Impact of Hair Coat on Thermoregulation in Brangus Heifers

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Synopsis
Heat stress has detrimental impacts on the beef cattle industry in the state of Florida causing producers and researchers to work towards the development of selection strategies for thermoregulation. Hair coat significantly impacts vaginal body temperature in Brangus heifers and the high amount of variation in the temperatures suggest that a genetic component may be influencing thermoregulation.

Summary
Daily body temperatures at 5-min intervals over a 5-day period were recorded on approximately 725 Brangus two-year old heifers from the Seminole Tribe of Florida during summer 2016. Hair coat is one of the many factors we are examining. Length and thickness of hair varies considerably not only between breeds but also within breeds. This variation suggests that selection for a coat advantageous for improved thermotolerance in cattle is possible. A repeated measures model was used to investigate the effect of coat score on body temperature The coat was scored as excessively smooth (score 1, n = 526), fairly smooth (score 2, n = 189) or long coat (score 3, n = 7). The coat score had a significant effect on body temperature, where heifers with excessively smooth coat had lower body temperature throughout the 3 days of continuous body temperature measurements indicating that coat type plays an important role in the control of body temperature.

Introduction
High production levels in livestock are dependent on a good environment while unfavorable environments could lead to lower productivity by not allowing the true genetic potential of the animal to be expressed. Heat stress is a major cause of economic loss for beef cattle producers in tropical and subtropical environments. To cope with harsh environmental conditions, many producers have introduced *Bos indicus* breeds into their herds. While this has improved the heat adaptability in the crossbred animals, it also introduced other challenges.

The hair type of an animal is one important factor influencing the ability of cattle to maintain a normal body temperature under extreme environmental conditions. Hair insulates the body by trapping air next to the skin, making heat exchange less efficient. More importantly, long and thick hair traps sweat, not allowing it to evaporate efficiently.

Materials and Methods
Data Collected on the ranch
This experiment was conducted in August to September of 2016 with a total of 725 two-year old Brangus heifers at the Seminole Brighton Reservation in Okeechobee, Florida. The experiment was conducted over 4 weeks with approximately 200 heifers per week.

Environmental variables were recorded. Temperature, humidity, and dewpoint temperature were measured using a HOBO U23 data logger. Additionally, two HOBO U22 data loggers recorded black globe temperature, with one being placed in the shade and the other in the sun at the location where the heifers were kept. All HOBO data loggers were programmed to take measurements every 15 minutes.

Vaginal temperature was measured for five consecutive days by I-button data loggers attached to a blank CIDR. Each week, data loggers were placed in all heifers on Monday and removed on Friday. The I-buttons were programmed to record temperature every 5 minutes. Several parameters to describe animal's response were developed, such as minimum and maximum vaginal temperature, the difference between minimum and maximum vaginal temperature, and time between minimum and maximum vaginal temperature.

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Each heifer was assigned a coat score based on the length and thickness of their hair. Coat score classes are as follows: 1) excessively smooth; 2) fairly smooth; 3) long coat. A photograph was taken of each animal to later confirm coat scores. A repeated measures model was used to investigate the effect of the coat score and body temperature. Additionally, hair samples were taken from the top coat and under coat of each heifer to be used for length and diameter measurements.

Results

Preliminary data from this ongoing research trial are summarized in Table 1. There was a good level of variation in the temperature-humidity index (THI) over the time period evaluated, ranging from a minimum of 73 to a maximum of 89. Previous studies suggest that 72 to 79 THI corresponds to mild level of heat stress, 80 to 89 THI represents moderate level of heat stress, and a THI greater than 90 is indicative of severe heat stress. There was also a high level of variation in the vaginal temperature (Figure 1), which ranged overall from 36.6°C to 42.3°C. Most importantly, the variation in the maximum vaginal temperature between 38.8°C and 42.3°C is suggesting that genetic variants controlling body temperature are segregating in Brangus cattle.

All heifers were managed on the same environment; therefore, the variation in vaginal temperature was not an effect of the environment. The coat was scored as excessively smooth (score 1, n = 526), fairly smooth (score 2, n = 189) or long coat (score 3, n= 7). The fairly smooth and long coat classes were combined into one due to the small number of long coat scores. The coat score had a significant effect on body temperature, where cows with excessively smooth coat had lower body temperatures throughout the 3 days of continuous body temperature measurements (Figure 2) indicating that coat type plays an important role in the control of body temperature. A slick dense coat provides a greater resistance to heat transfer to the skin and therefore reduces the heat gain from the environment when the animals is in sunlight. Differences in coat score significantly affected body temperature on the hottest day of the study. On average, animals with an excessively smooth coat score regulated their body temperature and kept themselves cooler than those with a coat score of fairly smooth.

