Production, Management, and Environment I


Study objectives were to determine whether electric heat blanket (EHB)-induced hyperthermia affects body temperature indices and production parameters similar to those generated in climate-controlled chambers. Multiparous Holstein cows (27) were subjected to 2 experimental periods (P): During P1 (4 d), cows were in thermoneutral conditions with ad libitum feed intake. During P2 (4 d), cows were assigned to 1 of 2 treatments: (1) thermoneutral conditions and pair-fed (PF; n = 8), (2) heat stress induced artificially by an EHB (Thermotex Therapy Systems Ltd. Calgary, Canada), with ad libitum feed intake (n = 19). Overall, the EHB markedly increased rectal temperature, vaginal temperature, skin temperature, respiration rate, and heart rate (1.3°C, 1.4°C, 1.1°C, 2-fold, and 15 bpm, respectively; P < 0.01) relative to PF cows. The EHB reduced DMI by 45% and by design PF cows had similar pattern of decreased DMI. Milk yield decreased in EHB and PF cows by 22.4% (9.8 kg) and 10.4% (4.2 kg), respectively (P = 0.03), indicating that reduced DMI accounted for only ~50% of decreased milk yield. Relative to PF cows, MUN increased (20.4%; P < 0.01) in EHB cows; however, no other differences were observed in milk composition between treatments. The EHB decreased blood total CO₂, partial CO₂, HCO₃⁻, and base excess levels (15, 13, 15, and 78%, respectively; P < 0.01) when compared with PF group. The EHB increased hemocrit and hemoglobin (both indicators of dehydration) by (9%; P < 0.01) compared with PF cows. A treatment by day interaction was detected for plasma NEFA levels; as they progressively increased in PF controls but remained unchanged in EHB cows (P < 0.01). BUN and BHBA increased in EHB cows (31 and 83%, respectively; P < 0.01) relative to PF controls. No differences in circulating glucose were observed; however, insulin levels tended to increase (74%; P = 0.07) in the EHB cows compared with PF controls. In summary, employing the EHB increased body temperature indices, reduced productivity, and altered metabolism similar to climate controlled chamber studies.

Key Words: milk, environment, cooling


Dry period heat stress impairs dairy cows’ subsequent lactation performance. We hypothesize that exposure of late-gestation dams to dry period heat stress also exerts transgenerational effects on their daughters’ and granddaughters’ productivity. We tested this hypothesis using lactation records from previous experiments conducted during 9 summers at the University of Florida (2007–2012, 2014, 2016, and 2017, THI >68 for all years). A total of 154 multiparous dams were provided active cooling (HTF₀ shade, fans and soakers, n = 75) or shade only (HT₁₀, n = 79) during a 46 d dry period. Milk yield, fat and protein records (Afimilk Ltd.) of the dams, daughters (CL₁₁ n = 64, HT₁₁ n = 44) and granddaughters (CL₂₂ n = 24, HT₂₂ n = 13) of those dams were used to estimate ECM from calving to 35 wk in milk (WIM) for 2 consecutive lactations. Data were analyzed using mix models in SAS with WIM as repeated measure and dam within treatment as random effect. Dry HT₁₀ dams produced 2.3 kg less milk/d in their subsequent lactation than dry CL₁₁ dams [ECM: 34.2 vs. 36.5 ± 0.07 kg, P < 0.01]. Daughters born to HT₁₀ dams, who experienced heat conditions through the intrauterine environment, produced 3.7 kg less milk/d during their first lactation [ECM: 28.6 vs. 32.3 ± 0.08 kg for HT₁₁ and CL₁₁, respectively; P < 0.01], and 3.4 kg/d less during their second lactation [ECM: 33.2 vs. 36.6 ± 0.13 kg, WIM by treatment interaction; P < 0.01], compared with those born to CL₁₁ dams. Similarly, the granddaughters of HT₁₁ dams, born to HT₁₁, produced 3.7 kg less milk/d during their first lactation [ECM: 28.5 vs. 32.2 ± 0.13 kg for HT₂₂ and CL₂₂, respectively; P < 0.01] and 6.5 kg/d less in their second lactation [ECM: 34.0 vs. 40.5 ± 0.21 kg, WIM by treatment interaction, P < 0.01] compared with granddaughters of CL₁₁ dams born to CL₁₁. Dry period heat stress not only impairs dam’s subsequent lactation but also has carryover effects on the productivity of daughters and granddaughters 2 generations later. Dry-period cooling is crucial to rescue milk loss of the dam, but also to prevent milk losses of their daughters and the granddaughters.

