
The objective was to evaluate feeding behavior, individual DMI and intake rate in dominant (DOM) and subordinate (SUB) pre-pubertal dairy heifers maintained under competitive situations. Holstein (n = 12) and Jersey × Holstein (n = 4) pre-pubertal heifers (250.8 ± 9.8 d old, 208.5 ± 13.9 kg; mean ± SEM) were allocated into 8 homogeneous dyads for 120 d (d 0 = beginning of measurements), and received a total mixed ration (TMR) on 1 feeder/day. The DOM and SUB heifers were determined by observation of the winner in agonistic interactions in each dyad after TMR supply. Behavioral activity of each heifer was recorded by instantaneous scan-sampling, every 10 min for 12 h (hour 0 = TMR), in 7 periods (corresponding to d 1, 21, 35, 60, 75, 100 and 120). Individual DOM was estimated with double marker technique, in 3 periods (I, II, and III corresponds to d 17–26, 78–87, and 112–120), while intake rate (DM/min) was calculated as DMI/eating time. Behavioral data were analyzed with PROC GLIMMIX, while DMI and intake rate were analyzed by PROC MIXED. During the first 5 h after feed delivery, DOM spent more time ruminating (12.2 ± 8.4%, DOM and SUB; SE = 1.2; P < 0.01) and lying (18.6 and 17.4%; SE = 2.7; P = 0.04) than SUB, but SUB spent more time standing than DOM (30.0 and 34.8%, DOM and SUB; SE = 2.4; P = 0.05). Along the 12 h of recording, DOM spent more time eating than SUB on hour 4 (32.1 and 26.6%; SE = 3.0; P = 0.05) and 6 (15.9 and 10.2%, SE = 3.6; P < 0.01). While on hour 1 (11.3 and 16.9%, SE = 3.6), 2 (21.6 and 28.7%; SE = 3.6) and 4 (44.6 and 51.6%; SE = 3.6) SUB spent more time standing than DOM heifers (P < 0.01). Dry matter intake was similar for DOM and SUB (6.7 and 6.9 kg/d, DOM and SUB; SE = 0.3; P > 0.05), but SUB ate at a faster rate (0.044 and 0.049 kg/min, DOM and SUB; SE = 0.003; P = 0.02) on Period II compared with DOM heifers. In conclusion, SUB had greater intake rate, with no differences on food intake, spent less time ruminating, and showed more behaviors probably associated with greater levels of social stress than DOM heifers.

Key Words: negative energy balance, sorting, behavior

139  Will dairy cows sort their diet in response to negative energy balance? S. M. Moore* and T. J. DeVries, Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada.

The objective of this study was to determine how feed sorting behavior of dairy cows is altered in response negative energy balance. Holstein cows (n = 30; DIM = 59 ± 5) were followed for 2 wk where they were fed (on a DM basis) a lactating diet (NEL = 1.66 Mcal/kg; 68% forage) and produced 44.6 ± 1.2 kg/d of milk. To induce negative energy balance, cows were then exposed for 3 wk to a TMR formulated for a 12% reduction in energy available for milk (NEL = 1.56 Mcal/kg; 73% forage). Blood samples were taken 1x/wk during the baseline period and every 4 d while on the treatment diet and analyzed for NEFA and BHB. TMR samples (fresh and orts) were collected every 3 d and separated into: long (>19 mm), medium (<19 mm, >8 mm), short (<8 mm, >4 mm), and fine (<4 mm) particles. Feed sorting was calculated as actual intake of each particle fraction expressed as a % of predicted intake. Data were analyzed in repeated measures, mixed-effect linear regression models. During the baseline period cow NEFA and BHB averaged 0.29 ± 0.04 mmol/L and 0.71 ± 0.08 mmol/L, respectively. During the experimental period, NEFA and BHB increased (P < 0.001) to 0.32 mmol/L and 1.00 mmol/L, on average, with a peak of NEFA (0.59 ± 0.06 mmol/L) and BHB (1.12 ± 0.11 mmol/L) occurring 4 d after dietary change. During the baseline period, cows sorted against long particles (95.3 ± 1.4%), did not sort medium particles (99.8 ± 0.2%), and sorted for short (101.1 ± 0.8%) and fine (101.8 ± 0.6%) particles. During the experimental period, cows increased (P = 0.008) sorting against long particles (92.2 ± 1.3%), continued to not sort medium particles (100.0 ± 0.1%), increased (P = 0.002) their sorting for short particles (102.1 ± 0.8%), and continued to sort for fine (102.5 ± 0.6%) particles. In the baseline period there was no association (P > 0.6) of feed sorting and blood NEFA levels. In the experimental period, higher NEFA levels were associated with greater sorting against long particles (% long sorting = −15.0 × NEFA(mmol/L) + 97.0; R² = 0.20; P = 0.01). Further, in that period higher NEFA levels were associated with greater sorting for short particles (% short sorting = 4.8 × NEFA(mmol/L) + 100.5; R² = 0.18; P = 0.02). The results indicate cows alter their feed sorting behavior in response to experience of a period of negative energy balance.