Conclusion

Beef cattle producers in tropical and subtropical climates, such as Florida, feel the burden of economic losses caused by heat stress. Although producers have greatly improved the heat tolerance of their herds by introducing *Bos indicus* genetics, there is still room for improvement. The preliminary analysis of the data we have collected so far leads us to believe that there is a genetic component to thermotolerance. The goal of this study is to develop the genomic tools that can be implemented in selection programs in order to increase thermotolerance while still maintaining high production traits.

Acknowledgements

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Table 1. Summary statistics including mean, standard deviation, minimum, and maximum values of 725 two-year old Brangus heifers exposed to heat stress during summer 2016.

Variable[1]	Mean	Std Dev	Minimum	Maximum
Minimum vaginal temp, °C	38.42	0.29	36.36	39.36
Maximum vaginal temp, °C	40.05	0.54	38.77	42.30
Minimum THI	75.05	1.40	73.04	76.44
Maximum THI	86.60	1.91	84.00	89.14
Max-Min vaginal temp, °C	1.56	0.44	0.56	2.99

[1]Minimum and maximum vaginal temperature during 3 consecutive days, minimum and maximum temperature-humidity index (THI) during the same 3 consecutive days, and the difference between the minimum and maximum vaginal temperature for each heifer.

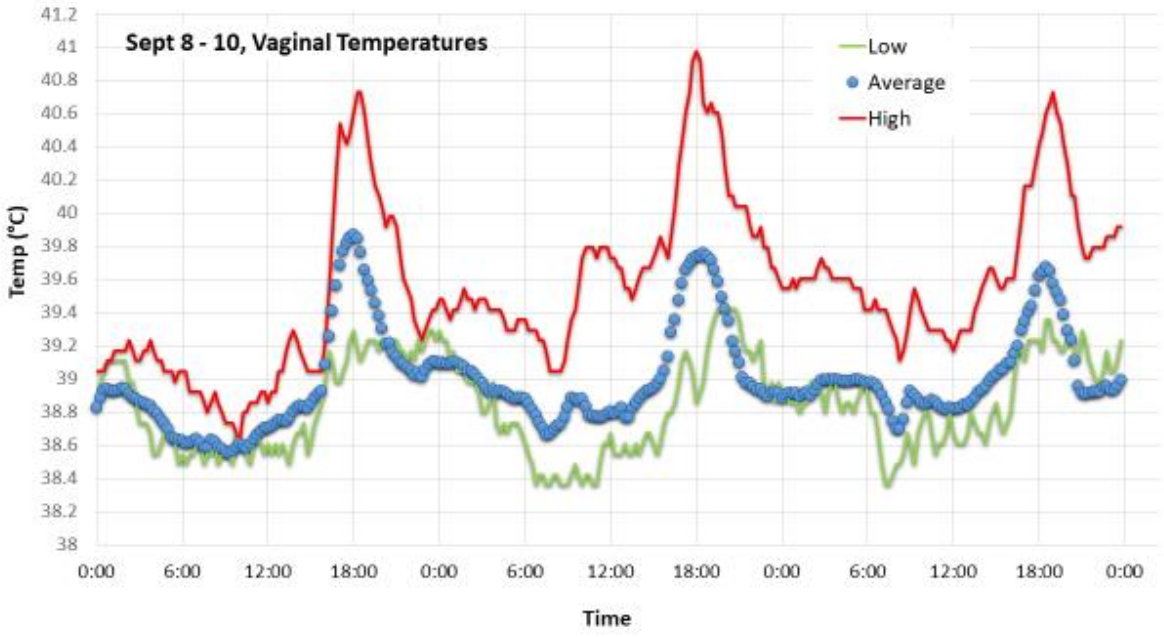

Figure 1. High (red), average (blue), and low (green) vaginal temperatures over a 3 day period.