Key Words: milk, environment, cooling

92  Relationship between environments, vaginal temperature, and behaviors of lactating cows on pasture. T. N. Marins*, R. M. Orellana, J. K. Bernard, and S. Tao, University of Georgia, Tifton, GA.

Understanding environmental impacts on physiology and behavior is critical to improve animal welfare and performance. Our objective was to identify correlations between environments, vaginal temperature (VT) and behaviors of grazing lactating dairy cows on pasture during summer. Lactating cows (n = 119, 29–30/farm) from 4 farms were randomly enrolled. Each farm had different milking schedules and cooling facilities in holding pens and feedlots. Pivots equipped for evaporative cooling were provided during day but not night on all farms. The VT was recorded every 5 min. Times of lying and standing were recorded every 15 min using Smarttag Leg (Nedap) for 6 consecutive days. Meteorological variables were measured on pasture, and temperature humidity index (THI) calculated. Data were averaged or summed every 30 min and only the data collected between milkings (on pasture during day and night, Table 1) were used for correlation analyses by PROC GLM procedure of SAS 9.4. At day, VT had strongest correlation with dry bulb temperature (= 36.79+0.08 × dry bulb temperature, r² = 0.168, P < 0.001), but lying time (= 28.21–0.58 × black globe temperature, r² = 0.172, P < 0.001) had strongest correlations with black globe temperature. At night, VT had the strongest correlation with dry bulb temperature, but black globe temperature explained more of the variation of lying and standing times. At night, THI is a better variable to predict VT, and lying and standing times had strongest correlations with dry bulb temperature. In conclusion, at day under pivots, VT had the strongest correlation with dry bulb temperature, but black globe temperature explained more of the variation of lying and standing times. At night, THI is a better variable to predict VT, and lying and standing times had strongest correlations with dry bulb temperature.
93 Differential gene expression in the rumen epithelium of heat stressed Holstein heifers. A. Bedford*1, L. Beckett1, T. T. Yohe1, L. Harthan1, C. Wang1, N. Jiang1, H. Schramm2, M. Hanigan3, K. M. Daniels1, and R. R. White1, 1Virginia Tech, Blacksburg, VA, 2Virginia-Maryland College of Veterinary Medicine, Blacksburg, VA.

Heat stressed cattle have depressed feed intake. However, performance reductions observed during heat stress are greater than could be expected from depressed intake alone. This disparity suggests that digestive, absorptive, or post-absorptive shifts in physiology may also influence the degree to which animals respond to heat stress. Our objective was to investigate the effect of heat stress on the expression of genes in the rumen epithelium associated with the transport and metabolism of volatile fatty acids (VFA), testing the hypothesis that absorptive function of the epithelium is impaired by heat stress. Eight ruminally cannulated Holstein heifers (200 kg) were used in a factorial, repeated measures experiment with 2 treatments and 2 periods. During the first period, animals were provided feed ad libitum and housed at 20°C. During the second period, one group (HS) was housed at 30°C and fed ad libitum. The other group (PF) was housed at 20°C and pair-fed to match the intake of heifers in the HS group. During each period, animals were exposed to the heat or intake treatment for 9 d and the 10th d of each period was used for papillae biopsy sample collection. During the second period, indicators of heat stress including feed intake, respiration rate, heart rate, and body temperature were significantly different between PF and HS animals (P < 0.05). There was a significant feed intake effect on BHD1 expression (P = 0.04), and a tendency for a heat stress effect (P = 0.08), with expression increasing in both cases. This data indicates increased β-hydroxybutyrate production. Differential expression of epithelial transporters responsible for VFA uptake into the epithelium (MCT4 and NH3), and transport into the blood (NHE1 and NHE2) was observed. Expression of MCT4 was significantly affected by feed intake (P = 0.003) as were all NHE genes (NHE1, NHE2, and NHE3; P < 0.05). These results indicate that both heat stress and feed intake can affect gene expression in the rumen epithelium. With low feed intake, the epithelium appears to increase capacity for VFA absorption and transport. However, during heat stress, it appears that butyrate metabolism and transport capacity is decreased.

Key Words: vaginal temperature, behavior, grazing

94 Relationship between the accumulative effects of heat stress and Holstein dairy cows’ milk performances in eastern Canada. V. Ouellet*1, V. E. Cabrera2, L. Fadul-Pacheco3,4, P. Grenier5, and É. Charbonneau1, 1Département des sciences animales, Université Laval, Québec, QC, Canada, 2Department of dairy science, University of Wisconsin, Madison, WI, 3Valacta, Saint-Anne-de-Bellevue, QC, Canada, 4Department of Animal Science, McGill University, Saint-Anne-de-Bellevue, QC, Canada, 5Consortium Ouranos, Montréal, QC, Canada.

