weighted average of general symmetry (24.92%), tracking (20.38%), spine curvature (19.81%), head bob (13.77%), speed (13.12%), and abduction/adduction (8%). Cows that scored ≥ 2 overall were classified as lame. A generalized linear model using the GENMOD procedure in SAS (SAS Institute, Inc., Cary, NC) was used to evaluate the effects of parity, season, LT, RUM, ACT, RETT, and MY on overall gait scores and their two-way interactions. Stepwise backward elimination was used to remove nonsignificant interactions ($P \geq 0.05$). Variables associated with a probability of being lame were an increase in LT by 1 h, a decrease in RUM by 30 min, a

decrease in ACT by 150 units, and an increase in RETT by one degree (Table 1). Milk yield was not associated with a probability of being lame (Table 1). When identifying lameness, using precision dairy monitoring technologies that determine LT, RUM, ACT, or RETT may be useful.

Key Words: lameness, accelerometer, precision dairy farming, technology

0065 Management and dimensions of footbaths on

California dairies. M. Pineda* and N. Silva-del-Rio, *Veterinary Medicine and Research Center, University of California, Tulare.*

Lameness is a common disease found on dairies with important economic and animal welfare implications. Digital dermatitis is one of most common infectious causes of lameness. Footbaths (FB) are commonly used on California dairies to prevent infectious foot diseases. The objective of this study was to describe footbath dimensions and management practices on California. Twenty dairies located in the San Joaquin Valley of California were enrolled in the study. Herds ranged in size from 800 to 10,000 cows. The length, width, and depth of FB was measured. Information on the chemical composition of FB solutions and the frequency that fresh FB solutions were added was obtained through interviews with hoof trimmers and dairy managers. Data collected was entered into spreadsheets for data analysis (Microsoft Office Excel; 2010). Dairies had 1 to 4 FB per dairy (total 39). One dairy applied disinfectant FB solution with front and rear jets. On four dairies, prebaths were placed <30 cm from the FB. No information on frequency of FB use was obtained from one dairy. The frequency of new FB solution application was seven ($n = 2$), five ($n = 6$), four ($n = 4$), three ($n = 5$), or two ($n = 1$) days a week. Cows walked through the FB once ($n = 12$), twice ($n = 6$), or thrice ($n = 1$) a day. One dairy walked dry cows through a FB once a week. The maximum FB length was <1.5 (15%), 1.5 to <2.5 m (57%), 2.5 to <3 m (18%), or >3 m (10%). Width measures were <1 m (39%), 1 to <2 m (20%), and ≥ 2 m (41%). FB solution depth averaged 10 cm (range: 5.4 to 15 cm). Volume of chemical solution in FB averaged 339 L (range: 109 to 1095 L). Most FB (66%) contained between 150 and 500 L of solution. Disinfectant chemical solutions used on dairies were CuSO_4 ($n = 3$), ZnSO_4 ($n = 2$), or formaldehyde ($n = 3$). However, some dairies combined CuSO_4 and formaldehyde ($n = 9$), CuSO_4 and chlorine ($n = 1$), or CuSO_4 and glutaraldehyde ($n = 1$). On average, 921 cows (range: 185 to 2000 cows) walked through a FB solution before adding fresh solution. Across dairies there was a wide variation on design, dimensions, and management of FB. Further research is needed to establish the implications of various management practices and FB designs on hoof health.

Key Words: lameness, footbath, dairy cow

0066 History of management procedures and hierarchy in dairy cows.

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This study assessed social interactions between cows in a 186 lactating cow herd, split into high milk yield (<35 wk into milking) and a low milk yield (>35 wk into milking) groups. The shifting hierarchical behaviors of the cows over 20 d was observed through analysis of video. The objective was to determine whether cows with a higher history of management procedures associated with treatment for common mastitis, lameness, and dystokia, would be lower in rank in the social hierarchy, and show more fluctuation in rank, than cows with a low management procedure history. A still-image photo library of the cows in the herd was compiled so that every cow could be identified from video recordings. Cows were identified as being in a high management history group (HMG) or a low management history group (LMG) based on their electronic farm management record. For blind analysis, the categorization into low and high management groups was made after the video analysis had been completed. Cows were filmed at the feed barrier using 1080 p 50 fps GoProHero 4 cameras, each camera supported to give a stable image along the feed barrier. Activity and time budget analysis of individual cow interactions from the video images allowed dominant (+) and submissive (-) interactions between cows to be noted. No significant difference was found in the “average hierarchical rank” between cows in the HMG and the LMG ($P = 0.330$). Heifers did rank significantly lower than cows, for example, when comparing heifers to cows in their third lactation ($P = 0.004$). The LMG showed a higher variability (deviation in means score) in rank than the HMG. This pilot study may aid understanding of possible long-term effects of common dairy management procedures. With further development, this method could (a) inform steps to reduce long-term impacts of common procedures, and (b) utilize altered hierarchical behavior as a detection tool for cattle showing long-term deleterious effects of previous management procedures. Cows that had a higher history of management for common dairy cow conditions (lameness, mastitis, or dystokia) did not experience long-term effects on hierarchical behaviors during feeding. However, significant behavioral differences in groups based on age were detected.

Key Words: dairy cows, management, disease, hierarchical, behavior

0067 Behavioral analysis and performance response of feedlot steers on concrete slats versus rubber slats.

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Concrete slats as a flooring substrate pose welfare concerns for feedlot cattle. An alternative system includes overlying rubber mats that fit existing slats. In this series of trials, three

sets of 16 steers were housed on either concrete slats (CONC) or rubber-covered concrete slats (RUBBER) during their finishing period. Each trial had four pens of four steers each, with two pens per treatment. Animals were fed a finishing diet once per day, the room was held at 18.3°C with continuous illumination. Cattle DMI, ADG, G:F, weight, and carpus circumference were tracked for the duration of the finishing period, up to 128 d. Lying and standing duration behavior was also measured on each treatment. Cattle also had their blood sampled at regular intervals for complete blood count analysis. After slaughter, carcass characteristics and front limbs were collected for soft tissue and histological examination. For growth measurements and CBC panel data, with pen as the experimental unit, there were no treatment differences ($P > 0.05$). Carpal circumference was larger on CONC than on RUBBER as each trial progressed, and in particular, the left carpus increased at a faster rate on CONC. Lying and standing behavior differed between treatment groups: on CONC, cattle consistently had fewer lying bouts per day than steers on RUBBER; in Trial 1, the average number per day was 21.2 ± 1.3 on CONC and 25.1 ± 1.3 on RUBBER ($P = 0.0039$). In Trial 2, lying and standing duration behavior did not differ between treatments. The average number of lying bouts per 24 h period was 33.1 ± 2.2 and 39.2 ± 2.2 on CONC and RUBBER, respectively ($P = 0.0068$). In Trial 3, average number of lying bouts per 24 h period was 14.6 ± 1.4 on CONC and 21.3 ± 1.4 on RUBBER ($P < 0.0001$). The behavioral results in conjunction with the joint circumference results, indicate that cattle were experiencing a greater amount of discomfort in lying and standing transition phases. It is concluded that steers on RUBBER have a higher standard of welfare than cattle on CONC.

Key Words: cattle, joint, rubber, lying

0068 Effect of corral modification for humane livestock handling on cattle behavior and cortisol release.

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Most traditional corral facilities are designed and built without the use of animal welfare principles, and can cause stress and fear reactions. This experiment was conducted to evaluate the influence of modifications to transform traditional corral into humane livestock handling system in cattle behavior and serum cortisol. The corral modifications consisted of blocking vision when the worker stands inside the animal's flight zone, eliminating contrast of light and dark or shadows, and

keeping the workers calm, not allowing them to scream or hit the animals during handling. Electric cattle prods were not permitted. A total of 382 Nellore steers, from 12 to 20 mo of age, from five different ranches were studied. First, the behavior of the animals in a traditional corral was evaluated. After corral modification and changing for calm handling procedures, the same animals returned (6 d later) for a second behavioral assessment. During restraining, before and after corral modifications, blood samples were collected from the jugular vein for analysis of serum cortisol. The cattle were evaluated using visual scores. Entry behavior (EB) into the restraint device was evaluated by observing whether the bovines walked, trotted, or ran. Chute temperament (CT) was assessed by considering whether the animal was very calm, calm, agitated, very agitated, or struggling to escape; and exit gait (EX) by observing whether the animal walked, trotted, or ran. After corral modification, cattle exhibited lower EB ($P < 0.0001$) and EX ($P < 0.0001$) and a higher proportion of animals was calm (CT-P < 0.0001) during restraining. The proportion of cattle that walked, trotted or ran was, respectively, 61.9, 30.4, and 7.7% for EB and 47.9, 36.9, and 13.4% for EX before corral modification, and 79.3, 16.8, and 3.9% for EB and 74.0, 19.7, and 6.3% for EX after corral modification. For CT, the proportion of very calm, calm, agitated, very agitated, and struggling to escape animals was 26.8, 36.6, 23.4, 12.1, and 4.2% before corral modification, and 48.1, 32.1, 15.1, 3.6, and 1.1% after corral modification, respectively. Serum cortisol levels were significantly lower ($P < 0.0001$) after corral modification. Mean serum cortisol was 47.87 mg/dL before corral modification and 32.49 mg/dL after corral modification. Good handling practices, corral reconstruction, blocking vision in specific areas, and respecting the natural movement can reduce stress in cattle.

