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Evaluate the efficacy of your cooling system through core body temperature

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THE EFFECTS of heat stress on animal production are well known and have been investigated and documented for a number of years. It is commonly accepted that a temperature humidity index (THI) at or above 72 creates a stressful environment for lactating dairy cattle.

The basic thermoregulatory strategy of a dairy cow is to maintain a core body temperature higher than ambient temperature to allow heat to flow out from the core via four basic routes of heat exchange:

- conduction
- convection
- radiation
- evaporation

When ambient temperature conditions approach body temperature the only viable route of heat loss is through evaporation, but if ambient conditions exceed body temperature heat flow will reverse and an animal will become a heat sink. Therefore, estimating the thermal environment around animals is necessary to understanding their cooling needs.

Because the typical location of cooling equipment relative to animals and because of the positions of the animals themselves within housing facilities, there are a wide variety of microenvironments present within a facility. As a consequence, accurately determining the degree of heat stress that a cow experiences over time is a challenge.

Traditionally, respiration rate (RR; breaths/minute) has been used as a tool to measure the severity of heat stress on an animal. Although RR will vary with body weight and milk yield of an animal, it is a relatively accurate tool for determining the degree of heat stress.

Recently, cattle housed in the Animal Research Complex (ARC; Tucson, AZ) environmental facility under thermal neutral conditions (65.8 ± 1.0ºF; 63.5 THI ± 0.7) for 48 hours, followed by heat stress (98.0 ±

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1.5ºF; 79.6 THI ± 1.0) for 16 out of 24 hours/day for 3 days, had RR of 50 during thermal neutral and 71 during heat stress conditions, respectively. If skin surface temperature of a dairy cow is below 95ºF, the temperature gradient between the core and skin is large enough for an animal to effectively use all four routes of heat exchange.

Infrared thermography guns have been shown to be a low cost approach to estimate actual skin surface temperature of animals. However, because of variability in skin surface moisture at a given point in time, the accuracy of infrared guns to predict an animal s heat load may be limited. For example, if an animal recently walked under a shade from being out in the sun (solar radiation) the infrared measurement of skin will not be accurately reflective of cows under the shade that were not recently exposed to the sun.

Core body temperature (CBT) has been shown to decrease in cooled cows compared to non-cooled cows. Recently, cattle housed in the ARC environmental facility under thermal neutral conditions (65.8 ± 1.0ºF; 63.5 THI ± 0.7) for 48 hours followed by heat stress (98.0 ± 1.5ºF; 79.6 THI ± 1.0) for 16 out of 24 hours/day for 3 days had vaginal temperatures of 101.8ºF during thermal neutral and 103.5ºF during heat stress conditions, respectively.

Our group has measured CBT using intravaginal probes attached to CIDRs (as applicators only) to determine where and/or when cows are getting hot and/or remaining the coolest. These devices are inserted and remain inside the cow's vagina measuring CBT every 60 seconds for up to six days. Such technology allows a cow's CBT to be monitored and recorded 24 hours per day as they move throughout a facility.

Specifically, a holding pen (designed to allow 15 square feet per cow) without proper cooling is an area where dairy cows may experience severe heat stress (see Figure 1). However, if properly cooled vaginal temperature will be reduced (see Figure 2).

Figure 1. Two 24-hour periods of elevated vaginal temperature in a holding pen.

