Relationships of Coat Color, Body Surface Temperature and Respiration Rate in Feedlot Steers

S. C. Arp[1], F. N. Owens[2],
S. L. Armbruster[3] and Scott Laudert[4]

Story in Brief

The relationships between coat color, body surface temperature and respiration rate were measured in an experiment using 978 steers in cooperation with a feedlot at Garden City, Kansas. Data were collected during different times of the day on three days throughout the trial. Respiration rates and body surface temperatures peaked at noon or slightly after. Respiration rates and body temperatures peaked much higher for black and red cattle than for white cattle, with red cattle usually being slightly lower than black cattle. Body surface temperatures followed a pattern similar to respiration rates except that differences due to coat color were less during the early morning and late evening. Comparison of predominantly black or predominately white Holstein steers in one pen indicated a direct correlation between respiration rate and surface temperature. The respiration rate of black Holstein steers was 35 percent greater ($P < .05$) and the surface temperature was 14 percent greater ($P < .05$ than for white Holstein steers.

Introduction

Death losses due to heat stress of feedlot steers is a summertime problem in the Southern Great Plains. Heat stress is generally considered to be a problem of high temperature and humidity. Normal respiration rates for cattle are between 20 to 50 breaths per minute. Since many of the cattle which succomb to heat stress in non-sheltered, non-shaded feedlots are black in color, the purpose of this study was to evaluate relationships among coat color, body surface temperature and respiration rate.

Materials and Methods

Steers were allotted to treatments as described in "Effect of Density, Coat Color and Heat Stress on Performance of Feedlot Steers" reported elsewhere in this publication. In addition, a group of Holstein steers in a confinement lot with no shade were used to examine the relationship of respiration rate and body surface temperature within a single breed to remove the influence of breed type and Brahman crossbreeding. Simultaneous measurements of respiration

[1]Graduate Assistant, [2]Professor, Animal Science, [3]Nutrition Consultant, Stillwater, [4]Area Feedlot Specialist, Garden City, KS

rate and surface temperature were made on predominantly white and predominantly black steers. Respiration rates and body surface temperature were measured on three different dates, 7/31/82, 8/21/82, 9/4/82. Respiration rates and surface temperatures were measured on five to ten animals per pen. Animals selected were those near enough to measure accurately, but measurements were not necessarily on the same animal within or between time periods. Body surface temperature was measured with a gun type, battery operated infra-red thermometer that collects infrared energy without contact. Respiration rates were calculated by stopwatch timing of the number of seconds required for an animal to inhale 30 times. Ambient air temperature and relative humidity were monitored continuously and black bulb temperatures measured intermittently. The diets were high energy feedlot diets and were the same for steers of all colors tested.

Results and Discussion

Weather data are provided in Tables 1 to 3. These can be related to respiration rates and body surface temperatures in Tables 4 to 9. On July 31, in all five time periods, white cattle had significantly lower ($P < .05$) respiration rates than either black or red cattle (Table 4). Except for the first period, which was near sunrise, and the final period, near sundown, the respiration rate of black

Table 1. Weather data (7-31-82)

Time	7:30 am	10:30 am	1:30 pm	4:30 pm	7:30 pm
Ambient air temperature, F	58	74	79	85	84
Relative humidity, %	90	44	32	30	41
Black bulb temperature, F	--	104	110	110	88

Table 2. Weather data (8-21-82)

Time	8:00 am	12:00 noon	4:00 pm
Ambient air temperature, F	66	69	80
Relative humidity, %	90	78	55
Black bulb temperature, F	77	111	104

Table 3. Weather data (9-4-82)

Time	7:30 am	10:30 am	1:30 pm	4:30 pm	7:30 pm
Ambient air temperature, F	62	73	87	90	87
Relative humidity, %	64	55	37	34	36
Black bulb temperature, F	74	91	102	102	--

Table 4. Comparison of respiration rates among coat colors (7-31-82).

Coat color	Time				
	7:30 am	10:30 am	1:30 pm	4:30 pm	7:30 pm
	Respiration rates, breaths/min.				
Red	76.5[a]	106.1[b]	126.1[a]	134.9[a]	105.8[a]
Black	75.3[a]	113.8[a]	129.6[a]	138.0[a]	103.5[a]
White	59.1[b]	67.3[c]	98.1[b]	87.6[b]	66.3[b]

[abc]Means in a column with different superscripts differ statistically ($P < .05$).

cattle was consistently greater than that of red cattle. Sprinklers began operating during the 1:30 time period which may confound the measurements. During the warmer part of the day and into the evening, white animals had lower body surface temperatures than red and black animals (Table 5). Black animals tended to have slightly greater surface temperatures than red animals throughout the day.