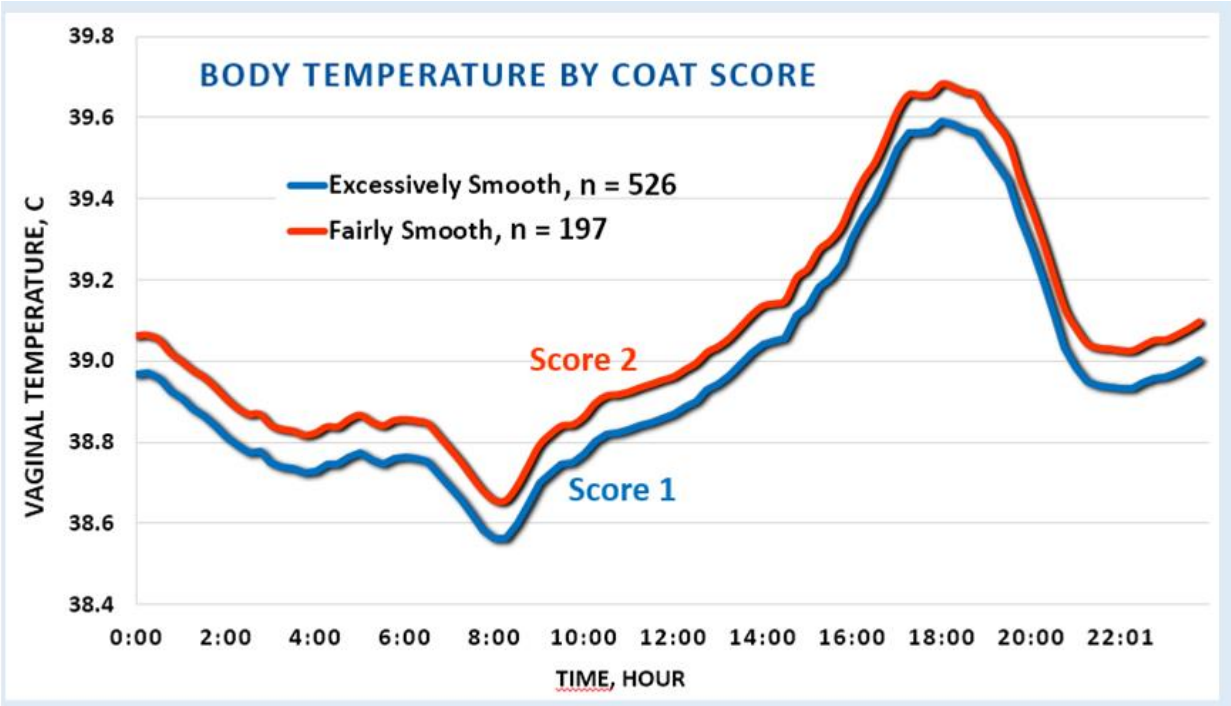

Figure 2. Relationship of vaginal temperature and coat score during a 24-h period. Excessively smooth = coat score 1, fairly smooth = coat score 2 and 3.

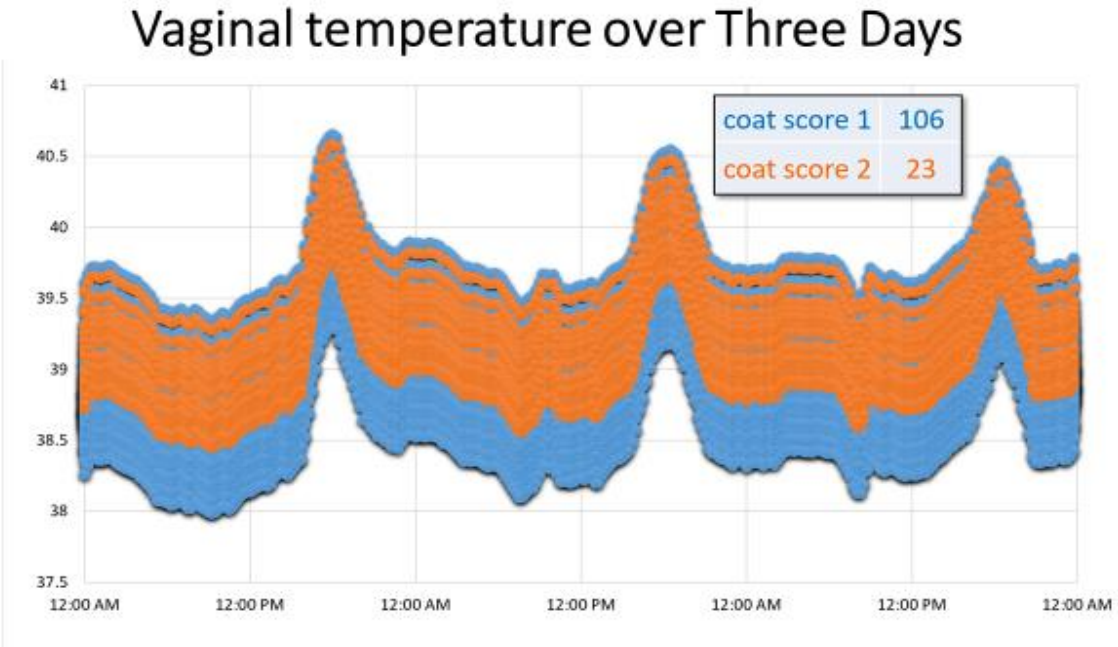

Figure 3. Relationship of coat score and vaginal temperature between coat scores and within coat scores over a 3 day period. Excessively smooth = coat score 1, fairly smooth = coat score 2.