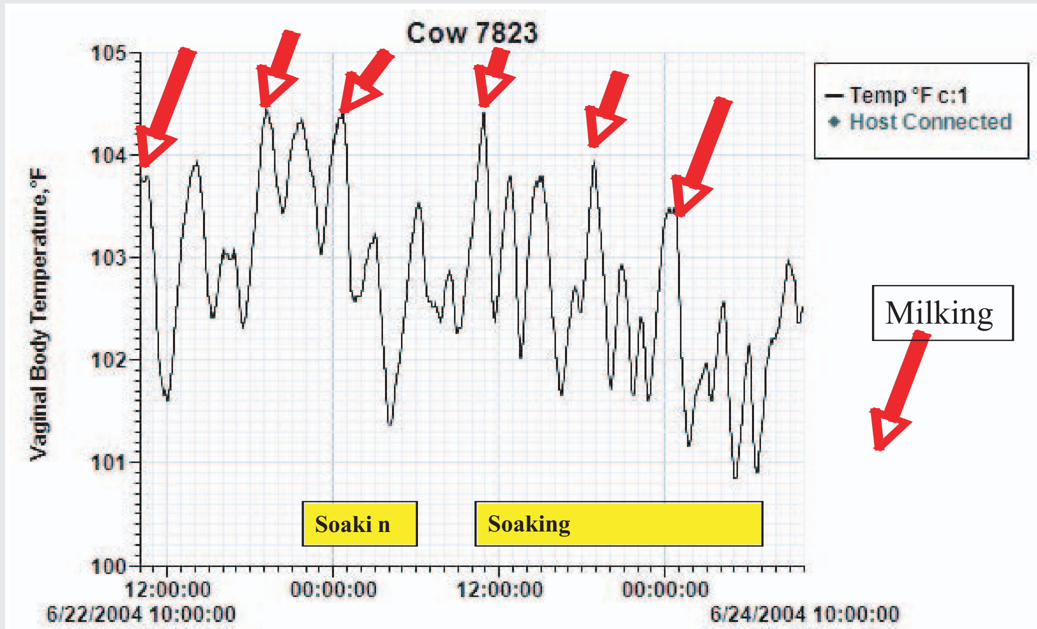
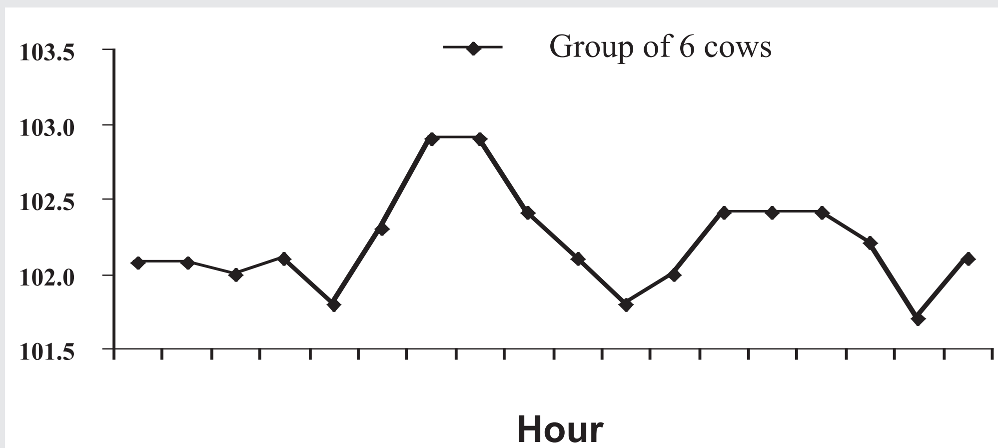


Figure 2. One 24 hour period of excellent holding pen and parlor exit lane cooling.



Utilizing a CBT probe to continuously monitor vaginal (core body) temperature allows a producer to accurately determine where and when a cow is experiencing the most heat stress. As a consequence, management decisions can be made to improve cooling and reduce heat stress, thus improving cow performance. In addition, parlor exit sprinklers have demonstrated that when a cow enters a corral with a wet body surface the moisture will evaporate, thus cooling the cow for an additional period of time depending on weather conditions.

The effects of barn and cooling system design are important factors in determining the efficacy of cooling on dairy facilities. Factors critical to the correct design and cooling system are obviously dependent on the geographic location of the dairy. Specifically, daily average high and low temperature, annual rain fall, humidity and prevailing winds.

Dairy producers are in business primarily to make a profit, which can be realized by increasing the price received for their product or decreasing the cost of producing it. Cooling systems installed in dairies located in hot semi-arid climates like Arizona can contribute up to 20 percent of the total construction cost ($200 to $500 per cow). In addition, since variable expenses such as electricity and water can cost 10¢ to 15¢ per cow per day, it is critical that the investment is paying off and cows are being cooled efficiently and effectively.

Using intravaginal probes to monitor core body temperature of dairy cows is an inexpensive and effective means of evaluating the impact of heat and heat stress on cows within a facility.

Western Dairy News is published as a service to people interested in the health and welfare of the Western dairy industry. Archives of this publication may be found at:
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