Key Words: negative energy balance, sorting, behavior

140  Dynamic feed delivery times of an automatic feeding system and the effects on feeding behavior of dairy cows. R. Oberschätzl-Kopp*, 1, B. Haidn*, 2, R. Peis2, K. Reiter2, and H. Bernhardt3, 1Lely Germany GmbH, Waldstetten, Germany, 2Bavarian State Research Center for Agriculture, Poing-Grub, Germany, 3Technical University of Munich, Freising, Germany.

Automatic feeding systems (AFS) are gaining importance due to rising demands on performance-related feeding and welfare of cows. Nevertheless, under practical conditions AFS are used with static settings for feeding times and frequencies without considering animal demands. Therefore, the objective of the study was to develop a dynamic way of feeding with an AFS concerning behavior of dairy cows and to analyze the effects of this feeding strategy on feeding behavior (frequency, duration, daily rhythm of visits at the feed bunk, meal criteria, frequency and duration of cows’ meals). 80 lactating dairy cows housed in a barn with an AFS and an automatic milking system were subjected to each of 2 treatment periods with 7: static (A) and dynamic (B) feeding times per day in winter and summer time (n = 6 d/period). During period A cows were fed at 815, 1115, 1400, 1600, 1945, 2315 and 345 h. A real time location system collected individual animal behavior. Based on real time process time of positioning data regarding cows’ duration of stay at the feed bunk, decisions were made about starting time of AFS feedings. A programmed algorithm using the median with boundaries time (60 s) and way (1 m) summarized positioning data. Meal criteria were calculated by fitting mixed models to observed frequency distribution of loge-interval lengths between feed bunk visits. Feedings in both trial periods in winter led to similar proportions of animals at the feed bunk, whereas cows stayed there longer (P = 0.003) in summer.
period B (5.42 ± 1.53 h/d). Meal criteria tended to be on a lower level during periods B, whereas there was a difference observed in summer investigation (39.74 ± 23.07 min vs. 32.63 ± 30.56 min, P = 0.02). Primiparous dairy cows showed slightly higher average duration of meals than multiparous cows during summer period B (1.03 ± 0.75 h vs. 0.93 ± 0.42 h). The results demonstrate that dynamization of feed delivery times by an AFS might be beneficial for an even distribution of feed bunk visits and meals, particularly in the summer time.

Key Words: automatic feeding system, dynamic feeding, animal behavior

142 Effect of a mechanical calf brush on the behavior and performance of recently weaned heifer calves. A. Velasquez*, D. Manriquez1, S. Paudyal1, G. Solano1, H. Han1, R. Callan2, J. Velez1, and P. Pinedo1, 1Department of Animal Sciences, College of Agricultural Sciences, Colorado State University, Fort Collins, CO, 2Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO, 3Aurora Organic Dairy, Boulder, CO.

Calf stress at weaning and after transfer to group pens is a concern in dairy farms. Favoring natural behaviors, such as grooming, may help to reduce this challenge. Our objective was to evaluate the effect of a mechanical brush on the performance and behavior of recently weaned calves. A paired comparison design with 2 treatment groups (control [CON, n = 81], treatment [TRT, n = 81]) was performed. Organic Holstein heifer calves (94 ± 7 d old) were each monitored for 3 wk. Four cohorts were enrolled sequentially considering one CON and one TRT group (1 brush/pen, n = 19–20 calves/pen). At enrolment, each calf was weighed and subject to a health evaluation. A 3-D accelerometer sensor was attached to the left ear. Continuous and excluding measurements (min/h) were generated for the following behaviors: Not-active, active, highly active, eating, and ruminating. Calf were weighted at the last day of the study. Data were summarized as daily averages (min/h). In addition, total monitoring time was divided in 4 periods of 5 d and analyzed as hourly averages (min). Data were examined using repeated measures analyses ANOVA, considering values by day or hour as the repeated measure. No difference was found in average daily weight gain between treatment groups. Significant differences were found for the interaction time and treatment group, indicating greater values for CON calves on the time spent not-active (22.8 ± 0.82 vs. 21.7 ± 0.82 min/h; P = 0.014) and lower values for the time eating (6.43 ± 0.40 vs. 7.01 ± 0.40 min/h; P = 0.01) during the 20 d in study. Hourly not-active time was greater for CON pens for Period 1 (18.3 ± 0.78 vs 17.9 ± 0.78 min/h; P < 0.001), Period 2 (24.7 ± 1.08 vs 22.8 ± 1.08 min/h; P = 0.01). Similarly, differences in favor of TRT group were found for time with high activity in Period 2 (10.3 ± 0.57 vs 10.0 ± 0.57 min/h; P < 0.001), Period 3 (9.7 ± 0.58 vs 9.1 ± 0.58 min/h; P = 0.049), and Period 4 (9.9 ± 0.58 vs 9.6 ± 0.61 min/h; P = 0.02). Differences in daily eating time were found for Period 1 in favor of CTR (8.3 ± 0.51 vs 8.0 ± 0.51; P < 0.001 min/h) and Period 2 in favor of TRT group (6.44 ± 0.54 vs 5.48 ± 0.54 min/h; P = 0.003). We conclude that the use of a mechanical brush throughout the days of group housing reduced inactive time, while increasing eating time.

