
Pre- and postnatal heat stress alters dairy calf thermoregulation and growth, but less is known about behavior. Herein, we characterized feed intake, activity patterns and cognitive function in dairy calves exposed to prenatal and/or postnatal heat stress. Holstein calves (n = 48) born to late-gestation heat-stressed or cooled dams (prenatal HT vs. CL; shade of barn vs. shade, fans, and soakers; –46 d; THI >78) were exposed to heat stress or cooling postnatally (prenatal HT vs. CL; shade of barn vs. shade and fans; 56 d; THI >68), resulting in 4 treatments: HTHT, HTCL, CLHT, and CLCL; n = 12/treatment. At 2 d of age, calves were allotted 10 L/d of milk replacer (MR) ad libitum via automatic feeders (8 pens, n = 6 calves/pen where n = 3 calves/prenatal treatment/pen). A 1-d stepdown weaning started at 42 d. Intake was analyzed in daily intervals [0000–0700 (INT1), 0700–1300 (INT2), 1300–1900 (INT3), and 1900–2400 h (INT4)], and intake speed and feeder visits were averaged weekly. Calf activity was recorded (d2–56) via electronic leg-based accelerometers. At 35 d, a procedural learning task in a T-maze was used to assess initial and reversal learning (i.e., participation, number of sessions to pass task). Data were analyzed by PROC MIXED in SAS where calf was experimental unit. Postnatal HT calves consumed less MR relative to postnatal CL calves during INT2, and HTHT calves consumed less MR than CLCL calves during INT3 (P < 0.01). Prenatal HT drank MR slower relative to prenatal CL calves at 14 d (P < 0.01). Postnatal HT calves had fewer unrewarded visits (P < 0.01). Prenatal HT calves spent more time standing relative to prenatal CL calves (421 vs 389 ± 4 min; P < 0.01). There was a prenatal x postnatal interaction (P ≤ 0.05) whereby CLHT calves had more standing bouts and decreased standing duration relative to other groups. More prenatal HT calves refused to drink MR in the T-maze task compared with prenatal CL calves (71 vs 100% participation; P = 0.04). Of calves that participated, the number of sessions to pass each learning stage did not differ (P ≥ 0.15). Heat stress either pre- or postnatally impacts calf activity and feeding behavior with potential negative implications on welfare.

Key Words: activity, intake

A yearlong study: Effects of weather and animal characteristics on respiration rate in dairy cattle. G. Tresoldi*1,2, M. Hejazi1, and C. B. Tucker1, 1College of Agriculture, California State University, Chico, CA, 2Center for Animal Welfare, Department of Animal Science, University of California, Davis, CA.

Respiration rate (RR) is often used to assess heat stress in cattle at earlier stages. However, it is unclear which RR thresholds indicate that cattle are hot. Throughout a year, we recorded weather variables and RR of 406 females (newborns to 6th lactation cows) totaling 11,210 records. Our goal was to determine which weather variable or thermal index best predicted RR. It accounted for 35% of the observed RR variation. During observations, AT ranged from 1.8 to 43.9°C. Our findings suggest that RR < 40 breaths/min, a threshold often considered the upper normal limit in veterinary textbooks, were unlikely. At 25°C, for example, only 1 in every 10 cows were estimated to have RR < 40 breaths/min. This AT is normally referred to as within the cow’s thermoneutral zone. Overall, every 10°C increase in AT resulted in +14 breaths/min. Among animal type categories, calves were the most vulnerable, while dry cows were the least sensitive (+17 and +11 breaths/min every 10°C, respectively, P < 0.01). Jersey animals were also more sensitive than Holsteins (P = 0.02), but the biological significance of the difference is unclear (+3 breaths/min every 10°C). RR were the lowest when lactating cows were near the feed bunk in comparison to other areas (46 vs. 53 breaths/min, respectively, P < 0.01). The latter can likely be attributed to the presence of soakers at the feedline. Finally, posture did not affect RR outcomes (lying vs. standing = 50 vs. 51 breaths/min; P = 0.17). In a Mediterranean climate, AT was the most reliable predictor of RR in dairy cattle. However, characteristics such as animal type, breed and location within pen should be taken into consideration when making decisions about heat load management. These decisions have important implications for the effectiveness of heat abatement strategies.