Heat stress (HS) is known to cause a strain on performances in dairy cows that experience high temperatures and humidity for long periods throughout the year. However, research on its consequences on dairy cows’ production performances in colder areas of the globe is limited. Our objective was to examine the relation between the accumulative effects of HS and daily milk, fat, and protein yields (kg/d), and milk composition (%) in Holstein dairy cows located in eastern Canada. The initial data set used in this study comprised 606,031 test-day (TD) records from 16,446 Holstein dairy cows of different lactations (2.7 ± 1.7). Weather data (2010–2015) were retrieved from the closest meteorological stations. Daily maximum temperature-humidity index (THI_max) was calculated using maximum ambient daily temperature and average relative humidity and merged with corresponding TD. This was also done for the 7 d before TD. The accumulative effects of HS were evaluated by calculating the number of consecutive d with a THI_max > 65. Number of consecutive days were then grouped in categories: 0 = 0 d with HS; 1 = 1 or 2 d; 2 = 3 or 4 d; 3 = 5 or 6 d; 4 = 7 or 8 d with HS. Effects of the categories on TD milk production and composition were assessed using the HPMIXED procedure of SAS. Fixed effects included in the model were DIM, exp DIM (calculated as e^{0.05(DIM)}), genetic value, and categories of consecutive d with HS. Random effects were year(herd), calving month × year(herd), the calving month × year(herd × cow). Cows subjected to more consecutive days with HS had lower (P < 0.05) ECM, fat, and protein yields, and fat, and protein concentration in milk compared with cows subjected to conditions not susceptible to induce HS. The cows most impacted by HS were of third lactation and higher, with declines of 4.1 and 2.9% of fat and protein yields and 6.5 and 4.0% of fat, and protein concentration in milk between category 0 and 4. Establishing actual effects of HS on dairy cows’ milk performances in cooler climates may help producers to better adapt to climate change and to develop appropriate management countermeasures.

Key Words: dairy cow, temperature-humidity index, heat stress

95 Effects of fully acidified close-up diets and dietary calcium content on production and milk composition of transition dairy cows. K. M. Glosson*1, X. Zhang2, S. S. Bascom3, A. D. Rowson3, and J. K. Drackley1, 1University of Illinois, Department of Animal Sciences, Urbana, IL, 2Institute of Animal Nutrition, Key Laboratory of Low Carbon Culture and Safety Production in Cattle in Sichuan, Sichuan Agricultural University, Dept. of Dairy Science, Chengdu, Sichuan, China, 3Phibro Animal Health Corp., Teaneck, NJ.

Dry cow dietary strategies of decreasing dietary Ca and using acidogenic diets with a negative dietary cation-anion difference (DCAD) vary in effectiveness to reduce subclinical hypocalcemia (SCH). The objective of this study was to determine the effects of 3 dietary strategies for close-up dry cows on dry matter intake (DMI) and production in multiparous Holstein cows (n = 81). Cows were assigned to 1 of 3 treatments during the close-up dry period (∼28 d to calving): (1) a positive DCAD diet with low dietary Ca (0.4% DM; CON); (2) a fully acidified DCAD diet (urine pH 5.7) with low dietary Ca (0.4% DM; LOW); or (3) a fully acidified DCAD diet (urine pH 5.7) with high dietary Ca (2.0% DM; HIGH). The DCAD was decreased by addition of a commercial anionic product (Animate; Phibro Animal Health) and Ca was increased by adding CaCO3. All cows were fed CON during the far-off dry cow period (∼50 to ∼28 d) and then all groups were fed the same lactation diet postpartum. Cows were milked 3x/d and production was summarized by week. Intake was recorded daily and DMI was calculated.
Dairy composition (3 consecutive milkings) was determined once weekly during the fresh period. The MIXED procedure in SAS was used to contrast: 1) CON vs the average of LOW and HIGH; and 2) LOW vs HIGH. Cows receiving CON had greater close-up DMI (P < 0.01). After calving, cows fed LOW or HIGH had greater DMI (18.9 and 19.5 kg/d) and greater milk yield (44.6 and 45.2 kg/d) when compared with cows fed CON (17.0, P < 0.01 and 42.0 kg/d, P < 0.05, respectively). Cows given CON had a greater milk fat percentage (P < 0.01), but protein (%) and component production (kg/d) did not differ among treatments (P > 0.10). Milk fat and protein were used to calculate the fat to protein ratio (FPR), which indicates subclinical ketosis (SCK) when above 1.4. Cows given CON had a higher FPR (1.57) than those given LOW or HIGH (1.36 and 1.28), while cows given LOW or HIGH had greater postpartum DMI and milk yield. Prepartum dietary Ca did not affect these variables in cows fed a negative DCAD close-up diet.

