

Animal Behavior and Well-Being 2

2190 Temperature-humidity index, behavior and respiratory rate in high yielding dairy cows. G. M. Martinez¹, G. Frossasco^{2,3}, P. Viretto², P. Turiello*^{4,5}, and V. H. Suarez¹, ¹*Instituto Nacional de Tecnología Agropecuaria, Salta, Salta, Argentina*, ²*Instituto Nacional de Tecnología Agropecuaria, Rafaela, Santa Fe, Argentina*, ³*Universidad Nacional de Villa María, Villa María, Córdoba, Argentina*, ⁴*Universidad Nacional de Río Cuarto, Río Cuarto, Córdoba, Argentina*, ⁵*Instituto de Formación e Investigación en Nutrición Animal—IFINA, Río Cuarto, Córdoba, Argentina*.

Heat stress is associated with temperature-humidity index (THI) values greater than 68 in lactating cows, although recent studies suggested a limit of 60 for high yielding dairy cows (>35 kg/d). The aim of this study was to evaluate the association between THI, respiratory rate (RR), and behavior of lactating cows housed in a compost barn during summer time. Forty high yielding Holstein cows (34.4 ± 8.75 kg/d; 183.6 ± 96.80 DIM) from a commercial dairy farm in Santa Fe province in Argentina were randomly enrolled in the study to be monitored during 3 consecutive days each week in February 2023. We calculated THI according to Thom (1958), based on data from a meteorological station located near the farm, and we categorized it into 2 levels: low (= 68) and high (>68). We evaluated behavior at 11 a.m. and 2 p.m. ($n = 918$) by direct observation and using a partial ethogram recording whether the cow was lying down, standing, or other (eating, interacting with other cows or the environment, and so on). We assessed RR (abdominal muscle movements per minute; AMM) and classified it into normal ($RR = 50$ AMM) or accelerated ($RR > 50$ AMM). We analyzed the results using a contingency table and compared them using a Pearson's chi-squared test ($P = 0.05$). In low ($n = 240$), 38.3% and 16.3% of cows preferred to be lying down or standing, respectively, whereas in high ($n = 678$), 27.7% and 35.5% of the cows were lying down and standing, respectively ($P < 0.0001$). In high, 406 cows with accelerated and 272 cows with normal RR were identified, whereas in low this ratio was 83 and 157, respectively ($P < 0.0001$). No association between behavior and RR was found ($P = 0.37$). These results show lactating cows generally express their discomfort through changes in behavior and RR under high THI conditions. In our study the lowest THI was 60. Some cows could have been affected under low, and this could explain some accelerated cows found in low. We conclude that there is an association among THI, behavior, and RR, although all the 3 variables should be considered to identify animals under heat stress.

Key Words: welfare, milk, heat stress

2191 Dairy cow behavior related to temperature-humidity index and temperature inside compost barn. P. Viretto¹, M. Martinez², G. Frossasco^{1,3}, P. Turiello*^{4,5}, and V. H. Suarez², ¹*Instituto Nacional de Tecnología Agropecuaria, Rafaela, Santa Fe, Argentina*, ²*Instituto Nacional de Tecnología Agropecuaria, Salta, Salta, Argentina*, ³*Universidad Nacional de Villa María, Villa María, Córdoba, Argentina*, ⁴*Universidad Nacional de Río Cuarto, Río Cuarto, Córdoba, Argentina*, ⁵*Instituto de Formación e Investigación en Nutrición Animal—IFINA, Río Cuarto, Córdoba, Argentina*.

The temperature-humidity index (THI) is a useful tool to detect risk of heat stress in dairy cows. A THI above 68 means the cow is under heat stress, no heat is dissipated and cows tend to spend less time lying down. The aims of this study were 1) to evaluate behavior of high-producing cows (>35 kg/d) according to THI and compost barn inside temperature

(IT) and 2) to explore the relationship between THI and IT. Twice a week during February and March 2023, we focally observed 29 cows from a commercial farm in Santa Fe, Argentina. Measurements were taken at 11, 12, 13, and 14 h ($n = 1,840$). We calculated THI according to Thom (1958), based on data from a meteorological station located on the farm. We registered barn IT using a datalogger located inside a black globe in the middle of the barn, 2 m above the floor. We evaluated behavior by direct observation using a partial ethogram recording whether the cow was lying down (L), standing (S), or other (eating, interacting with other cows or the environment, and so on). We classified THI into 2 levels: no stress (NS; $THI = 68$) and with stress (WS; $THI > 68$). For IT, we considered it as adequate (A; $IT = 21^\circ\text{C}$) or not adequate (NA; $IT > 21^\circ\text{C}$). Results were analyzed using a contingency table and compared using a Pearson's chi-squared test ($P = 0.05$). Spearman coefficient ($P = 0.05$) was used to evaluate the correlation between THI categories and IT. Results show behavior changes according to the considered variables ($P < 0.001$). When cow comfort was affected by THI, the proportion of L and S cows was 31.7% and 32.6%. Similar results (31.1% and 31.5% for L and S cows, respectively) were obtained under NA IT. However, under NS conditions or A IT, the proportion of cows L were higher (42.9% and 47.1%) than those S (16.1% and 18.8%). We also found a high ($r = 0.79$) and significant ($P < 0.0001$) correlation between THI and IT. According to these results we conclude that cows changed their behavior, increasing the proportion of animals S and diminishing those L when THI and IT increased. Measurement of IT could be useful to monitor dairy cows' comfort when no meteorological data are available.