On August 21 and September 4, sprinklers were turned off while measurements were taken. On August 21, red animals tended to have higher respiration rates (Table 6), but lower surface temperatures than black animals (Table 7). Though white steers had lower surface temperatures than colored steers, respiration rate of white animals was equal to other cattle at noon. Surface temperatures on this particular day were subject to variation due to intermittent cloud cover. Surface temperature of one steer can vary from 10 to 15 F between the side exposed to the sun and the shaded side. Temperatures were generally taken on the sunny side the animal, however rate of change in surface temperature with time of exposure to the sun is unknown. A slight mist or fog at 8 am apparently aided evaporative cooling. September 4 was sunny all day. Respiration rates were very low at 7:30 am (Table 8) and except at the peak time, 1:30 pm, were lower for white than colored cattle. Black cattle tended to have slightly higher respiration rates than red cattle except at 4:30 pm. During four of the five periods when they were observed, white cattle had significantly lower ($P < .05$) body surface temperatures than either red or black cattle (Table 9). Black cattle tended to have slightly higher surface temperatures throughout the day as compared to red cattle.

Table 5. Comparison of body surface temperatures among coat colors (7-31-82).

Coat color	Time				
	7:30 am	10:30 am	1:30 pm	4:30 pm	7:30 pm
	Surface temperature, F				
Red	89.0	104.3[b]	107.1[a]	102.1	84.1[ab]
Black	92.3	113.1[a]	111.7[a]	103.3	86.5[a]
White	88.7	96.6[c]	90.8[b]	91.8	82.4[b]

[abc]Means in a column with different superscripts differ statistically ($P < .05$).

Table 6. Comparison of respiration rates among coat colors (8-21-82).

Coat color	Time		
	8:00 am	12:00 noon	4:00 pm
	Respiration rate, breaths/min		
Red	70.1	138.7	134.0[a]
Black	59.0	132.9	126.2[ab]
White	62.8	137.1	109.9[b]

[ab]Means in a column with different superscripts differ statistically ($P < .05$).

Table 7. Comparison of body surface temperatures among coat colors (8-21-82).

Coat color	Time		
	8:00 am	12:00 noon	4:00 pm
	Surface temperature, F		
Red	85.8	104.9[b]	107.9[a]
Black	88.1	114.9[a]	109.4[a]
White	86.8	96.1[b]	97.1[b]

[ab]Means in a column with different superscripts differ statistically ($P < .05$).

Table 8. Comparison of respiration rates among coat colors (9-4-82).

Coat color	Time				
	7:30 am	10:30 am	1:30 pm	4:30 pm	7:30 pm
	Respiration rate, breaths/min				
Red	40.4[ab]	95.3	131.8	113.3	82.9
Black	43.9[a]	97.1	134.5	106.2	86.1
White	28.8[b]	79.4	132.1	102.7	77.9

[ab]Means in a column with different superscripts differ statistically ($P < .05$).

Table 9. Comparison of body surface temperatures among coat colors (9-4-82).

Coat color	Time				
	7:30 am	10:30 am	1:30 pm	4:30 pm	7:30 pm
	Surface temperature, F				
Red	84.4	102.3[a]	107.3[a]	103.7[a]	86.2[a]
Black	85.7	105.7[a]	109.0[a]	106.8[a]	86.5[a]
White	----	92.0[b]	98.1[b]	94.0[b]	84.7[b]

[ab]Means in a column with different superscripts differ statistically ($P < .05$).

Table 10. Comparison of black versus white Holstein (9-4-82).

Item	Treatments	
	Black	White
Breaths/min	114.1[a]	84.4[b]
Body surface temperature, F	106.3[a]	93.6[b]

[ab]Means in a row with different superscripts differ statistically ($P < .05$).

Twelve Holstein steers were used to directly compare respiration rate and body surface temperatures by measuring both on six predominantly black animals and six predominantly white animals. This was at 6:00 pm, the hottest part of the day (92F). Respiration rate of black animals was 35 percent greater than that of white animals and body surface temperature of the black animals was 14 percent greater than that of white animals (Table 10). In summary, using respiration rate as an index of heat stress, black cattle appear more subject to heat stress than either red or white cattle, and white cattle appear least subject to heat stress. Surface temperatures of white cattle were consistently lower than colored cattle. With exposure to sun, light colored cattle should be more adapted to tropical or subtropical conditions or possibly to confinement situations where heat stress could be increased due to reduced air movement and radiation from other cattle.