Key Words: fully acidified close up diet, production, calcium

96 Determining the change in body weight per unit of body condition score in Holstein cows. R. A. de Souza* and M. Vande-Haar, Michigan State University, East Lansing, MI.

Our goal was to quantify the change in BW (ABW) per change in body condition score (ΔBCS). Our database had 69 studies of 2,181 Holstein cows (75 to 263 DIM) with weekly records of BW, BCS, and DMI. The average interval between consecutive BCS for each animal was 38 d. Means and standard deviations were 644 ± 83 kg BW, 3.1 ± 0.4 BCS, and 25 ± 4 kg DMI with 12 ± 22 ΔBW, 0.07 ± 0.18 ΔBCS, and 0.0 ± 2.6 ΔDMI for the period. Using HPMIIXED from SAS 9.4, a mixed regression with random effects of animal, study, and location and fixed effects (as described next) was fitted to determine the ΔBW per ΔBCS. To determine the best model to predict ΔBW, we developed 4 candidate models with 2 levels of complexity for fixed effects with and without effects of parity. A simple model contained only linear effects of initial BCS, initial BW, ΔDMI, and ΔBCS, whereas a complex model also included 2-way interactions of all main effects and quadratic and cubic polynomials. Cross-validation across study was used to select the best fitting model based on concordance correlation coefficient (CCC), root mean square error of prediction (RMSEP). Parity was highly significant but had little impact on CCC and RMSEP. Model complexity also had little impact on CCC but the simple models had lowest RMSEP. The interaction of ΔBCS with initial BCS was not significant (P = 0.8), so we conclude that ΔBW per ΔBCS does not depend on starting BCS. Our proposed model is ABW = −17 + 0.042 × BW + 2.7 × ΔDMI + 54 × ΔBCS + PARITYi (CCC = 0.77, RMSEP = 20), where PARITYi of 1, 2, and 3 or more, adds 0, −3.6, and −5.9, respectively. With this equation, a 1-unit ΔBCS is associated with ΔBW of 54 kg, which equals 8.4% of live BW or 9% of empty BW (assuming gut fill is 5.2 x DMI). Using the proposed model is ΔBW = −17 + 0.042 × BW + 2.7 × ΔDMI + 54 × ΔBCS + PARITYi, so

Key Words: automated estrus detection, grazing, low-input dairy

98 Evaluation of G7G-Ovsynch protocol with or without heat detection and milk pregnancy-associated glycoproteins as non-invasive pregnancy diagnosis method. A. H. Shahzad*,1, A. Abbas2, R. S. Baloch3, I. Khan1, and S. Abbas1, 1University of Veterinary and Animal Sciences, Lahore, Lahore, Punjab, Pakistan, 2Livestock and Dairy Development, Punjab, Lahore, Punjab, Pakistan.