Key Words: cattle stress, good practice, welfare

0069 A preliminary examination of swine caretakers' perspectives for euthanasia technology and training.

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An observational study was performed to better understand swine caretaker attitudes and opinions about euthanasia methods in swine production. A questionnaire was developed for swine caretakers to document the following: (1) psychosocial aspects, such as moral stress and job satisfaction associated with euthanasia, (2) current use of euthanasia techniques, and (3) views on animal welfare. To gain insight on caretakers'

perspectives on the issues listed above, caretakers were asked to rank their personal opinions on these topics. A total of 2104 surveys were mailed between December 2014 and June 2015 to caretakers associated with four swine production companies in eight states. The return rate was 8.3% ($n = 175$), with 168 completed surveys used for analysis. Respondents included 115 male and 53 female caretakers, whose work experiences with pigs ranged from <1 to 55 yr. Sixty-seven percent of caretakers worked in swine breeding units, while the remainder worked in farrowing, nursery, grow finish units, or a combination of production cycle units. Odds ratio analyses were performed to examine the effects of gender on caretaker opinion and acceptance regarding euthanasia techniques. There were no differences between male and female caretakers regarding the acceptance of different euthanasia methods in suckling pigs ($P > 0.05$). A large percentage of caretakers agreed that it is important to have good skills for euthanasia, that they knew how to euthanize humanely, and that it is more humane to euthanize terminally ill pigs than to let them die (93, 95, and 95%, respectively). Male and female caretakers did not differ in their personal opinions about euthanizing pigs, speaking publicly about their job, or euthanasia preferences ($P > 0.05$). Forty-nine percent of caretakers were trained in euthanasia techniques within the last year, and 30% reported that they would like more training. Caretakers preferred to be trained on-farm, followed by the use of video, classroom setting with a trainer, and reading materials. Caretakers rated carbon dioxide more acceptable than the use of blunt force trauma for suckling pigs (70% and 37%, respectively). The current study suggests that swine caretakers agree that proper euthanasia techniques are important and male and female caretakers do not differ in perspectives concerning euthanasia technology and training.

Key Words: swine caretakers, caretaker attitudes, euthanasia, animal welfare

0070 Slow doesn't win the race: Reduced energy diets did not improve sow articular cartilage.

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Sow lameness accounts for approximately 15% of culling, resulting in a decrease in productivity and welfare. Previous research in our laboratory has shown a high incidence of osteochondritic lesions in young sows. We hypothesized that decreasing the growth rate of sows would allow for proper formation of articular cartilage. The objectives of this study were to (1) quantify behavioral changes associated with the diet, and (2) prevent the development of osteochondritic lesions. Therefore, 70-d old gilts were placed on either a control diet (CON; $n = 23$) or a low energy diet (LOW; $n = 24$). The CON

diet contained 3427 Kcal/kg ME. The LOW diet utilized wheat middling and soy hulls, and contained 2643 Kcal/kg ME, targeting 65 to 70% of growth. Both diets were available ad libitum from d 70 to 182. Gilts were fed LOW or CON diets in four 28 d phases, and were weighed at diet changes to calculate ADG and ADFI, which were 0.80 and 0.92 kg, respectively, for CON gilts and 0.61 and 1.06 kg, respectively, for LOW gilts. A G:F of 1.15 resulted for CON and 1.73 for LOW gilts. Behavioral observations were recorded monthly and included posture, activity, agonistic behavior, and vices. Joint samples were taken (CON = 9; LOW = 10) between d 182 to 361 and analyzed for damage. Joints were evaluated for number of lesions, lesion size, and received an articular cartilage score from 0 to 4, with 0 representing healthy cartilage and 4 representing severely lesioned cartilage. The LOW gilts spent more time standing ($P < 0.01$), sitting ($P < 0.01$), and feeding ($P < 0.01$). Overall, diet did not alter sham chewing ($P = 0.76$), nosing ($P = 0.11$), or tail biting ($P = 0.36$). Both LOW and CON gilts did not differ in the number of fights ($P = 0.67$); however, CON gilts spent less time fighting than LOW gilts ($P < 0.01$). Energy restricted feed did not decrease the lesion size or prevalence of lesions ($P > 0.10$). Older gilts had larger lesions on the proximal humerus ($P < 0.01$) and femur ($P < 0.01$) and the distal humerus ($P < 0.03$) and femur ($P < 0.04$) than younger gilts. An energy restricted diet is not a suitable solution to decrease fighting or to improve joint health in young sows.

Key Words: articular cartilage, energy restriction, sow longevity

0071 WS Use of a human triaxial pedometer for measurement of sheep activity.

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The accuracy of a simple, human triaxial pedometer at measuring sheep steps at a walk was investigated. Adult ewes ($n = 10$) were subjected to a three week halter-training program, with the end result of ewes being able to walk for 100 m next to a handler with little or no resistant behavior. A triaxial pedometer was attached to the left hind leg. Ewes were led for 100 m and the number of steps reported by the pedometer was recorded. A handheld video camera was used to record each trip, and the visual step count of the ewe was determined from the video recording. Each ewe was led through this pattern twice, and the average of the pedometer and visual step count at 80 m was used for statistical analysis. A Wilcoxon signed rank test was used to compare the means of the pedometer and visual step counts, and a Pearson correlation was drawn. The means of the pedometer and visual step counts were statistically different ($P < 0.001$) and the correlation was negligible ($r = 0.03$). The simple triaxial pedometers overestimated the amount of steps each ewe made, and therefore, cannot be considered accurate at measuring sheep activity.

Key Words: sheep, activity, triaxial pedometer

0072 Cooling cows with soakers: Spray duration affects heat loss in dairy cattle. G. Tresoldi^{*1}, K. E. Schütz², C. B. Tucker¹, ¹University of California, Davis, ²AgResearch, Hamilton, New Zealand.

Soakers reduce heat load in cattle. Determining appropriate spraying strategies (e.g., time on and off) may improve the efficiency of heat loss and water use. Our objective was to evaluate the effects of a single cycle of spray on evaporation time, the surrounding air temperature, and heat load responses in dairy cows. In a crossover design, five spray durations (0, 0.5, 1.5, 3, and 13 min; flow rate = 4.9 L/min) were tested in 15 Holstein cows (milk yield 38 ± 3 kg/d) and replicated on 3 d/treatment (15 d total/cow) when air temperature, humidity, and the combined index averaged 31 ± 3°C, 27 ± 10%, and 76 ± 2, respectively. Cows were restrained in shaded head gates at the feed bunk for up to 1.75 h. Respiration rate (RR), skin temperature on the shoulder (received direct spray) and upper leg (remained dry), and the air temperature surrounding the leg were measured immediately before and after the spray application (water temperature 30 ± 3°C), and every 3 min until their coat was dry (a proxy for evaporation time), as measured by water sensitive paper applied to the coat. Data were analyzed with mixed models using SAS. In contrast to 0 min, all treatments reduced skin temperature on the shoulder (range of mean ± SE: -1.1 to -4.4 ± 0.2°C; *P* < 0.01), whereas treatments ≥ 1.5 min reduced RR (range: -7 to -24 ± 2 breaths/min; *P* ≤ 0.04), and the surrounding air temperature (range: -0.3 to -1.8 ± 0.0°C; *P* < 0.01). Only spraying for ≥ 3 min reduced the upper leg temperature (range: -0.1 to -0.6 ± 0.0°C; *P* < 0.01). In general, the magnitude of the changes described above increased as the longer spray was on (*P* < 0.05). The coat took slightly longer to dry when cows were sprayed for 13 min compared with ≤ 3 min (mean ± SE = 16 ± 0.6 vs. 14 ± 0.5 min, respectively; *P* < 0.01). Within this period, RR increased by 5 breaths/min regardless of treatment (*P* = 0.75). Cooling benefits, as well as changes in air temperature surrounding the leg, were more pronounced when water was sprayed for longer. Spray duration had a little effect on evaporation time, and no additional cooling was observed in this phase.