Key Words: mechanical brush, grooming, behavior

144 A novel approach to estimate intake of lactating dairy cows through multiple on-cow accelerometer sensors. N. A. Carpinelli*, F. Rosa, R. C. B. Grassiotti, and J. S. Osorio, Dairy and Food Science Department, South Dakota State University, Brookings, SD.

Accurate prediction of intake of dairy cows will provide substantial improvements in herd health and management. Therefore, the objective was to evaluate the feasibility of using 3-dimensional accelerometer sensors for the estimation of individual intakes of lactating dairy cows. Twenty-four late-lactation Holstein dairy cows housed in a freestall barn were fitted with 3 sensors that record acceleration in the 3 axes (i.e., x, y, and z), one on the lateral side of the left hind leg and 2 attached to a halter directly superpose over the jaw and nose. Cows were assigned 2 groups, a data collection group (A; n = 12) and a validation group (B; n = 12). Cows were trained to use Calan gates during an adaptation period (7 d), and followed by 10 consecutive days of data collection of acceleration and individual intakes for both groups. Four cameras were used to continuously video record all cows, and eating times for each cow were generated. Sensors were set to record the 3D accelerations at 10-s intervals. Eating times and accelerometer data from group A was cross-reference based on date and time. Acceleration data corresponding to eating times and falling between the 1st and 3rd quartile was selected. The REG procedure of SAS 9.4 was used to regress the pre-selected acceleration data against the daily intake data for each cow to evaluate which accelerometer combination could account for most of the varia

Key Words: behavior, overstocking, heat stress

143 Short-term overstocking, heat stress, or combination on the welfare of lactating dairy cows. A. R. Lee*, G. M. Pighetti1, R. J. Grant2, J. L. Edwards1, and P. D. Krawczel1, 1University of Tennessee Knoxville, Knoxville, TN, 2William H. Miner Agricultural Research Institute, Chazy, NY.

Overstocking (OS) and heat stress (HS) are 2 primary management challenges impacting dairy cow welfare. The objective was to evaluate the effects of a single stressor, OS or HS, or concurrent dual stressors (OS and HS; OSHS) on behavior and milk production of lactating dairy cows. A 4 × 4 Latin square was implemented on 64 cows (parity and days in milk (DIM) ± SEM; 1.7 ± 0.1 and 129 ± 8, respectively) housed in sand freestalls and milked 2×/d during summer 2017. Each period included a 7 d acclimation and 7 d of data collection. Respiration rate (RR) was recorded at 16:00 ± 1 h ×/weekly and vaginal temperature (VT) was collected via blank CIDR and Ibutton (Embedded Data Systems, Lawrenburg, KY) on 6 cows/pen, to determine cows’ heat stress. Pen temperature humidity index (THI) was recorded during all periods. A subset of cows (n = 11/pen; parity and DIM ± SEM; 1.5 ± 0.8 and 122 ± 39, respectively) were equipped with accelerometers. The MIXED procedure (SAS 9.4, Cary NC) evaluated the fixed effects of DIM, parity, treatment, and THI on lying time, steps/d, milk production, and all 2-way interactions, blocked by pen and period. Manual backward elimination removed non-significant 2-way interactions, with all fixed effects remaining in the model, regardless of significance. Respiration rate was 14 to 16 breaths/min greater among HS and OSHS cows than non-HS cows (P < 0.001), and VT was equal between treatments (P ≥ 0.73). Elevated RR suggested cows experienced mild HS without modifying VT. Primiparous OSHS cows lay 51 and 71 min/d less than OS and HS cows, respectively (P < 0.003). Overstocked and OSHS cows took 186 and 193 more steps/d than cows exposed to no induced stressor (P < 0.002), suggesting more displacements and standing time among OS cows. Heat stressed and OSHS cows produced 1.7 ± 0.8 and 2.1 ± 0.8 kg/d (P < 0.001) less milk than non-HS cows. Despite short duration of treatments, behavior and milk production were influenced by individual stressors, with no greater effect on cows exposed to dual stressors. We hypothesize prolonged dual stressors may be more detrimental to animal behavior and production.

