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Effects of Summer Climatic Conditions on Body Temperature in Beef Cows

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Summary

Tympanic and vaginal temperature logging devices were used to collect internal body temperature in three trials using mature nonpregnant beef cows. A model was developed to predict daily patterns for internal body temperature of a cow as a function of ambient temperature. Panting scores were recorded and differed across days as cows experienced changes in ambient temperature and humidity. Vaginal and tympanic temperatures were positively correlated, thus tympanic temperature may be used to predict internal body temperature of cows.

Introduction

In cow-calf production systems, reproductive performance is essential to the success and profitability of the enterprise. Heat stress can delay puberty in heifers, cause anestrous in cows, depress estrus activity, induce abortions, and increase perinatal mortality. Effects of heat stress on fertility are prominent when occurring at or near the time of estrus. The mean body temperature of cows is 101.4° to 101.5°F. Indicators of heat stress in cattle include elevated rectal body temperature and an increase in respiration rate.

Most beef cows and heifers are bred in late spring through midsummer when environmental conditions may cause heat stress and affect reproductive performance. The objective of this study was to determine the effect of heat-stress indicators on internal body temperature and panting scores of beef cows in a dry-lot setting and to determine the relationship between vaginal and tympanic temperatures.

Procedure

Three trials using mature, nonpregnant crossbred cows were conducted to determine effects on internal body temperature during the spring/summer. To monitor internal body temperature, a modified CIDR containing a logging device with a resolution of 0.5°C was inserted into the vaginal cavity of each animal. The loggers were deployed to record internal body temperature every 60 minutes for each trial period.

Trial 1 occurred in late June and early July 2006. Body temperatures were measured in mature, nonpregnant beef cows (n = 20; BW = 1,270 lb; BCS = 5.9) for a 14-day period in a dry-lot at the ARDC feedlot facility near Mead, Neb. Besides body temperature, panting scores were recorded during the final 6 days of the trial period. Panting scores were assigned to individual animals between 1400 and 1500 in the afternoon (CDT) by visual observation using the scoring system presented in Table 1. Trial 2 was conducted in late July to August 2006, using nonpregnant beef cows (n = 20; BW = 1,270 lb; BCS = 5.9) for a 14-day period in a dry-lot at the ARDC feedlot facility near Mead, Neb. Body temperature and panting scores were recorded throughout the entire trial period. Panting scores were assigned to each animal between 1400 and 1500 CDT by visual observation.

Environmental conditions were also monitored and obtained from weather stations located near all sites for each of the trials. The weather history was downloaded in a daily format and included minimum and maximum temperature as well as average relative humidity. The average temperature and average relative humidity were used to calculate the Temperature-Humidity Index (THI) for each day using the following equation: *THI = Temperature-(.55-(.55x(RH/100))) x (Temperature-58).*

Trial 3 was completed in April 2007, with nonpregnant beef cows (n = 20; BW = 1270 lb; BCS = 5.6) used for a period of 7 days to determine the correlation between vaginal and tympanic temperatures. Temperatures were measured in both the tympanic and vaginal areas using a logging device with 0.125°C resolution.

Body temperature and panting score data were analyzed using the mixed procedures of SAS with cow effects assumed random. Hourly body temperature was fit to a Fourier series (sine plus cosine) model. After examining multiple models, the best fitting model retained periodicities of 12, 10, 9, 8, and 7 hours. This model, accounting also for the interaction with ambient temperature, was used to predict internal body temperature patterns in cows when subjected to different daily maximum temperatures. The correlation between vaginal and tympanic temperatures was estimated using SAS.

Results

Figures 1, 2, and 3 depict the average body temperature of a cow on

Table 1. Panting scores assigned to cows.

Score	Description
0	Normal respiration
1	Elevated respiration
2	Moderate panting and/or presence of drool or small amount of saliva
3	Heavy open-mouthed panting; saliva usually present
4	Severe open-mouthed panting accompanied by protruding tongue and excessive salivation; usually with neck extended forward

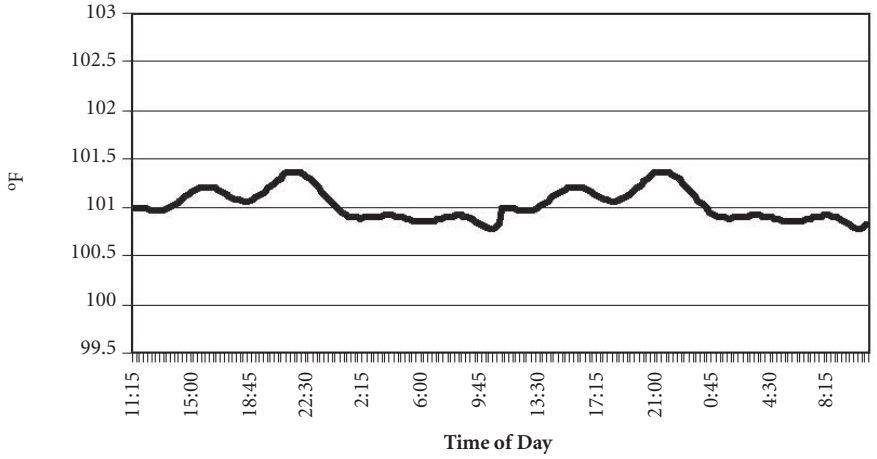

Figure 1. Cow body temperature (°F) within time of day over a 48-hour period when 70°F is the maximum daily temperature.