Key Words: heat stress, comfort, thermoneutral zone

2192 Effect of shade availability on the physiological responses, water intake, and feeding behavior of grazing cows with an increasing heat load. A. Pontiggia^{1,2}, L. Eggerschwiler¹, A.-M. Reiche¹, N. M. Keil², and F. Dohme-Meier*¹, ¹*Ruminant Nutrition and Emissions, Agroscope, Posieux, FR, Switzerland*, ²*Centre for Proper Housing of Ruminants and Pigs, Swiss Federal Food Safety and Veterinary Office, Ettenhausen, TG, Switzerland*.

This study investigated the effect of shade availability on pastures in a temperate zone on the physiological traits, water intake, and feeding behavior of grazing dairy cows in relation to increasing heat load. Twenty-four lactating Holstein cows (108 ± 32 DIM, 2.8 ± 1.7 lactation) in 6 subgroups of 4 cows grazed all day on 6 paddocks equipped either with or without a shade sail. Data were collected across 24 d in 4 crossovers (with/without shade). Each crossover lasted 3 d twice. Heat load was expressed as a comprehensive climate index (CCI in $^\circ\text{C}$). Each subgroup had a water station available. Cows' water intake, reticular temperature, heart rate, and feeding behavior were continuously recorded for each cow, and respiration rate and use of shade were recorded by visual observation between 1300 and 1500 h. The data were analyzed using generalized linear mixed models (fixed effects: shade provision, CCI, interaction; random effects: crossover, subgroup, cow; experimental unit: cow). The CCI varied from 16.7 to 28.2°C and the temperature-humidity index from 56.2 to 71.1. Over 24 h, water intake and reticular temperature increased, and time spent ruminating decreased with increasing CCI (all $P < 0.01$). However, no treatment \times CCI interactions (all $P > 0.05$) were detected for these traits. From 1300 to 1500 h, cows used the available shade less (10%–25% of the time), but the use increased with increasing CCI as did reticular temperature, heart

rate, and respiration rate (all $P < 0.01$). No treatment and treatment \times CCI interactions (all $P > 0.05$) were observed for heart rate (80.1 ± 8.9 beats/min), water intake (9.4 ± 4.6 L), and time spent eating (81.3 ± 16.7 min) and ruminating (15.7 ± 9.4 min) between 1300 and 1500 h. However, cows offered shade had a lower reticular temperature (38.9 ± 0.2 vs. $39.1 \pm 0.3^\circ\text{C}$, $P < 0.05$) and a lower respiration rate (50.5 ± 7.3 vs. 56.3 ± 10.4 breaths/min, $P < 0.01$) than cows without shade. In conclusion, offering shade seemed to lower the body temperature and respiration rate of grazing dairy cows, although the cows did not use it much in the afternoon.

Key Words: cow, pasture, heat stress

2193 Behavioral and physiological differences of dry dairy cattle under heat stress based on median core body temperature.

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Heat stress results in significant economic losses to the dairy industry. Here, we investigated behavioral and physiological differences of dairy cows with above or below median core body temperature (CBT) assessed for 1 wk during late gestation. Temperature data were collected every 5 min for 7 d using a temperature logger attached to an intravaginal

insert between d 225 and 239 of gestation. Cows having above-median CBT were classified as high temperature (HT) and those below median CBT were classified as low temperature (LT). Behavioral data from 50 cows (10 cows per replicate; primiparous [$n = 19$] and multiparous [$n = 31$] Holstein cows) were collected using automated activity monitors equipped with accelerometers in addition to visual observations. Accelerometer data were evaluated from d -21 to 21 relative to calving. Cows were visually observed for 8 h in the far-off pen and 8 h in the close-up pen. Repeated measures ANOVA was employed to analyze the accelerometer data. For each visual observation, the percentage of time allocated to each behavior was analyzed by fitting generalized linear mixed models. Morning and afternoon behavioral observations (lying, standing, eating, drinking, and perching [only recorded in the far-off pen]) of both far-off and close-up pens showed no detectable differences ($P \geq 0.12$). An interaction between temperature and parity ($P = 0.02$) showed that HT primiparous cows spent the most time eating in the afternoon visual observations (30.9%), followed by LT multiparous cows (25.4%) and LT primiparous cows (22.5%), whereas HT multiparous cows spent the least time eating (19%). Accelerometer data indicated that HT cows were more active ($P < 0.01$) than LT cows. Multiparous cows were more active than primiparous cows during both prepartum ($P = 0.02$) and postpartum ($P < 0.01$) periods. Results from the present study indicate distinct behavior patterns between HT and LT cows; however, further research is required to determine precise thresholds for classifying cows as HT and LT, as well as to assess behavior indicators that could predict the likelihood of postpartum health issues.

Key Words: thermal stress, activity monitors, transition period