Important components of reproductive efficiency are, in dairy industry, fertility and early pregnancy diagnosis on global level. The objectives of the present study were to appraise the G7G-Ovsynch protocol in postpartum Holstein cattle with or without Estretect heat detector and to evaluate ELISA-based milk pregnancy-associated glycoproteins (PAG), optical density (OD), as a non-invasive method of pregnancy diagnosis (PD). A total of 178 multiparous postpartum cows were divided either in (1) G7G-Ovsynch-FTAI (n = 88) or (2) G7G-Ovsynch-AIDE (n = 90). Pregnancy was observed on d 30, PAI via ultrasonography (US), P4 and PAGs while on d 60, 90 with US. Pregnancy rate (PR) was compared by chi-squared. Milk PAGs and plasma P4 conc. were analyzed using REG procedures of SAS (P < 0.05). The PR on all 3 timelines was 49% (43/88) versus 55.60% (50/90); (P = 0.30) on d30, 44% (39/88) versus 49% (44/90); (P = 0.54) on d60 and 43% (38/88) versus 47% (42/90); (P = 0.70) on d90 PAI in G7G-Ovsynch-FTAI and G7G-Ovsynch-AIDE groups respectively. Pregnancy loss (PL) was 9% (4/43) in G7G-Ovsynch-FTAI versus 12% (6/50) and 5% (2/44) on d 60 (P = 0.70) and 90 (P = 0.66) in G7G-Ovsynch-AIDE group respectively. Overall PL on d90 PAI was 12 versus 16% in G7G-Ovsynch-FTAI and G7G-Ovsynch-AIDE groups respectively. The OD of milk PAGs (n = 16) was, mean ± SEM, 0.75 ± 0.08 on d30 PAI. Duplicate aliquot of milk samples that were stored at 4°C, resulted in slight reduction of OD (0.55 ± 0.057) after 60 d of storage period. P4 profile (ng/mL; mean ± SEM) was measured (n = 16) by RIA and was 6.0 ± 0.31 on d30, 6.68
Factors associated with low colostrum yield in Jersey cattle.
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Some US dairy herds have reported seasonal low to no colostrum production. However, little information regarding this problem exists. The purpose of this study was to describe the phenomenon and identify potential risk factors. A 2,500-cow commercial Jersey dairy farm was enrolled. Cow information on parity, previous lactation length, previous 305ME milk production, and dry period length were collected from the farm’s dairy management software. First-milking colostrum weight and calf information were recorded just after calving. Over a year of enrollment, 1,845 cows and 1,143 heifers (38\%) calved with colostrum weights recorded. Average colostrum yield differed across the year; 6.6 ± 3.2 kg per cow in June 2016, 2.5 ± 2.4 kg in December 2016, and 4.8 ± 3.2 kg in May 2017 (P < 0.01). Multiparous cows had a larger decline in colostrum production June to December (6.6 ± 3.2 kg to 1.3 ± 1.6 kg) compared with primiparous animals (6.5 ± 3.2 to 4.2 ± 2.3 kg per cow) (P < 0.001). Average colostrum production decreased by 0.17 kg per cow per week during this time, 0.22 kg for multiparous and 0.08 kg for primiparous cows (P < 0.01). A multivariate logistic regression model was constructed for multiparous cows only for the probability of low colostrum yield (<2.7 kg at first milking). Dry period length, calf sex, singleton or twin, age at freshening, month of calving and previous lactation length were associated with low colostrum yield (P < 0.05). Pedigree analysis for cows calving October 23, 2016 through January 21, 2017, showed that extremes of colostrum production followed some sire lines: low (<0.45 kg; n = 102) and high (>5.44 kg; n = 112) yield. Using a single-factor ANOVA, colostrum weight for offspring were different between sire lines (P = 0.0002). A cross-correlation function analysis between the time series for colostrum yield and photoperiod revealed a high correlation (0.91 ± 0.13) at the time of calving and one month prior (0.84 ± 0.14) for multiparous cows, higher correlations than for primiparous cows (0.53 ± 0.13 and 0.48 ± 0.14, respectively). These data indicate that photoperiod, in some cow families, may be involved with seasonal low colostrum production in Jersey cows.

Key Words: postpartum Holstein cow, G7G-Ovsynch, milk pregnancy-associated glycoproteins (PAG)

100 Improving nutritional accuracy and economics through multiple ration-grouping strategy. J. A. Barrientos Blanco\textsuperscript{*}, V. Cabrera, and R. D. Shaver, University of Wisconsin Madison, Madison, WI.

Study objective was to evaluate implementation of nutritional grouping strategy (NGS) to improve nutritional accuracy and reduce feed costs for lactating cows 148 ± 65 DIM. A 2,500-cow Wisconsin commercial dairy farm was used in the study. Three months (June–August 2017) of data, including individual cow reproductive and productive performances, were used to simulate NGS. Three pens (450 cows total) of multiparous cows currently grouped in 3 pens indiscriminately, were regrouped using k-mean algorithm based on their net energy (NE) and metabolizable protein (MP) requirements. An equation was developed to calculate a diet accuracy index (DAI = [(Nutrient requirement/pen DMI) – (nutrient requirement/required DMI)]) utilized to assess and compare nutritional accuracy of feeding cows clustered by NGS to the farm grouping strategy (FGS). The lower the DAI value, the more accurate the diet. Minimum least squares algorithm (L2 - norm) was used to calculate the most representative NE and MP requirements per pen from NGS. These NE and MP requirement values where utilized to formulate diets using the same recipe and equal or lower cost than the current farm diet. Supplied NE, MP by the diets, DAI and cost per pen at the farm, were compared with the simulated pens using NGS. Results from the simulation suggest that NGS increases diet accuracy for supply of NE and MP per pen (see Table 1). DAI values were lower for NGS in both NE and MP. Total cost of 3 mo of feeding lactating cows using FGS was $51,894, whereas it was $43,041 for NGS; $8,943 diet cost savings.

Implementing NGS in groups of lactating cows has potential to increase nutritional accuracy of diets and savings through decreased diet costs.

Key Words: colostrum production, photoperiod, pedigree analysis