Key Words: sprinklers, heat stress, spray length

0073 Association between rumination behavior, milk yield, and milk composition in dairy cows kept on commercial farms. T. Miedema and T. J. DeVries*, *Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada.*

Automatic sensors are able to give an accurate indication of the duration of time that dairy cows spend ruminating, allowing for collection of rumination data on cows kept in commercial environments. The objective of this study was to associate rumination behavior with milk yield and milk composition for lactating dairy cows kept in commercial operations. In this

study, 8 commercial dairy farms in Eastern Ontario, Canada, were recruited for participation. Selection criteria included: free-stall housing, parlor milking, >90 lactating cows in the herd, primarily have Holstein-Friesian genetics, participated in a DHI program, and fed a TMR. Chosen farms had a mean herd size of 187 cows (range: 95 to 419 cows), mean adjusted 305-d milk yield of 11,228 kg (range: 9787 to 13,006 kg), and a geometric mean annual bulk milk SCC of 162,000 cells/mL (range: 145,000 to 172,000 cells/mL). Rumination time for 30 cows/herd was monitored using an automated rumination monitoring system. In total, the rumination activity of 240 lactating Holstein cows (57 ± 29 DIM) was monitored for 6 d and associated, in a multivariable general linear mixed model, with their production data (as measured by the closest in time DHI test, on average ± 3.5 d from the day of rumination sensor placement), controlling for farm, parity, DIM, body condition score, and dietary (TMR) characteristics (nutrient content and particle size). Across cows, rumination time averaged 506 ± 85 min/d (mean ± SD), milk yield averaged 44.7 ± 10.2 kg/d, milk fat averaged 3.69 ± 0.54%, and milk protein averaged 2.97 ± 0.24%. Rumination time increased with cow parity (*P* < 0.001) and tended (*P* = 0.09) to be positively associated with the percentage of long particles (>19 mm) in the TMR fed to the cows (+10.0 ± 5.5 min/d rumination time per 5% increase in long particles). Milk yield increased with cow parity (*P* < 0.001), milking 3× vs. 2× (+4.5 ± 2.3 kg/d; *P* = 0.05), and was positively associated with rumination time (+0.2 ± 0.07 kg milk per 10 min increase in rumination time per d; *P* = 0.01). Rumination activity was not associated with milk fat content, and tended (*P* = 0.08) to be quadratically associated with milk protein content. In summary, the results of this study demonstrate that rumination time, as measured on lactating cows on commercial dairy farms, could be indicative of milk yield; however, it showed less consistent association with milk components.

Key Words: rumination, behavior, dairy cow

0074 Lameness, productivity and cow behavior in dairy herds with automated milking systems. M. T. King^{*1}, E. A. Pajor², S. J. LeBlanc³, and T. J. DeVries¹, ¹Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, ²University of Calgary, Calgary, AB, Canada, ³Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada.

The objective of this study was to evaluate how herd management, barn design, and lameness relate to productivity and cow behavior in herds with automated milking systems (AMS). We visited 41 AMS farms in Canada (Ontario: *n* = 26; Alberta: *n* = 15), averaging 105 ± 56 (mean ± SE) lactating cows and 2.2 ± 1.3 AMS units. Details of barn design, stocking density, and herd management were collected. At each farm, 40 cows

were gait scored (or 30% for herds > 130 cows) using a five-point numerical rating system (NRS; 1 = sound to 5 = lame). Cows were defined as clinically lame with NRS ≥ 3 (26.2 \pm 13.0%) and severely lame with NRS ≥ 4 (2.2 \pm 3.1%). For 6 d periods, we collected milking data from AMS units and lying data from electronic data loggers. Data were analyzed in multivariable mixed-effect linear regression models. At the herd level, an increase of 1 percentage point (p.p.) in the prevalence of severe lameness was associated with production losses of 0.6 kg of milk produced/cow/d ($P = 0.05$) and 32 kg milk harvested/AMS/d ($P = 0.03$), while each 10 p.p. increase in clinical lameness prevalence was associated with 0.1 fewer milkings/cow/d ($P = 0.05$). One additional cow/AMS unit was associated with 32 kg more milk harvested/AMS/d ($P < 0.001$), but also decreased milking frequency (-0.2 milkings/cow/d for each 10 additional cows/AMS; $P < 0.001$). Daily lying time was positively associated with the frequency of feed push-ups (+3 min/cow/d/push-up; $P = 0.05$) and negatively associated with the placement of neck rails from the rear curb of lying stalls, such that cows lied down less as neck rails were placed farther forward (-23 min/cow/d/10 cm; $P = 0.03$). Lying bouts (min/bout) were 12 min longer in deep-bedded stalls vs. mattresses ($P = 0.003$), and 5 min longer with each 10 p.p. increase in the prevalence of clinical lameness ($P = 0.001$). In a cow-level comparison (30 cows/farm) of lame (NRS ≥ 3 ; $n = 353$) and sound cows (NRS < 3 ; $n = 865$), lame cows were fetched more often ($P = 0.002$), produced 1.6 kg/d less milk ($P = 0.002$) in 0.3 fewer milkings/d ($P < 0.001$), and spent more time lying down (+38 min/d; $P < 0.001$) in longer bouts (+3.5 min/bout, $P = 0.03$). In conclusion, lameness is especially problematic for AMS herds, reducing productivity at the cow and herd level. Although few cows in our study were severely lame, producers need to identify and reduce clinical lameness. Widening lying stalls, providing deep-bedded stalls, and scraping alleys more frequently were factors associated with reduced lameness prevalence and are potential ways to optimize productivity in AMS herds.

Key Words: automated milking, dairy cow behavior, lameness

0075 Assessment of biomarkers of pain and daily activity patterns in lactating dairy cows diagnosed with clinical metritis. A. A. Barragan¹, S. Bas^{*1}, J. M. Piñeiro¹, G. M. Schuenemann¹, P. Rajala-Schultz¹, and D. Sanders², ¹Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, ²Vaca Resources, Urbana, OH.

Postpartum uterine diseases such as clinical metritis (MET) are associated with substantial economic losses due to reduced milk yield, delayed time to conception, treatment costs, and increased culling and death rates. Furthermore, MET has been characterized by bovine veterinarians as a painful event and can be regarded as a welfare concern since it can be associated

with systemic signs, such as fever, depression, loss of appetite, and visceral pain. The objectives of this study were to: (1) assess the circulating concentrations of substance P, and (2) daily activity patterns (i.e., lying and standing time) in lactating dairy cows diagnosed with MET. Lactating dairy cows ($n = 200$) from two commercial dairy herds were enrolled in the present study. Cows diagnosed with MET ($n = 100$) at 7 ± 3 d in milk (DIM) were matched according to parity and DIM to cows without MET (noMET; $n = 100$). On study d 1, MET was diagnosed (using a metricheck device) by the presence of watery, reddish, or brownish foul-smelling vaginal discharge; blood samples were collected for assessment of circulating concentration of substance P. In addition, on study d 1 activity monitors were placed on the hind leg of cows (MET; $n = 56$; noMET; $n = 56$) and were kept until study d 7. Cows showing any other signs of disease were not included in the study. Data were analyzed using the MIXED procedure of SAS. Cows with MET had higher ($P = 0.0004$) plasmatic concentrations of substance P when compared with noMET cows (MET = 72.44 pg/mL; noMET = 55.73 pg/mL). Furthermore, cows with MET tended to spend more time lying ($P = 0.06$; MET = 635.60 min/d; noMET = 603.02 min/d) and less time standing ($P = 0.06$; MET = 804.08 min/d; noMET = 837.25 min/d) than noMET cows. These findings provide evidence that circulating concentrations of substance P are increased, and activity is affected in lactating dairy cows diagnosed with MET.

Key Words: metritis, substance P, activity

0076 Effect of social feeding environment on the feeding behavior of dairy cows and their willingness to consume a novel feed. G. Mainardes and T. J. DeVries*, Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada.

Social contact may improve the willingness of dairy cattle to consume a novel feed. To test the impact of social contact while feeding and the reaction of mature cows toward a novel feed, we compared (1) animals fed individually (Single) and (2) cows fed in side-by-side in social pairs (Pairs). It was hypothesized that animals feeding beside each other would show similar behavioral patterns to each other, and a greater willingness to consume a novel feed product compared with those fed individually. Twelve Holstein cows (parity = 3.3 ± 1.3 ; mean \pm SD) were assigned to four groups of three animals (each with two cows fed beside each other in adjacent feed bins and 1 fed alone on her own feed bin). Two feed types were offered separately: a familiar food made up of a total mixed ration (TMR) and an unfamiliar 5 kg of chopped carrots topped with 6 kg of TMR (as-fed). Each group was observed for 10 d, each consisting of 3 periods: (1) 4 d of adaptation (only TMR); (2) d 5 to 7 the carrots were introduced to the Single cow and to 1 of the 2 cows eating in Pairs; and (3) from d 8 to 10, all three cows were fed carrots and TMR. Dry matter intake (DMI), feeding behavior, rumination time, and sorting activity were

monitored for each animal. Cow behavior was observed for an hour after each feed delivery. Data were summarized by cow and period and analyzed in a repeated measures general linear mixed model. No differences in DMI of TMR (27.1 kg/d) or carrots (0.09 kg/d) and feeding time (193.9 min/d) were found between any animal eating as a Single or in Pairs. However, the DMI of carrots increased from Period 2 to Period 3 (0.04 to 0.12 kg/d; $P = 0.03$). In Period 2, Paired animals (typically heifers or younger animals feeding socially) ate faster than the other cows (0.19 vs. 0.13 and 0.12 kg DM/min; $P = 0.05$). In period 2, Paired cows tended to select more for medium particles (106 vs. 102% of predicted intake; $P = 0.08$) and sorted to a greater extent against short (97 vs. 99%; $P = 0.02$) and fine fractions (89 vs. 97 and 96%; $P = 0.05$). Overall, the intake of carrots was very low in all treatments; however, animals consumed more carrots in the third period. These results suggest that the acceptance of novel food might increase with the length of exposure. It is also concluded that animals showed similar feeding behavioral patterns regardless of feeding situation.