Key Words: behavior, overstocking, heat stress

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Validation of an ear-tag accelerometer to identify feeding and activity behaviors of tie-stall housed dairy cattle. A. Zambelis, T. Wolfe, and E. Vasseur*, Department of Animal Science, McGill University, Ste-Anne-de-Bellevue, QC, Canada.

The objective of this study was to validate the CowManager SensOor ear-tag accelerometer against visual observations of feeding, rumination, resting, and active behaviors in a tie-stall dairy facility. Prior validation of the sensor has been published for free-stall and grazing dairy herds, however the vast array of behavioral differences that exist among these and a tie-stall system necessitate additional validation. Lactating Holstein cows (n = 10) in different lactation stages and parities were included in the study at the McGill University Macdonald Campus Dairy Complex. Cows were monitored both visually and with the sensor for 10 h/d for 4 consecutive days (10 cows × 10 h × 4 d = 400 h of observation total). A single trained observer classified each minute of visual observation into 1 of 13 behaviors, and then summarized them into the 4 categories of eating, rumination, not active, or active. The sensor registered ear movements continuously and based on a proprietary model, converted them into the 5 behavioral categories of eating, rumination, not active, active, and high active. Multivariate mixed models were run to obtain covariance estimates, from which correlation coefficients were computed to assess agreement between observer and sensor data. The models included the percentage of each behavioral category per day as the dependent variable, and technology (observer versus sensor) and day as fixed effects. The models also included the random effects of technology, and the repeated effects of technology and day. The correlation strength between visual observation and sensor data varied from poor to almost perfect by behavior category (eating: r = 0.27; rumination: r = 0.69; total nutrition: r = 0.83; not active: r = 0.95; and active: r = 0.89). The results suggest that the sensor can be used to accurately monitor active and not active behaviors of tie-stall housed dairy cows. The results also suggest that while the sensor shows promise for identifying feeding behaviors in general, the independent classification of rumination and eating requires additional sensitivity.

Key Words: accelerometer, intake, sensor technology

146 The effect of two different indoor AMS loose-housing options and pasture-access on dairy cow step activity and time budget. E. Shepley*1, H. Leruste2, J. Lensink2, and E. Vasseur1, 1McGill University, Ste-Anne-de-Bellevue, QC, Canada, 2Yncréa Hauts de France, ISA Lille, Lille Cedex, France.

Dairy producers are moving away from tie-stall housing to loose-housing systems. However, gaps in knowledge on the effects of different indoor loose-housing systems exist, particularly regarding cow movement and activity opportunity. The study objectives were to determine (1) the effect of freestall vs. strawyard housing of dairy cows with AMS on step activity and time budget, and 2) whether activity was affected by pasture access. Twenty-four cows, balanced by DIM and parity, were randomly assigned to 6 groups and subjected to both a freestall (FS) and strawyard (SY) treatment for 1 wk each in a crossover design. Leg-mounted pedometers were used to obtain step activity and lying data. Time budget was assessed by instantaneous live scan sampling 2×/wk for 2 h/d. This design and procedure was repeated twice: at the end of winter housing and in the summer after 6 wk of pasturing. Correlations between step activity and pasture visits were done at the cow level and all other analyses were done at the group level using mixed models. There was no difference in step activity between housing types in winter or summer. In summer, number of visits to pasture was positively correlated with higher step activity in both the FS (r = 0.59) and SY (r = 0.59). There was no difference in lying time, but SY cows had more daily lying bouts during winter than FS cows (10.69 vs 9.23 bouts, P ≤ 0.05). Maintenance behaviors were not affected by housing treatment, but SY cows socialized more than FS cows in winter (1.7 vs 0.9%, P ≤ 0.05) and tended to exhibit more locomotor behaviors in summer (3.28 vs 1.58%, P = 0.06). Fewer environmental obstructions in the SY may have facilitated the expression of non-maintenance behaviors as well as ease of lying and rising, thus increasing lying bouts. Cows that were most active in both areas were also more likely to seek pasture access, suggesting that these cows had a greater motivation to move and may be more restricted by extensive indoor confinement. While SY had some benefits over FS housing, additional research is needed to find housing options that can meet cow movement and activity needs.

Key Words: housing, movement opportunity