View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by K-State Research Exchange

USING VAGINAL TEMPERATURE TO EVALUATE HEAT STRESS IN DAIRY CATTLE

M. J. Brouk, B. Cvetkovic, J. F. Smith, and J. P. Harner[1]

Summary

A rise in body temperature is a signal that heat stress has exceeded the heat-exchange capacity of the dairy cow. Previous studies have shown a strong positive correlation between vaginal temperature and respiration rate, demonstrating a stress response to an increased body temperature. Vaginal temperature was collected by using temperature probes attached to an external data logger. Although these devices were very sensitive to changes in body temperature of cows housed in tie-stalls, the external data logger presented a significant application challenge for free-ranging animals housed in freestalls. A data logger was acquired that would be completely indwelling in the vagina. The U12 stainless steel model (Onset Computer Corporation, Pocasset, MA) was 0.5 × 4 inches and weighed about 2.6 oz. It was retained in the vagina with foam and a blank CIDR insert. These devices were used continuously to measure and record body temperature in free-ranging cattle for 5 to 7 days. Vaginal temperature was recorded at 1-minute intervals and then averaged into 5-minute blocks. Data were then graphed over a 24-hour period. Vaginal temperature increased with activity and amount of heat stress. Effective heat-abatement systems were shown to reduce vaginal temperature. On commercial farms, data were used to identify where heat abatement should be improved. Heat stress issues with milking parlor holding pens were easily identified. Producers and industry personnel could use data loggers to evaluate heat stress and the effectiveness of heat-abatement systems on free-ranging dairy cattle. Devices also could be used to validate the effectiveness of modifications to heat-abatement systems identified by the initial evaluation.

(Key Words: Cow Comfort, Cow Cooling, Heat Abatement.)

Introduction

Heat stress abatement is a critical management concern for dairy producers in Kansas. Many producers have installed heat-abatement systems and some have questioned the effectiveness of the systems. Methods to evaluate the effect of systems have been limited to evaluating respiration rates and milk response. An evaluation system that incorporated frequent measurement of body temperature would more accurately show where and when body temperature begins to rise in response to heat stress. Previous studies have used data loggers with an external temperature probe (model H08-031-08, Onset Computer Corporation, Pocasset, MA). The external probe was inserted into the vagina and held in place with foam, and the logger was then secured to the thurl with common duct tape. Data measurements were recorded over a period of 2 hours. Although these devices were

[1]Dept. Biological and Agricultural Engineering.

very sensitive to changes in body temperature of cows housed in tie-stalls, the external data logger presented a significant application challenge for free-ranging animals housed in freestalls. A data logger was acquired that would be completely in-dwelling in the vagina. The purpose of this study was to validate the use of this logger for heat stress evaluation in lactating dairy cattle.

Procedures

To validate the system, 22 lactating Holstein cows were housed in a tie-stall barn for a period of 3 weeks. Body temperature was measured and recorded 4 days each week with the vaginal probes. The U12 stainless steel model (Onset Computer Corporation, Pocasset, MA) was 0.5 × 4 inches and weighed about 2.6 oz. It was held in the vagina with foam and a blank CIDR insert. Devices were programmed to measure continuously and record body temperature in free-ranging cattle for 5 to 7 days. Vaginal temperature was recorded at 1-minute intervals and then averaged into 5-minute blocks. Three days each week, rectal temperature, respiration rate, and skin surface temperature were measured and recorded at 6:00 a.m., 4:00 p.m., and 10:00 p.m. Respiration rate was visibly observed for 20 sec and recorded. Rear-udder skin surface temperature was measured with an infrared thermometer (Model 4KM98, Raytek®, Santa Cruz, CA). Before the start of the experiment, vaginal probes and rectal thermometers were validated in a water bath over the range of 85 to 110°F with a certified thermometer to ensure similar temperature responses in a controlled environment. Vaginal temperature data representing the same day and time as the rectal, respiration, and skin surface measurements were selected for analysis. Data were subjected to mixed-model procedures of SAS®. In a separate study, 4 lactating cows in each of 2 pens were used in a switchback design to evaluate the effect of supplemental fans or no fans on vaginal temperature. The pen designs were similar in construction, and feedline fans were either operated (6:00 a.m. until 10:00 p.m.) or not operated on 2 similar summer days.

Results

Rectal and vaginal temperatures did not differ, and averaged 102.1 and 102.3°F, respectively. Rear-udder skin surface temperatures (94.3°F) were lower ($P<0.01$) than rectal and vaginal temperatures. Regression analysis of skin temperature on rectal temperature yielded an R^2 of 0.5, whereas vaginal temperature regressed on rectal temperature yielded an R^2 of 0.95. Results demonstrated that vaginal temperature was a good indication of body temperature and that rear-udder skin surface temperature was as accurate at predicting body temperature.

Data collected on a commercial farm are displayed in Figure 1. Cows with access to supplemental fan cooling had lower vaginal temperatures than did those without supplemental fan cooling. A dramatic drop in vaginal temperature was observed within 1 hour after the fan cooling system began to operate, compared with a rise in vaginal temperature when fans were not used. Lack of fan cooling in the evening resulted in a rise in vaginal temperature until the fans resumed operation the next day.

Data collected and summarized show the efficiency of the evaluation system to detect heat stress in dairy cattle. This evaluation tool was useful in evaluating heat-abatement treatments and in identifying needed changes in heat-abatement protocols. Further evaluation and use of this technology will aid producers, allied industry partners, and researchers in identifying heat stress issues on farms and in research projects.

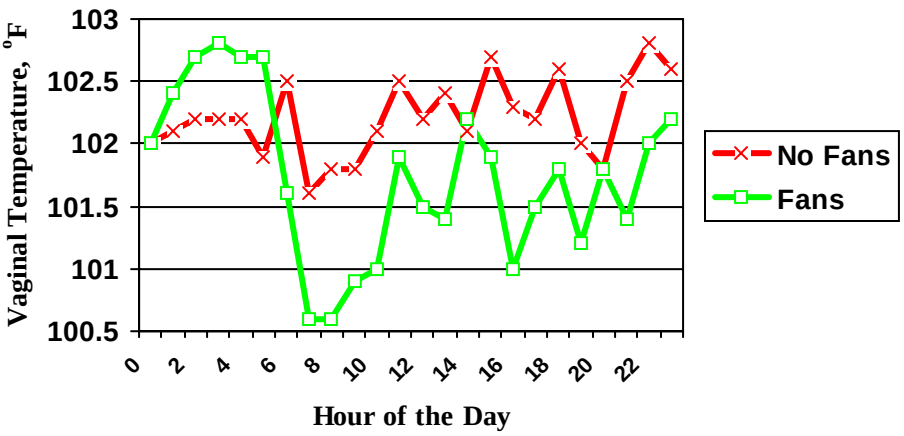

Figure 1. Average Vaginal Temperature of Cows, With and Without Supplemental Fan Cooling.