Key Words: novel feed, dairy cow, social feeding

0077 Effects of acute and chronic heat stress on feed sorting behavior of lactating dairy cows.

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The objectives of this study were to assess the effects of acute and chronic exposure to heat stress on feed sorting of dairy cows. Lactating Holstein dairy cows ($n = 32$; parity = 2.8 ± 1.2 ; mean \pm SD) were group-housed in a free stall barn and milked three times per day. Cows were fed individually using Calan gates and offered ad libitum access (target 20% orts) to TMR (containing on DM basis: 3.3% ryegrass hay, 16.5% ryegrass baleage, 24.7% corn silage, 11.1% brewers grains, 19.7% ground corn, 19.8% concentrate, and 4.9% protein/mineral supplement), provided once per day. Cows were divided into two groups (balanced by days in milk and parity) and, beginning at 186 ± 60 DIM, were exposed to either heat stress (HT; $n = 15$) conditions (average temperature-humidity index in barn: 77.6), or evaporative cooling (CL; $n = 17$), consisting of misters and fans over the freestall and feed bunks to alleviate heat stress. Data were collected during a 4 d baseline period (starting 18 d before treatment), and two 4 d experimental periods: starting at 10 d after implementing treatments (during acute heat stress for HT cows), and at 62 d after implementing treatments (chronic heat stress for HT cows). Fresh TMR and orts samples were collected daily from individual cows for particle size analysis. The particle size separator had three screens (19, 8, and 1.18 mm) and a bottom pan, resulting in four fractions (long, medium, short, fine). Sorting was calculated as the actual intake of each particle size fraction

expressed as a percentage of the predicted intake of that fraction. Data were analyzed using a repeated measures general linear mixed model, with sorting during the baseline period included as a covariate. During both acute and chronic heat stress, HT cows sorted in favor of the long particle fraction to a greater extent than CL cows (105.0 vs. 100.6%; SE = 1.09, $P = 0.001$). Sorting of medium and short particles were subject to treatment by period interactions ($P < 0.006$): in the period of acute heat stress, HT cows sorted to a greater extent than CL cows against medium (86.5 vs. 93.0%; SE = 0.36; $P = 0.006$) and short particles (94.1 vs. 97.5; SE = 0.64; $P = 0.002$), whereas in the period of chronic heat stress, sorting of HT cows did not differ from CL cows ($P > 0.9$). These results suggest that exposure to heat stress influences feed sorting and that feed sorting may increase in response to acute heat stress.

Key Words: feed sorting, heat stress, lactating dairy cow

0078 In utero exposure to heat stress during late gestation has prolonged negative effects on activity patterns of dairy calves.

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Exposure to heat stress (HS) during the dry period not only negatively affects cow performance, but it also exerts carryover effects on postnatal performance of the calf. The objective of this experiment was to evaluate the health, responsiveness, and activity of heifer calves born to cows exposed to HS (provided only shade, $n = 13$) or cooling (CL, fans, soakers, and shade, $n = 9$) environmental conditions during the entire dry period (~56 d). On the day of calving, calves were fed 3.8 L of maternal (HS or CL) colostrum. Within 2.8 ± 2.6 h of birth, we scored suckling reflex (1–3; 1 = no suckling response, 3 = strong suckling response) and movement (1–3; 1 = not able to stand when prompted, 3 = stands promptly). Calves were housed in individual pens and provided pasteurized milk (6 L/d) and ad libitum access to grain and water, until weaning at 49 d. Activity was assessed during the first week of life (week 1), weaning (week 7), and the first week postweaning (week 8) using electronic data loggers (HOBO Pendant G data Logger, Onset computer corp., Pocasset, MA) attached to the left rear leg of the calf. Heifer health was monitored weekly from birth to weaning (heath score 1–5). Data were analyzed by time period in a general linear mixed model, with day as a repeated measure for activity data. All heifers were healthy through the duration of the experiment. At birth, the suckling reflex (1.8 vs. 2.1; SE = 0.24; $P = 0.33$) and movement score (2.42 vs. 2.33; SE = 0.18; $P = 0.69$) were similar for CL and HS calves, respectively. However, CL calves spent more time standing in the first week of life (303.6 vs. 254.3 min/d; SE = 9.6; $P < 0.001$) as a result of longer standing bouts (14.2 vs. 12.2 min/bout; SE = 0.55; $P = 0.006$). In weeks 7 and 8,

CL calves maintained greater total daily standing time (442.6 vs. 406.8 min/d; SE = 10.7; $P < 0.019$) and spent more time standing/bout (30.7 vs. 24.3 min/bout; SE = 1.2; $P < 0.001$). However, CL calves had less frequent standing bouts than HS calves (15.4 vs. 17.7 bouts/d; SE = 0.6; $P < 0.01$). These results suggest that in utero HS during late gestation can have prolonged negative effects on activity patterns of dairy calves.

Key Words: heat stress, calves, behavior

0079 Factors associated with the occurrence of stillborn calves.

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The aim of this study was to determine the prevalence of stillborn calves in nulliparous and pluriparous cows in the Laguna region, as well as the effect of the type of delivery, duration of pregnancy, occurrence of dystocia, use of sexed semen and sex of calf on the occurrence of stillborn calves. The study was conducted in a large dairy operation in Laguna region (26° N). A data set of both pluriparous and nulliparous Holstein cows (2010–2014) were collected, with a total of 22,996 births. The data were statistically analyzed with descriptive methods for determining the percentage of stillborns. Odds ratios were calculated using logistic regressions (PROC LOGISTIC of SAS) for risk factors that affect the occurrence of stillborns. The results showed that gestations > 279 d decreased the occurrence of stillborns (odds ratio = 0.07, CI = 0.5–0.8; $P < 0.004$). Male calves were six times more likely (95%CI = 4.6–7.9; $P < 0.001$) to be stillborn than females. Calves with birth weight at calving ≥ 39 kg were less likely to be stillborn (odds ratio = 0.02, 95% CI = 0.1 to 0.2; $P < 0.001$) than lighter calves at birth. Calves derived from sexed semen breedings were twice as likely to be stillborn (95% CI = 1.6–2.7; $P < 0.001$) than calves from conventional semen. Calves coming from dystocic parturition were twice as likely (95% CI = 1.4–2.9; $P < 0.001$) to be stillborn than calves coming from normal deliveries. It was concluded that all variables studied importantly influence the occurrence of stillborns, particularly, sex of the offspring.

Key Words: stillbirth, calves, dystocia

0080 Reducing heat stress in calf hutches using reflective covers: Optical properties and implications.

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Previous research found that reflective hutch covers reduced ceiling, black globe, and air temperatures within polyethylene hutches, reduced panting, and tended to improve weight gain and calf health. This engineering study reports on the

Table 0080.

Table 1. Mean percent absorptivity (range) in the infrared and solar spectrums for the materials tested.

Material tested	Infrared	Solar
Commonly used calf hutch	50.4 (0.6)	83.8 (1.3)
Aluminized side white LDPE	9.3 (2.8)	16.3 (0.8)
White side of Al LDPE	60.1 (3.8)	38.6 (0.9)
Aluminized side black LDPE	9.7 (0.6)	19.8 (0.4)
Black side of Al LDPE	85.5 (1.5)	94.3 (0.0)

optical properties of materials that can be used to improve the comfort of calves housed in polyethylene calf hutches. The opaque materials were tested in the infrared and solar ranges to determine the efficiency of the surface to absorb radiation at the NASA Johnson Space Center's Thermal Design Branch, Materials Laboratory, in Houston, TX (NASA-JSC). A model was also developed by NASA-JSC to assess the relative impact of each material in terms of British Thermal Unit (BTU)/h. The price and longevity in on-farm testing indicated that a custom aluminized low-density 3-mil thick white and black polyethylene (LDPE) was the most promising material for optical testing. Samples were tested in triplicate (unless the first two tests were identical), and the results were averaged. The high absorptivity (83.8%) of solar radiation of the hutch (Table 1) indicates reflective coverings could be very useful in keeping calves cooler. The aluminized side of the white aluminized LDPE had a low solar absorptivity (16.3%), indicating it reflects 83.7% of the incident solar energy. The aluminized black LDPE has characteristics that indicate its potential to be useful during winter, with the aluminized side turned toward the calf. The NASA-JSC model found that the bare hutch absorbed 1959 BTU/h/m² while the aluminized white LDPE absorbed 893 BTU/h/m² at its surface, indicating its potential to reduce solar heating of the hutch. The black side of the aluminized black LDPE absorbed 5037 BTU/h/m², indicating potential to warm hutches during sunny days in the winter. The optical properties of the aluminized polyethylene helps explain the findings from prior hot weather trials and supports further research on its winter applications.

