Recent Studies Using A Reticular Bolus System For Monitoring Dairy Cattle Core Body Temperature

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Dairy farmers and veterinarians have used body temperatures, most commonly rectal temperatures, in detection and management of febrile disease and changes in the state of cows (estrus, heat stress, and onset of calving) for many years. Although valuable for monitoring animals, core body temperatures are inherently difficult to obtain, and rectal temperature only approximates core body temperature. Because restraining animals to manually collect rectal temperatures may cause stress that alters those temperatures, a reliable method with no human intervention is likely to provide a more accurate measure. Attempts to measure body temperature of cattle have been made at various anatomical locations including rectum, ear (tympanic), vagina, reticulum-rumen, and udder (milk). Rumen temperatures have been demonstrated to be effective measures of core body temperature (Prendiville et al., 2002). The objective of this research was to explore the technical capabilities of a commercially available temperature monitoring system.

Cattle Temperature Monitoring System

The Bella Health System (BHS, Bella Health Systems, Greeley, CO), formerly marketed in an earlier version as MaGiiX™ Cattle Temperature Monitoring System (CTMS, MaGiiX Inc., Post Falls, ID), utilizes RF identification (RFID) technology within a rumen bolus, a panel reader placed at a parlor entrance or exit, and a software package to collect, analyze, and view data. This system was installed at the Purdue Dairy Research and Education Center (DREC) from June 1, 2006 to August 31, 2007. Following is a summary of research to determine relationships with rectal temperature, impact of water consumption on reticular temperature, and association of recorded temperatures with mastitis and estrus.

Relationship with Rectal Temperatures

The intent of this experiment was to evaluate the association between rectal and reticular temperatures, (Bewley et al., 2008a). Reticular (RETT) and rectal (RECT) temperatures were recorded simultaneously in the milking parlor's exit lane in 4 consecutive milkings in each of 4 seasons, totaling 16 measurements per cow. The RETT were obtained using the CTMS while RECT were obtained manually with a GLA M750 thermometer (GLA Agricultural Electronics, San Luis Obispo, CA). Data were edited to remove RETT likely to have been impacted by a recent drinking bout. For the 2042 observations used in analyses, means (± SD) were 39.28 (± 0.41), 38.83 (± 0.36), and 0.45 (± 0.33) for RETT, RECT and difference between RETT minus RECT, respectively. The RETT and RECT were strongly correlated ($r = 0.645$, $P < 0.0001$). The relationship between RETT and RECT varied by season, milking, housing system, and parity. Because dairy producers and veterinarians are accustomed to viewing rectal temperatures, equations to adjust reticular temperatures to a rectal-based scale may increase the utility of the CTMS. The resulting conversion equations were RECT = 19.23 + 0.496 (RETT) for the a.m. milking and RECT = 15.88 + 0.587 (RETT) for the p.m. milking.

Effect of Water Intake

Two replicated 3 x 3 Latin Square experiments were conducted to assess the impact of water intake on reticular temperatures using the CTMS (Bewley et al., 2008b). Nine high-producing, mid-lactation, 2nd parity cows with low somatic cell counts (SCC) were selected. Prior to administering a water treatment, access to feed and water was restricted for at least 2 h. Baseline reticular temperatures were established from measurements prior to water intake. In experiment 1, treatments were 25.2 kg of hot water (34.3°C ± 1.0), warm water (18.2°C ± 0.4), or cold water (7.6°C ± 0.4). In experiment 2, treatments were 18.9 kg of body temperature water (38.9°C ± 0.2), cold water (5.1°C ± 0.4), or control (no water). Following water intake, reticular temperatures were collected for 3 h. In experiment 1, an initial dramatic drop in reticular temperature was observed followed by a gradual rise toward baseline. Least squares means for maximum drop in temperature were 8.5 ± 0.5, 6.9 ± 0.5, and 2.2 ± 0.5°C for cold, warm, and hot water treatments, respectively. Yet, at 3 h, reticular temperatures did not return to the baseline. In experiment 2, control cows remained within the baseline through the observation period and cows receiving body temperature water experienced an initial drop in temperature 0.4 ± 0.2°C with a return to within the baseline within 15 min. Cows receiving cold water did not return to within the baseline confidence interval after a large drop of 9.2 ± 0.2°C during the 3 h observational period. Moreover, a regression analysis of continued ascent in temperatures predicted that temperatures would return to baseline within 3.5 h. These results demonstrate that, when cows consume large quantities of cold water, the impact of water intake is sizable and sustained.

Association with Mastitis and Estrus Events

Temperatures were collected immediately following twice-daily milking from 298 Holstein cows from June 1, 2006 to August 31, 2007. Raw reticular temperatures were edited to remove erroneous reads and temperatures potentially influenced by water intake. The unadjusted mean of the remaining 131,181 temperatures was 38.77°C (±0.44). Temperatures were then adjusted for the impact of milking time, parity, temperature humidity index, housing system, DIM, and milk. Ninety-three distinct natural estrus events and 101 distinct mastitis events were used in all subsequent analyses. A rolling mean temperature was calculated using all recorded temperatures within the previous four weeks. The number of standard deviations (NUDEV) from which each respective temperature varied from this baseline was then calculated. The maximum temperature and NUDEV among all recorded temperatures within the previous week was used as a baseline to assess whether a temperature deviation was observed for mastitis events. Mean maximum temperature and NUDEV were 39.73 (± 0.82) and 3.58 (± 2.84), respectively. The NUDEV was more than 3 in 45.7% of mastitis events and MAXTEMP was greater than 40 °C for 39.6% of mastitis events. The maximum temperature and NUDEV among all recorded temperatures within the previous week was also used as a baseline to assess whether a temperature deviation was observed for breeding events. Mean maximum temperature and NUDEV were 39.10 (± 0.44) and 1.59 (± 1.01), respectively. The NUDEV was more than 3 in 7.6% of estrus events and MAXTEMP was greater than 40 °C for 1% of estrus events. Natural variation in cow body temperatures may limit the utility of a reticular-based temperature monitoring system with twice-daily recordings.

References

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