Key Words: heat stress, welfare, physiology

Effects of shade provision on the behavior of prepartum dairy cows in southern Chile. D. Cartes*, F. Matamala1, A. Strappini2, and P. Sepúlveda-Varas1, 1Escuela de Graduados, Facultad de Ciencias Veterinarias, Universidad Austral de Chile, Valdivia, Chile, 2Instituto de Ciencia Animal, Facultad de Ciencias Veterinarias, Universidad Austral de Chile, Valdivia, Chile, *Instituto de Ciencias Clinicas Veterinarias, Facultad de Ciencias Veterinarias, Universidad Austral de Chile, Valdivia, Chile.

The aim of this study was to investigate the effects of providing shade on the behavior of prepartum dairy cows managed outdoors and exposed to warm weather conditions in a temperate climate. Twenty-four multiparous Holstein prepartum dairy cows were randomly assigned to 6 groups approximately 21 d before their expected calving date based on BW, body condition score and parity. Each group (n = 4/group) were housed in open dirt corrals at the Experimental Dairy Farm of the Universidad Austral de Chile (Valdivia, Chile) during the summer months (January and February) until calving. Three groups had access to shade and 3 groups in adjacent corrals had no shade. Shade use and drinking time were daily recorded using scan sampling every 3 min during the hottest part of the day (1100 to 1800 h), whereas feeding time was daily recorded from 0830 to 2030 h. The daily lying time was measured with data loggers and rumination time was recorded using an automated monitoring system over the study period. Data were summarized by wk, compared between groups (shaded vs non-shaded) and analyzed using mixed linear models (R-Studio). On average, cows used shade during 47%, 46% and 20% of the observation period per day during wk 3, 2 and 1 before calving, respectively. During the morning, shaded cows spent more time feeding on wk 3 (79.2 vs. 61.1 min; P = 0.003) and wk 1 (88.2 vs. 69.1 min; P = 0.006) before calving compared with non-shaded cows. Drinking time was lower in cows that had access to shade during the wk 3 (9.1 vs. 21.8 min; P = 0.004), wk 2 (11.6 vs. 20.4 min; P = 0.05) and wk 1 (11.0 vs. 20.8 min; P = 0.02) before calving compared with those without. Total time spent ruminating tended to be higher when cows had access to shade during the prepartum period compared with non-shaded cows (wk 3: 534 vs. 471 min/d; P = 0.09 / wk 2: 539 vs. 472 min/d; P < 0.08/ wk 1: 517 vs. 453 min/d; P = 0.07), but the daily lying time was not affected by shade treatment. These results confirm the importance of providing shade to prepartum dairy cows exposed to summer conditions under temperate regions. Project founded by FONDECYT 11170820.

Key Words: shade, prepartum, dairy cow


To assess the impact of episodic heat stress on lameness, resting time and body temperature of dairy cattle on farms in northern New York with varying degrees of heat abatement, a study was conducted from June through September 2019 on 4 Holstein herds. Farm A was a sand-bedded...
freestall with no mechanical ventilation in housing area. Farm B was a sand-bedded freestall with fans over stall beds. Farm C was a freestall, sawdust/mattress with fans/misters over feedbunk and stall beds. Farm D was a freestall, sawdust/mattress with fans over stall beds. Thirty cows with lameness score ≤2 served as a focal group averaging over 45.4 kg/d on each farm. Temperature and relative humidity were recorded continuously and temperature humidity index (THI) was calculated every 10 min. Wind speed (m/s) was measured weekly at standing and lying positions throughout pens. Lameness was scored at beginning and end of study. Lying behavior (h/d) and body temperature (reticular, °C) were measured continuously. Lameness (not lame vs. lame) from beginning to end of study was analyzed by Chi-squared analysis using Freq procedure (SAS 9.4). Retrospectively, 6 d of cool weather (mean THI <65, COOL) and 6 d of hot weather (mean THI ≥75, HOT) were selected and lying behavior and reticular temperature (RT, °C) data were analyzed by farm using Mixed procedure (SAS 9.4). All farms except Farm B increased lameness ($P < 0.05$) from beginning to end of summer. While all farms were impacted by heat stress ($P < 0.01$), Farm A was impacted the greatest with 21.4% decrease in lying time and 0.9°C increase in RT on HOT days. Farm B and C were impacted the least with 10.8% and 12.5% decrease in lying time and 0.4°C and 0.3°C increase in RT on HOT days, respectively. The wind speed on Farm A averaged 0.3 m/sec throughout the pen with least air flow in stall beds. Farms B and C had greater air flow in stall beds at resting level (1.0 and 0.9 m/sec, respectively) which likely resulted in less impact on lying time of cows during heat events compared with Farms A and D. Cows on all farms were impacted by episodic heat events to varying degrees with the cows without additional mechanical ventilation being impacted the greatest.

**Key Words:** heat stress, lying time, body temperature