Key Words: calf, hutch, heat stress

0081 Sprinkler system in a holding pen: Behavioral responses of dairy cows during the subsequent grazing.

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Our objective was to evaluate the effects of cooling systems in a holding pen and its effects on the behavioral responses of pasture-based dairy cow. The experiment was performed

during February and March, 2014. Thirty-six black and white Holstein cows (BW = 527 ± 49 kg) were used in a crossover design (6 × 3). The cows were divided into groups of two animals ($n = 18$ groups) and each group was acclimated for 3 d following 6 d of data collection (2 d/treatment). The treatments used were: (1) control: no cooling, (2) sprinkler with media flow (MF): 0.08 L of water/nozzle/min, and (3) Sprinkler with high flow (HF): 1.00 L of water/nozzle/min. The sprinkler cycle included 30 s of water spraying and 60 s turned off. Cows were milked twice daily (0630 h and 1430 h) and treatments were applied during 20 min before each milking. After the milking routine, dairy cows were allowed to graze as a single herd. Environmental variables air temperature (AT), relative humidity (RH), black globe temperature (BGT), temperature humidity index (THI), and heat load (HLI) were recorded in a holding pen, in a pastured area and under the natural shade present at the grazed area. The dairy behavior (posture, location, and activity) was monitored from 0800 to 1230 h and from 1530 to 1800 h every 10 min. Panting score (PS) was evaluated each 15 min. The difference in water flow used in sprinkler systems reduced ($P < 0.01$) HLI and THI in a holding pen. However, sprinkler systems did not change behavioral patterns of dairy cows on pasture. The lowest PS average occurred at 0800 h (0.04) and highest at 15 h (0.75). PS was positively correlated ($\rho = 0.94$) with the THI under the shade, and it was negatively associated with the time spend on the paddock ($\rho = -0.63$). Cows were observed 50% of the time in rest activity, followed by grazing activity (25%), rumination (14%), other activities (9%), and drinking water (2%). The HLI was negatively correlated ($\rho = -0.82$) with the percentage of time spent on grazing. Cows spent 89% under natural shade during the hottest hours. The results demonstrate which evaporative cooling system used in a holding pen has immediate and short-term effect on dairy cows.

Key Words: welfare, evaporative cooling, pasture-based system

0082 Evaluation of alternative flooring surfaces

for dairy goats. M. A. Sutherland*, G. L. Lowe, C. M. Ross, D. Rapp, and G. A. Zobel, *AgResearch, Hamilton, New Zealand.*

In New Zealand, dairy goats are predominantly housed on sawdust; however, previous studies suggest that goats may prefer alternative surfaces. Therefore, the aim of this study was to evaluate the effect of four different flooring types on goat behavior and cleanliness. At 6 mo of age, 32 female Saanan cross does (45.4 ± 6.10 kg) were restricted to one of four different flooring types for 10 d, then restricted to the other three surfaces (10 d per surface) using a Latin square design consisting of eight replicates ($n = 4$ goats per replicate). The four flooring types included sawdust (SW), metal slats/grating (MT), plastic slats (PL), and rubber matting (RB). Goats were then given free access to all four flooring

types simultaneously for 48 h. Lying behavior and position in the pen were recorded for 24 h at the end of the free access period using camcorders and accelerometers. To assess goat cleanliness, swab samples were collected from the udder of two goats per replicate over the restriction period, and *Escherichia coli* counts were analyzed by the most probable number method. Data were analyzed by ANOVA and results are presented as least square means ± SE. At the end of the study, when given free access to all flooring types simultaneously, goats spent more ($P < 0.005$) time lying on RB (50 ± 4.5%) than PL (31 ± 4.5%), MT (8.6 ± 4.5%), or SW (9.7 ± 4.5%), and more ($P < 0.005$) time on PL than MT or SW. The same preference was shown for the standing surface ($P < 0.05$). The number of *E. coli* recovered from the udder was highest ($P < 0.001$) after goats were restricted on SW (median: 0.5 Log per cm²; range: 0.1–1.0 Log per cm²) than MT (median: 0.1 Log per cm²; range: 0–1.0 Log), PL (median: 0 per cm²; range: 0–0.2 Log per cm²) or RB (median: 0 per cm²; range: 0–2.1 Log per cm²). These results suggest that goats had a preference for lying on RB and least preferred lying on MT and SW. In addition, RB appeared to be cleaner than SW. Therefore, it may be advantageous to provide dairy goats with RB lying surfaces, but further investigation into implementing this into commercial dairy goat housing facilities is needed.

Key Words: bacteriology, behavior, welfare

0083 Risk factors associated with lameness severity

in feedlot cattle. S. Marti^{1,2}, E. D. Janzen¹, K. Orsel¹, M. J. Jelinski³, L. C. Dorin³, E. Pajor¹, J. K. Shearer⁴, S. T. Millman⁵, J. F. Coetzee⁶, D. U. Thomson⁷, and K. S. Schwartzkopf-Genswein^{*2}, ¹University of Calgary, Calgary, AB, Canada, ²Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, ³Veterinary Agri-Health Services, Airdrie, AB, Canada, ⁴Iowa State University, Ames, ⁵Department of Veterinary Diagnostic & Production Animal Medicine, Iowa State University, Ames, ⁶Pharmacology Analytical Support Team, Iowa State University College of Veterinary Medicine, Ames, ⁷Department of Diagnostic Medicine/Pathobiology, Kansas State University, Manhattan.

Lameness is of significant health, welfare, and economic concern in feedlot cattle. However, few studies have identified the risk factors associated with becoming lame or the severity of lameness. The objective of this study was to determine the relationship between animal, feedlot management, and environmental risk factors associated with lameness severity in feedlot cattle. Between 2013 and 2015, data on lame cattle was collected weekly from two large feedlots (>10,000 head) in Southern Alberta. Animal variables included sex, breed, days on feed (DOF), type of cattle, source, number of implants/vaccination, body weight (BW), body condition score (BCS),

rectal temperature, hide mud score, location of affected limb, salivary cortisol, and lameness diagnosis. Feedlot management variables included diet composition, frequency and time of feeding, pen and bunk space, group size, and location of the water. Finally, environmental variables included weather (minimum, maximum, average temperature, and temperature differential; relative humidity; THI, and precipitation), pen condition, pen mud depth, and season. Lameness severity was assessed in 1128 cattle using a five-point gait score: (1) Sound; (2) Mild: slightly abnormal gait and arches back when walking; (3) Moderate: stands and walks with arched back, head bob with short strides (4) Severe: (as described for score 3) with the addition of reduced weight bearing on affected limb and slow movement with frequent stops (5) Highly Severe: reluctant to move, bears no weight on affected limb. Animal, management and environmental risk factors were tested for collinearity and data were analyzed using a stepwise multiple logistic regression separately for each group of risk factors. Significant variables remaining in each model were combined and analyzed as described above. The F-to enter and F-to remove were set at 0.15 and 0.10, respectively. Animals lame in the fore limbs had greater ($P = 0.03$) lameness severity than those with hind limb lameness. Lameness severity increased ($P < 0.01$) by 0.4% for every 1 d increase in DOF. In addition, lameness severity increased ($P = 0.001$) with number of implants/vaccinations administered. Finally, cattle housed in pens with a mud depth greater than 5 cm had double ($P < 0.01$) the risk of becoming severely lame as those cattle housed in pens with a mud depth < 5 cm. To successfully reduce lameness in feedlots, interventions should be focused on reducing DOF, handling frequency and pen mud depth.

Key Words: lameness, beef, risk factors

0084 Assessment of acute pain during and after knife and band castration following a single dose of Meloxicam in 1-wk-old beef calves.

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Beef producers are often advised to castrate calves as early as possible to reduce pain associated with tissue damage. However, there has been no research to determine if 1-wk-old calves do not feel pain at the time of castration. The aim of this study was to assess the effects of a single dose of s.c. meloxicam (Metacam®, 0.5 mg/kg BW) immediately before castration on pain mitigation during and after castration in 1-wk-old beef calves. Seventy-two 1-wk-old Angus bull calves were randomly assigned to one of 6 treatments ($n = 12$): control (C), band (B), or surgical castration (S) without meloxicam; and control (CM), band (BM) or surgical castration (SM) with meloxicam. Data were collected on d -1

before castration, immediately before castration, 60, 90, 120 min and 1, 2, 3, and 7 d after castration, except for the visual analog score only obtained during castration. Physiological measures included salivary cortisol (SC), haptoglobin (HP), substance P (SP) and scrotal area temperature (SAT). Behavioral measures consisted of a visual analog score (VAS), hind limb stride length (SL) and daily lying and standing durations. None of the physiological or behavioral parameters assessed differed between calves castrated with or without pain medication. A time \times treatment interaction ($P = 0.02$) was observed for SC, S and B calves had greater SC concentrations 60 min after castration compared with C calves, while B calves had greater concentrations compared with C calves 90 min after castration. A time \times treatment interaction ($P = 0.01$) for SAT was observed; S calves had lower scrotal temperatures compared with C calves 60 min after castration, while S had lower temperatures compared with B, and S and B had lower temperatures compared with C 90 and 120 min after castration. A time \times treatment interaction ($P < 0.01$) was also found where B calves had lower temperatures compared with C and S 1, 2, 3, and 7 d after castration. The VAS was greater ($P < 0.001$) in S than B calves, and in S and B compared with C calves. As expected, knife and band castrated calves exhibited more signs of acute pain compared with noncastrated controls; however, results suggest that subcutaneous Meloxicam administered immediately before band or knife castration did not eliminate behavioral or physiological indicators of acute pain or discomfort in 1-wk-old calves.