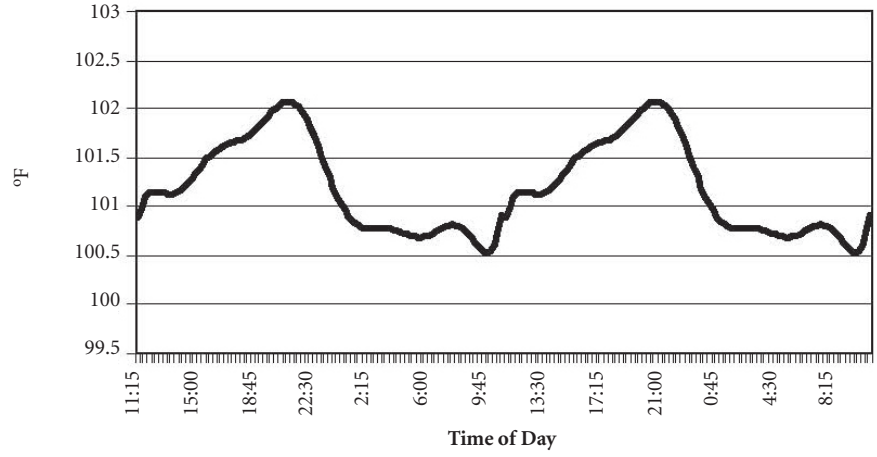

Figure 2. Cow body temperature (°F) within time of day over 48-hour period when 80°F is the maximum daily temperature.

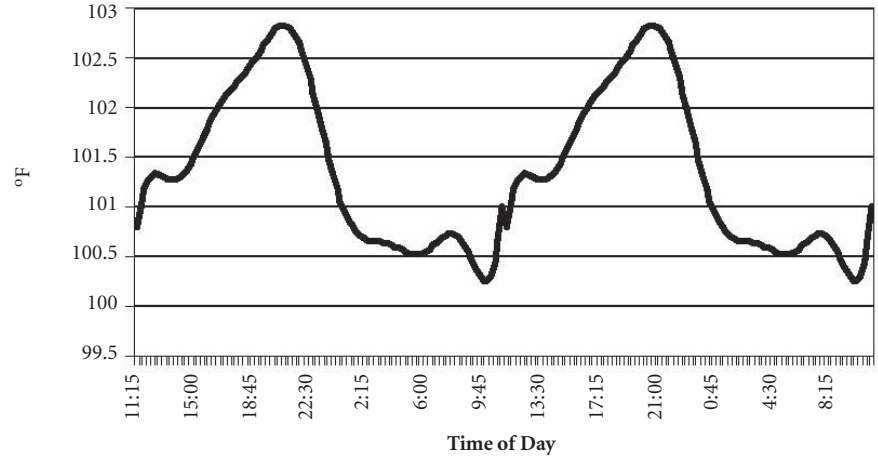

Figure 3. Cow body temperature (°F) within time of day over 48-hour period when 90°F is the maximum daily temperature.

days when the maximum temperature reached either 70°, 80°, or 90°F, based on data from Trial 2. The body temperatures are displayed starting at 1115 CDT and continue for a 48-hour time period to get a clear picture of the pattern. When cows experienced a 70°F day, there appeared to be little variation in body temperature and it deflects minimally from normal body temperature of 101.4°F (Figure 1). When beef cows are subjected to environmental temperature of 80°F to 90°F, there was a greater deflection from normal body temperature (Figures 2 and 3). Cows took on a heat load during the day, and if environmental conditions were conducive, the heat load was dissipated during the evening hours. Body temperatures approached 103°F on a day when environmental temperatures were 90°F.

Table 2 illustrates the low, high, and average ambient temperatures, humidity, and THI index for the last 6 days of Trial 1 during June and July. Table 3 depicts the percentage of cows that exhibited 0, 1, 2, 3, or 4 on the panting score scale during this period. A regression was performed on panting score using ambient temperature ($p = 0.335$), humidity ($p < .0001$) and THI ($p < .0001$) as the variables. As temperature, humidity, and THI increase, a larger percentage of cows exhibited a panting score of 1 or 2. On days 5 and 6, the cows were subjected to heat loads due to high temperature and humidity, and there were more cows with a panting score of 2. Prior to days 5 and 6, cows had panting scores of 0 and 1 when environmental conditions were less adverse and the cattle were able to accumulate and dissipate a heat load more effectively.

The correlation between vaginal and tympanic temperatures was significant ($p < .0001$) at 0.83. At this level of correlation, tympanic temperature can be used to predict internal body temperature. Tympanic temperatures would be useful for research protocols that preclude using vaginal temperature measurement.

These preliminary data will enable us to better understand the impact

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of the environmental conditions that impact reproductive performance of beef females. Future research will be aimed at modeling body temperature when environmental conditions are not conducive to dissipation of a heat load, such as high temperature and high humidity that extend into the night when heat load accumulated during the day is typically lost.

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Table 2. Temperature (ºF), humidity (%), and Temperature-Humidity Index (THI) by day—trial 1.

Day	Temperature			Humidity			THI		
	L[a]	H	A	L	H	A	L	H	A
1	63.4	81.2	72.5	49.2	95.2	71.6	63.1	75.6	69.9
2	62.7	89.4	76.3	44.7	100	75.0	62.7	79.8	72.8
3	68.3	74.4	71.0	92.1	100	96.5	68.2	73.4	70.7
4	68.3	80.8	74.3	61.5	100	84.4	68.0	76.7	72.5
5	62.8	86.3	75.3	52.5	100	80.0	62.8	79.0	72.7
6	69.0	93.6	77.3	55.7	100	85.2	66.3	93.0	85.8

[a]L = low, H = high, A = average (over 24-hour period).

Table 3. Percentage of cows displaying specific panting scores by day—trial 1.

Day	0	1	2	3	4
1	75	25	0	0	0
2	80	20	0	0	0
3	20	80	0	0	0
4	30	70	0	0	0
5	0	75	25	0	0
6	0	65	35	0	0