Key Words: castration, acute pain, beef, calf, cortisol, behavior

0085 Effect of castration method and analgesia on inflammation and behavior in feedlot cattle.

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There is little agreement on the best castration method in feedlot cattle; a recent USDA survey reported 52.3 and 41.1% of bulls are surgically and band castrated, respectively, and analgesia may mitigate inflammatory pain associated with either method. Our objective was to determine the effect of castration timing (birth vs. feedlot entry), method (surgical vs. banding) and use of the analgesic meloxicam (MEL) on behavior and inflammation in feedlot cattle. This study was a randomized complete block design conducted over a 3-yr period. Single-source Angus \times Hereford steer ($n = 42$) and bull ($n = 152$) calves were randomized at birth to one of five treatments arranged as a $2 \times 2 + 1$ factorial: (1) steers castrated near birth (CON), (2) bulls surgically castrated without MEL (SUR), (3) bulls surgically castrated with MEL (SUR+MEL), (4) bulls band castrated without MEL (BAN), and (5) bulls

band castrated with MEL (BAN+MEL). Upon feedlot arrival (d-10), animals were blocked by initial BW (224 ± 4.5 kg) and assigned randomly to treatment pens ($n = 6$). Oral MEL was administered at 1 mg/kg BW concurrent with castration on d 0. Blood samples were collected from a subset of animals ($n = 5$ animals/pen) on d 0, 0.25, 1, 4, 7, and 14 to determine haptoglobin (Hp) concentration, as a proxy for inflammation. On d -10, accelerometers were placed on the same subset of cattle to determine baseline and postcastration changes in behavior indicative of pain; activity variables (standing, steps, lying bouts, motion index) were continuously logged and averaged by d. There was a treatment \times day interaction ($P = 0.04$), with SUR animals having the greatest ($P < 0.01$) concentration of Hp on d 1 and 4. Meloxicam administered during surgical castration reduced ($P = 0.01$) Hp concentration relative to SUR on d 1. Method of castration had contrasting effects on specific behavior variables. Relative to baseline, standing duration for surgical castration increased 113 min ($P < 0.01$), while banding caused 6.7 more lying bouts ($P < 0.01$) immediately following castration on d 0. Steps were increased on d 0 for banded (2723), intermediate for CON (2216), and least (1801 steps) for surgical ($P < 0.01$). Results suggest that MEL mitigated the more pronounced inflammation observed for surgical castration; whereas, behavior was differentially altered for castration method indicative of a divergent pain response.

Key Words: analgesia, beef cattle, castration

0086 A systematic review-meta-analysis of castration and welfare indicators in beef cattle.

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To quantify the effects of castration in male beef cattle on welfare indicators based on cortisol concentration, average daily gain (ADG) and vocalization, a systematic review and meta-analysis were performed. We searched on five electronic databases (CAB Abstracts, ISI Web of Science, PubMed, Agricola, and Scopus) from January 1900 to May 2015 and included conference proceedings and electronically contacted experts, and also checked references of relevant review papers. Inclusion criteria were complete studies using beef cattle until 1 yr of age undergoing castration that analyzed cortisol level, ADG, or vocalization. Data were extracted using predefined protocols. The included documents were written in English, Spanish, Portuguese, or Italian. Random effect meta-analyses were conducted for each indicator separately with the mean of control and treated group. Possible influences of study characteristics and quality were assessed in meta-regression analyses. A total of 18 prospective publications reporting 23 studies and 156 trials were included in the MA involving 1617 animals. Significant between studies heterogeneity was observed

for MA results when analyzing cortisol and ADG. Regardless the control group and the castration technique, the comparison analyses showed no changes ($P \geq 0.05$) changes on cortisol levels when castration was performed without drug administration. We found no evidence ($P \geq 0.05$) for multimodal therapy in decrease cortisol concentration 30 min after surgical procedure. Anesthesia tended to decrease cortisol level ($MD = 0.411$ nmol/L; $P = 0.077$; 95% CI: -0.868, 0.045) 120 min after surgical castration compared with castrated group without drug administration. Random-effect meta-analysis suggested an increase in ADG in surgical ($MD = 0.231$ g/d; $P = 0.010$; 95% CI: 0.056, 0.405) and nonsurgical castration ($MD = 0.883$ g/d; $P < 0.001$; 95% CI: 0.313, 1.453) with no pain mitigation in comparison to uncastrated cattle. Publication bias was observed when cortisol was studied as an outcome, indicating that small size studies reporting nonsignificant effect were less likely to be published than similar studies with significant effect. In a meta-regression, only publication type contributed to the total variation (18.52%) when the outcome evaluated was ADG. The vocalization score presented data in a manner that was not suitable to MA. Our MA study demonstrates an inconclusive result to draw recommendations on preferred castration practices to minimize pain in beef cattle.

Key Words: animal welfare, cattle, cortisol, pain, vocalization, weight

0087 Blocking the steer's view of people during restraint in a squeeze chute results in calmer behavior.

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The aim of this study was to evaluate if facility design influences cattle behavior. Two types of systems were compared: open sides (OP) or solid wall (SW). To meet the objectives of this study, cattle were assessed at nine feedyards, according to the BQA Feedyard Assessment (FA) guidelines for cattle handling in commercial feedlots. Each bovine was observed once during and after vaccination processing. Four-hundred steers, from five feedyards were observed in the OP design, and 380 steers, from four feedyards were observed in SW. The variables recorded were vocalization, miscaught (MH), exit gait (run, trot, or walk) and exit behavior (jump, stumble, and fall). The statistics model for analyses included two factors: facility design (SW \times OP), and feedyard. The SW design reduced vocalization ($P = 0.0003$) and had no effect for MH ($P = 0.3158$). From observed animals, respectively for OP and SW, 41.5% and 26.3% vocalized and 1.6% and 2.5% MH. There was effect on exit gait ($P < 0.001$) and on exit behavior

($P = 0.0008$). Steers processed in OP conditions exited faster than steers observed in the SW design, with 56.2 and 36.2% running and trotting for OP, and 23.2 and 66.9% running and trotting for SW, respectively. In conclusion, if the view of cattle is restricted during restraint, the frequency of vocalization will decrease, and exit speed will be reduced.

Key Words: cattle behavior, corral, feedyard

0088 Effect of different hydraulic squeeze chute and cattle breed on behavior of steer during restraining in feedyard facilities.

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The objective of this study was to investigate the relationship between hydraulic squeeze chute brand, breed of steers, and their behavior during processing in feedyard facilities. Two brands of hydraulic squeeze chute (A and B) and three breeds of cattle (Angus, Hereford and Continental cross) were compared. The assessments were made in 11 feedyards, totaling 1083 steers, using the BQA Feedyard Assessment (FA) guidelines for cattle handling in commercial feedlots. Each steer was observed once during and after the vaccination processing. Six feedyards had hydraulic squeeze chute (HSC) brand A (A) and eight feedyards had HSC brand B (B). The behavior variables of interest were vocalization, miscaught (MH), exit gait (run, trot or walk) and exit behavior (jump, stumble and fall). An effect of HSC brand on vocalization ($P < 0.0001$), exit gait ($P < 0.0001$) and exit behavior ($P < 0.0001$) was observed, but no effect on MH ($P = 0.52$) was observed. There was an effect of breed on vocalization ($P < 0.0001$), exit gait ($P < 0.001$) and exit behavior ($P < 0.0001$). The results for vocalization, run, trot, and jump were 25.8, 53.9, 40.4, and 14.4% for HSC A and 63.7, 42.5, 48.7, and 37.6% for HSC B, respectively. The results for vocalization, run, trot and jump were 15.1, 44.4, 47.5, and 29.4% for Angus; 2.7, 66.7, 28.8, and 17.8% for Hereford; and 22.2, 40.8, 50.7, and 31.8% for Continental cross, respectively. Brand of hydraulic squeeze chute and breed of cattle can influence the behavior of steers during and after restraining in feedyard facilities.

Key Words: breed, cattle behavior, feedyard, squeeze

0089 Movement and spatial proximity patterns of rangeland-raised Raramuri Criollo cow-calf pairs. S. Nyamurekung¹, A. Cibils¹, R. Estell^{*2}, A. Gonzalez², O. Roacho-Estrada³, and F. A. Rodríguez-Almeida³, ¹New Mexico State University, Las Cruces, ²Jornada Experimental Range, Las Cruces, NM, ³Universidad Autónoma de Chihuahua, Chihuahua, Mexico.

The objective of this study was to compare movement patterns of nursing vs. nonnursing mature cows and to characterize cow-calf proximity patterns in two herds of Raramuri Criollo cattle. Herds grazed rangeland pastures in southern New Mexico (4355 ha) and west-central Chihuahua, Mexico (633 ha). At each site, five nursing and four nonnursing adult cows weighing approximately 325 kg were fitted with Lotek 3300 LR GPS collars which recorded animal position at 10-min intervals for 25 d during March to April 2015. Nursing cows and their calves were also fitted with Sirtrack proximity loggers that recorded number and length of dam-calf contact events (≤ 3 m distance). All calves were ≤ 2 wk old at the onset of the study. Collared animals grazed with a herd of 30 and 68 adult cows at the NM and Chihuahua sites, respectively. Distance traveled and path sinuosity of cows and time spent by calves within 3 m of their dam and number of dam-calf contact events during day and nighttime hours were calculated. Movement data were subjected to ANOVA to determine effect of cow state (nursing vs. nonnursing) on distance traveled and path sinuosity. ANOVA was also used to determine if calves spent similar amounts of time within 3 m of their dam during day vs. nighttime hours. PROC MIXED (SAS 9.3) with a randomized complete block design was used for statistical analyses. No differences were detected in distance traveled by nursing and nonnursing cows over a 24-h period (8.43 vs. 8.56 ± 0.29 km; $P = 0.67$), daytime (5.47 km vs. 5.75 ± 0.24 km; $P = 0.24$), or nighttime hours (2.96 vs. 2.80 ± 0.15 km; $P = 0.32$). However, nighttime/daytime ratio of distance traveled was greater for nursing cows (0.62 vs. 0.55 ± 0.08 ; $P = 0.05$). Nursing cows exhibited more sinuous 24 h travel trajectories compared with nonnursing counterparts (0.13 vs. 0.18 ± 0.05 km; $P < 0.01$). Calves spent on average 66.9 ± 3.41 min/d within 3 m of their dam, distributed over 86.4 ± 3.7 proximity events/d. Minutes spent by calves within 3 m of their dam were not different for day vs. nighttime periods ($P = 0.07$); however, more contact events occurred during daytime hours (predawn = 13.8; AM = 26.1; PM = 22.0; postsunset = 24.5 ± 2.02 contact events). Physiological state of Criollo cows affected their movement patterns in large rangeland pastures.

Key Words: Raramuri Criollo, beef cattle, maternal behavior

0090 Effects of predation on cortisol and progesterone levels in gestating ewes. M. Ward^{*1}, A. F. Summers², S. Roscano¹, J. Beard¹, S. A. Soto-Navarro¹, and D. M. Hallford², ¹New Mexico State University, Las Cruces, ²Animal and Range Science Dep., New Mexico State University, Las Cruces.

Production losses due to predation in range livestock are typically quantified by death loss. However, little is understood concerning the long term impacts chronic exposure to predation may have on surviving animals. Pregnant Dorper and Suffolk × Hampshire ewes ($n = 40$) located on the main sheep unit of the NMSU campus farm were attacked by two dogs in February 2015. During the attack, four ewes were killed or had to be euthanized and five died later based on complications from injury. Over 75% of the remaining flock sustained injury. To better understand the impacts of predation on surviving animals, blood was collected via jugular venipuncture at 4, 24, 48, and 72 h post attack. Furthermore, a subset of ewes located at the west sheep unit, not exposed to the attack, were only bled at 4 h (CON). Ewes were classified based on injury status and location into three treatments; CON = no exposure, E = exposed to dog attack with no visible injuries, and EI = exposed to dog attack with visible injury. At 4 h, EI had greater cortisol levels than both CON and E ($P < 0.01$). At 24 h, both E and EI had greater circulating cortisol than CON ($P < 0.01$). At 72 h, EI was still greater than CON ($P < 0.01$); however, CON and E cortisol levels were similar ($P > 0.05$). The attack had no effect ($P > 0.05$) on circulating progesterone across treatments. These data demonstrate increased circulating concentrations of cortisol in ewes receiving injury 4 h after attack,

whereas blood cortisol concentrations were not greater than CON in the E group until the 24 h sampling. Although dog attack occurred approximately 2 wk before lambing, there was no difference in proportion of ewes experiencing dystocia ($P = 0.27$) or the level of dystocia ($P = 0.15$) based on a 3-point scale (0 = no complications, 1 = some complications, 2 = severe complications) for EI and E ewes. These data indicate exposure to predation impacts stress responses at similar levels as those injured. Additional information is needed to determine the length of time cortisol remains elevated within the two treatment groups and at which stage of gestation predation would negatively impact lambing success.

Key Words: sheep, livestock, cortisol

0091 Feeding and watering behavior of Nelore bulls fed with or without calcium, phosphorus and trace minerals supplemental sources. D. Zanetti^{*1}, L. A. Godoi², M. M. Estrada², F. A. S. Silva³, L. F. Prados², T. E. Engle⁴, and S. C. Valadares Filho⁵, ¹Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, ²Universidade Federal de Viçosa, Viçosa, Brazil, ³Universidade Federal de Vicos, Vicos, Brazil, ⁴Colorado State University, Fort Collins, ⁵Universidade Federal de Viçosa, Department of Animal Science, Viçosa, Minas Gerais, Brazil.

Forty-two Nelore beef bulls were utilized to investigate the impact of roughage source and mineral supplementation on feed and water intake. Basal diets were formulated with feeds commonly utilized in Brazilian feedlot diets, with or without

Table 0091.

Table 1 – Water and feeding behavior of Nelore bulls fed with or without calcium (Ca), phosphorus (P) and trace minerals (TM)

Item	Treatments						SEM	Contrasts			
	SH100 ¹	SH0 ²	SC100 ³	SC0 ⁴	CS100 ⁵	CS0 ⁶		A ⁷	B ⁸	C ⁹	D ¹⁰
<i>Feeding behavior</i>											
kg/d	7.68	7.56	7.55	7.67	7.47	7.32	0.30	0.7718	0.7844	0.7193	0.8315
min/d	97.61	96.79	95.95	91.80	98.58	85.96	6.37	0.9286	0.6481	0.1568	0.2626
# Visit/d	67.02	85.24	68.94	80.80	111.58	99.88	4.17	0.0038	0.0518	0.0478	0.0772
rate, kg/min	0.1629	0.1586	0.1571	0.1700	0.1871	0.2188	0.01	0.817	0.4889	0.0841	0.2104
rate, kg/# visit	0.2286	0.1814	0.2157	0.1957	0.1614	0.1850	0.01	0.0068	0.2315	0.1471	0.1305
min/visit	0.71	0.94	0.73	0.89	1.17	1.18	0.08	0.0589	0.1977	0.9215	0.0577
<i>Watering behavior</i>											
Total water	30.73	23.77	22.90	24.80	29.79	29.34	1.72	0.0069	0.4397	0.8477	0.1950
l/d	23.23	16.29	15.70	17.01	19.31	18.19	1.48	0.0022	0.5398	0.5868	0.0692
min/d	19.97	24.56	19.97	22.29	22.78	20.13	2.57	0.2155	0.5283	0.4573	0.4993
Visit/d	8.12	7.42	6.67	7.22	7.67	7.34	0.51	0.3412	0.4496	0.6418	0.7049
rate, l/min	1.26	0.72	0.89	0.76	1.00	0.94	0.14	0.0150	0.5262	0.7788	0.0504
rate, l/visit	2.90	2.24	2.41	2.40	2.59	2.49	0.22	0.0445	0.9748	0.733	0.1621
min/visit	2.49	3.44	2.99	3.18	3.02	2.72	0.38	0.0909	0.7277	0.5663	0.3789

¹Diet composed by sugarcane and concentrate based in soybean hulls, with supplementation of Ca, P and TM. ²Diet composed by sugarcane and concentrate based in soybean hulls, without supplementation of Ca, P and TM. ³Diet composed by sugarcane and concentrate based in soybean meal and grounded corn, with supplementation of Ca, P and TM. ⁴Diet composed by sugarcane and concentrate based in soybean meal and grounded corn, without supplementation of Ca, P and TM. ⁵Diet composed by corn silage and concentrate based in soybean meal and grounded corn, with supplementation of Ca, P and TM. ⁶Diet composed by corn silage and concentrate based in soybean meal and grounded corn, without supplementation of Ca, P and TM. ⁷A = SH100 versus SH0. ⁸B = SC100 versus SC0. ⁹C = CS100 versus CS0. ¹⁰D = (SH100, SC100 and CS100) versus (SH0, SC0 and CS0).

supplemental Ca, P, and trace minerals. Dietary treatments consisted of: (1) Sugarcane as the roughage source and a concentrate that consisted of soybean hulls with (SH100) and without (SH0) Ca, P, and TM supplementation; (2) Sugarcane as the roughage source and a concentrate base that contained soybean meal and ground corn with (SC100) and without (SC0) Ca, P, and TM supplementation; and (3) corn silage as the roughage source and a concentrate that contained soybean meal and ground corn with (CS100) and without (CS0) Ca, P, and TM supplementation. Supplemental minerals were formulated to meet or exceed the BR Corte (2010) requirements for Nellore bulls. Cattle were housed in a group pen for 125 d. The pen contained electronic feeders and waterers that allowed for individual animal consumption data to be collected. Comparisons between treatment means were made using orthogonal contrasts. The contrasts evaluated were: (A) SH100 vs. SH0; (B) SC100 vs. SC0; (C) CS100 vs. CS0; and (D) (SH100, SC100, and CS100) vs. (SH0, SC0 and CS0). Total DMI and time spent consuming feed (kg/min) were not affected by supplemental Ca, P, and TM. Cattle receiving supplemental minerals tended ($P < 0.08$) to have less visits to the feeder per day when compared with cattle not supplemented with minerals. Cattle consuming sugarcane based diets had more ($P < 0.05$) visits to the feeder per day than cattle consuming corn silage based diets, but DMI was similar across treatments. Cattle receiving diets containing soybean hulls with supplemental minerals consumed more water (total and liters/d) and liters per minute and per visit when compared with cattle receiving diets containing soybean hulls with no supplemental minerals. We concluded that, with absence of Ca, P, and TM in diet, the number of feeding times increased without affecting DMI, and water intake was reduced.

Key Words: corn silage, feeding rate, sugarcane

0092 Effects of ventilation and water misting on the physiological response of pigs kept in a stationary trailer before unloading. T. Pereira¹, N. Devillers², R. Somavilla³, R. Friendship⁴, F. Guay⁵, F. Dalla Costa⁶, E. A. Titto⁷, L. Faucitano^{*8}, ¹University of Sao Paulo, Pirassununga, Brazil, ²Agriculture & Agri-Food Canada, Sherbrooke, QC, Canada, ³Agriculture & Agrifood Canada, Sherbrooke, QC, Canada, ⁴Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada, ⁵Universite Laval, Quebec City, QC, Canada, ⁶Universida Estadual Paulista, Jaboticabal, Brazil, ⁷University of São Paulo, School of Animal Science and Food Engineering, Pirassununga, Brazil, ⁸Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada.

This study aimed at evaluating the effects of ventilation combined with water-misting on the physiological response of pigs kept in the truck during the waiting time before unloading at

the slaughter plant. In the summer 2015 ($19.7 \pm 4.0^\circ\text{C}$, ranging from 16.5 to 28.1°C), a total of 2674 pigs were transported from a farm to a slaughter plant (2 h trip) using two pot-belly trailers (seven loads of 191 pigs/trailer). On arrival at the plant, the two trailers were kept stationary during a 30 min waiting period before unloading. During this time, one of the two trailers was exposed to external forced ventilation and misting for 30 and 10 min, respectively, using a fan-mister bank located near the unloading dock, while the other trailer (control) was not exposed to any cooling procedure. A total of 168 pigs (24 per trailer) were equipped with a gastro-intestinal tract temperature (GTT) monitor (High Resolution ThermoChron iButton) for real-time recording of GTT data. Blood was collected from these pigs at exsanguination for the analysis of cortisol, lactate and creatine kinase concentrations, and hematocrit. Data were analyzed using the mixed model procedure of SAS. A probability level of $P \leq 0.05$ was chosen as the limit for statistical significance in all tests. A delta GTT (ΔGTT) was calculated as the difference between the measured GTT at a determined event and the GTT measured at rest. Except for the blood hematocrit level that was lower ($P < 0.05$) in pigs being exposed to the cooling procedure while waiting in the trailer, the cooling treatment had no effect on any blood parameter. At the end of the wait period and at unloading, the decrease of GTT was greater (higher- ΔGTT value; $P < 0.05$) in control pigs than in those exposed to the cooling treatment. This result may be explained by the greater heat loss of control pigs due to heat stress. Based on these results, the cooling method applied in this study appears to improve the thermal comfort and reduce dehydration in pigs kept in a stationary truck before unloading at the slaughter plant.

Key Words: pigs, transport, thermal comfort

0093 Increased intake of tannin-rich sainfoin (*Onobrychis viciifolia*) pellets by parasitized and nonparasitized sheep after a period of conditioning. M. Costes-Thiré^{*1}, J. J. Villalba², H. Hoste³, and C. Ginane⁴, ¹INRA Clermont-Ferrand/Theix, St Genès-Champanelle, France, ²USU- Utah State University, Logan, ³UMR 1225 INRA DGER, 23 Chemin des Capelles, Toulouse, France, ⁴Institut National de la Recherche Agronomique (INRA), St-Genès-Champanelle, France.

Individuals alter their behavior and phenotypic traits in response to environmental challenges. Recent studies suggest that parasitized herbivores are able to select tannin-containing plants with anthelmintic activity. The objective of this study was to determine whether parasitized sheep learn to prefer tannin-rich sainfoin pellets. Forty lambs (4 mo old) were randomly assigned to two groups ($n = 20$). The parasitized group (PG) was infected with 3000 L3 stage larvae of *Haemonchus contortus*, and the other group (nonparasitized; NP) was not infected. Animals were submitted to preference tests by

offering a free choice between sainfoin pellets with high (T+; 4%) or low (T-; 2%) concentration of condensed tannins during three periods of 4 d each: Initial (Test 1), after the group PG developed an infection (Test 2), and after conditioning, when all animals consumed just T+ for 21 d so that parasitized animals experienced the benefits of therapeutic doses of condensed tannins (Test 3). Preference ($[\text{intake of T+ or T-}] \times 100 / [\text{total intake}]$) and fecal egg counts (FEC) were analyzed as a repeated measures design with animals nested within group. The group PG showed a clear increase in FEC after infection (from 0 to 3512 ± 446.34 eggs per gram; $P < 0.05$), but no further increase was observed after animals received T+ during conditioning (3145 ± 401.44 eggs per gram; $P > 0.05$). During Tests 1 and 2 animals preferred T- (Test 1: PG = $71.0 \pm 3.9\%$; NP = $71.2 \pm 4.3\%$; Test 2: PG = $73.9 \pm 2.8\%$ NP = $74.7 \pm 2.7\%$; $P < 0.05$). However, preference reversed after conditioning (Test 3): Both groups, PG and NP, preferred T+ (PG = $61.0 \pm 3.9\%$; NP = $62.6 \pm 3.4\%$; $P < 0.05$). These results stand in contrast with previous studies using other types of antiparasitic condensed tannins (e.g., tannins extracted from the quebracho tree) with antinutritional properties. In such studies, only parasitized animals increase preference for a quebracho tannin-containing food relative to nonparasitized individuals. When condensed tannins do not exert negative postingestive effects on consumers, or even provide postingestive benefits (i.e., improved nitrogen utilization) like those observed in sainfoin, both parasitized and nonparasitized animals may display similar levels of acceptability to the tannin-rich feed. These results are consistent with a feed-forward mechanism in which endoparasitic loads are controlled by the frequent ingestion of safe bioactive-containing feeds which are typically preferred by consumers.

Key Words: diet selection, foraging, *Haemonchous contortus*

0094 Mitigation of variability in feeding patterns between competitively-fed dairy cows through increased feed delivery frequency.

ANIMAL BEHAVIOR AND WELL-BEING SYMPOSIUM: METRICS FOR ON-FARM ANIMAL WELFARE ASSESSMENT—CURRENT STATE AND FUTURE NEEDS

0095 Poultry welfare assessments: Where do we go from here. R. Blatchford*, *University of California, Davis.*

Recent attention has been given to developing welfare assessment tools for research purposes and for use directly on poultry

farms. Historically, most of these tools have relied on resource- and management-based measures, but it is unclear how well they correlate with outcomes indicative of positive animal welfare. The subjective nature of many of these tools also makes it difficult to generalize across studies and farms without extensive training. More recently, the European Union Welfare Quality® project set out to design assessment tools that were scientifically based and combined resource- and management-based measures with animal-based measures. Adding these measures was especially important for farm-level comparisons where farms may be utilizing different housing systems with inherent differences affecting the utility of resource- and management-based measures. The Welfare Quality® Assessment protocol for poultry offers researchers a tool that has been validated, tested for repeatability, and standardized across farms. This tool has been used in the United States and Canada both at the experimental and farm levels. However, assessment tools were only developed for layer-type hens and broiler chickens. There is a vast need for the development of assessment tools for other poultry species such as ducks, turkeys, quail, and game birds. Tools are continuing to be developed, but many have measures that need validation and benchmarking and creating tools that can be used by producers without needing training to use successfully is important on a go-forward basis. Tools must be designed for North American commercial production with a better understanding of the appropriate sample size, as well as their utility for use in alternative and extensive housing systems. These tools show promise in helping to understand the influence of genetics, housing design, and management factors on the welfare of poultry.

Key Words: assessment tools, poultry, welfare

0096 Metrics for beef cattle welfare. D. Griffin*, *Great Plains Veterinary Educational Center, Clay Center, NE.*

The “Five Freedoms” of livestock is an important concept in the stewardship of beef cattle. These are the backdrop for evaluating the beef cattle welfare husbandry guidelines. The beef cattle care, husbandry, and welfare guidelines for cow-calf, pastured stocker cattle and feeder cattle developed by the National Cattlemen’s Beef Association (NCBA) are reviewed. The Canadian and Australian feeder cattle care and welfare guidelines will also be reviewed and compared with the NCBA guidelines. A U.S. packer currently has developed and implemented a Feedlot Cattle Audit. Their audit will be reviewed and the unique items not included on other beef cattle welfare assessments will be discussed. Important differences between site assessments and site audits are listed, and the utility of each approach to improving beef cattle care and husbandry. The major areas included are development of SOPs for; safety of employees and cattle, employee training, living space design and management, feeding and feed stuff selection management (including water), cattle handling, health