

COMPARATIVE EVALUATION OF THE ADAPTIVE RESPONSES OF YANKASA AND SUDAN FAT-TAILED SHEEP IN THE TROPICAL HOT-DRY SEASON

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ABSTRACT

The aim of the study was to comparatively evaluate the variation in physiological parameters of Yankasa (n=10) and recently introduced, Sudan Fat-tailed (n=10) sheep during the peak of the hot-dry season in the Guinea Savannah climate. Results revealed that the rectal, skin, eye and hair temperatures, as well as respiratory and pulse rate were significantly higher in the afternoon as compared with the morning and evening hours in both breeds. The Sudan Fat-tailed exhibited lower ($P < 0.05$) skin and hair temperatures in the morning, while in the afternoon hours, they had higher ($P < 0.05$) eye temperature and heart rate compared with Yankasa sheep. There was no significant breed difference in respiratory rate and rectal temperature. It was concluded that although both breeds of sheep showed some variation in physiological response to the heat stress during the peak of the hot-dry season, they are equally adapted to the peak of the heat stress in the Guinea Savannah climate. However, the adaptive responses of Sudan Fat-tailed to other seasons need to be evaluated.

Keywords: Respiratory rate, Rectal temperature, Skin temperature, eye temperature.

INTRODUCTION

The high level of malnutrition in some African settlements and other developing nations can be reduced through improving the productivity of livestock. Low genetic production potentials is one of the factors limiting the productivity of livestock in Africa. Low productivity has been reported in some breeds inhabiting some regions of Africa resulting from lack of intensive efforts to develop more productive breeds through genetic improvement. Although introduction of high producing breed of livestock aid in improving productivity and human nutrition, adaptation of such breed to novel climates remain a consistent challenge (Cardoso *et al.*, 2015; Habibu *et al.*, 2017).

Variation in ambient temperature and relative humidity are the most challenging environmental conditions that affect productivity of animal that are poorly adapted to a thermal stress. To evaluate the adaptation of animals exposed to thermal stress, physiological parameters, including rectal temperature, body surface temperature, respiratory, sweating and pulse rates are commonly used (Sejian *et al.*, 2014). The aim of this study was to comparatively

evaluate the variation in physiological parameters of indigenous Yankasa sheep and the recently introduced Sudan Long Fat-tailed sheep during hot-dry season of the Northern Guinea Savannah.

MATERIALS AND METHOD

Experimental site:

The Yankasa

rams were sourced from the Small Ruminant Unit, Division of Agricultural College, Ahmadu Bello University, Zaria, Nigeria (Farm A), while the Sudan Long Fat-tailed breed were sourced from a private farm in Samaru (Farm B). The study was conducted in the peak of hot-dry season in April, 2016.

Experimental Design: This study was conducted during the peak of the hot – dry season (April). Twenty ($n = 20$) apparently healthy male animals belonging to Yankasa ($n = 10$) and Sudan Long Fat-tailed sheep ($n = 10$); aged between 1-5 years, body weight of 20 - 25 kg and 20-45 kg for Yankasa and Sudan Long Fat-tailed sheep, respectively. The body condition score of both breeds ranges between 2 – 2.9.

Meteorological Parameters: The values of dry (AT) and wet bulb temperatures in the pens where the experimental animals were housed were recorded three times a day at 09:00-10:00 h (morning), 13:00 - 14:00 h (afternoon) and 17:00 – 18:00 h (evening) for three consecutive experimental days using Mason's type hygrometer (GH Zeal limited, London, England). The relative humidity was extrapolated and the values of temperature humidity index (THI) calculated (Thom, 1959).

Determination of Physiological Variables: The physiological variables determined were rectal temperature (RT), respiratory rate (RR), heart rate (HR), eye temperature (ET), skin temperature (ST), hair temperature (HT) and scrotal length (SL). These parameters were measured in the morning (9:00h), afternoon (13:00 h) and evening (19:00 h) hours for three consecutive experimental days. The RT, body surface temperature, sweating rate (SR) and SL were measured using a digital thermometer, infrared thermometer, cobalt chloride paper and a measuring tape, respectively.

Data Analysis: The values obtained were expressed as mean ($\pm$ SEM). The data were subjected to student's *t*-test and repeated measure analysis of variance. The statistical package used was Graph pad prism version 5.01 for windows (2007) from Graph pad software, San Diego, California USA. Values of $P < 0.05$ were considered significant.

RESULTS AND DISCUSSION

Mean ($\pm$ SEM) values of ambient temperature (AT) and temperature humidity index (THI) of the experimental sites are presented in Table 1. According to the report of Khalifa *et al.* (2005), the sheep in the current study were exposed to severe heat stress since the THI was greater than 85.

Respiratory, heart and sweating rates: Mean ($\pm$ SEM) values of RR, HR and SL are presented in Table 2. Significantly higher ($P < 0.05$) values of HR and SL were observed during the afternoon and evening hours in Sudan Long Fat-tailed as compared with Yankasa sheep. Irrespective of breed, there was significant increase ($P < 0.05$) in RR during the afternoon

hours as compare with the morning hours. Similarly there was no significant breed difference in RR. There was no significant breed different in sweating rate (Figure 1) between the two breeds. The increase in RR, HR, ST, ET and HT during the afternoon hours in both breeds indicates a physiological response to stress, which was aimed at reducing body heat load (Saddiqi *et al.*, 2011). This is a thermoregulatory response to increase respiratory and cutaneous heat loss, (Crandall *et al.*, 2008; Habibu *et al.*, 2017). In agreement with the present study, increase in body surface temperatures during the afternoon hours has been reported in sheep exposed to solar radiation (Paim *et al.*, 2014).

Rectal and Body Surface Temperature : Mean ($\pm$ SEM) values of rectal, skin, hair and eye temperatures are presented in Table 3. The Yankasa sheep had significantly higher skin temperature in the morning hours than the Sudan Long Fat-tailed sheep, where as, the Sudan Long Fat-tailed sheep showed higher eye temperature than Yankasa sheep at all times of the day. The afternoon hours had higher ($P < 0.05$) values of all temperatures than the morning and evening hours. No significant breed variation was observed in rectal and hair temperature during morning, afternoon and evening hours. The higher ET, HR and SL in Sudan Long Fat-tailed sheep as compared with the Yankasa sheep may be inherent due to the adaption of the Sudan Long Fat-tailed sheep to the hot Sudan belt of Africa. On the other hand, the lower ST in Sudan Long Fat-tailed sheep during the morning hours may indicate that this breed of sheep are less affected by the rise in ambient temperature during the morning hours. Similarly, breed difference in skin temperature has been reported in cattle exposed to heat stress (Cardoso *et al.*, 2015).

CONCLUSION

Diurnal variations occur in rectal, skin, eye and hair temperatures as well as respiratory rate and heart rate in Yankasa and Sudan Long Fat-tailed sheep. Both the indigenous Yankasa and the recently introduced Sudan Fat-tailed sheep

showed similar thermoregulatory responses during heat stress. More studies are needed to evaluate the thermoregulatory responses of Sudan Fat-tailed sheep in other seasons of the Northern Guinea Savannah Zone of Nigeria.

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Table 1. Mean values of metrological parameters for morning, afternoon and evening during hot-dry season at DAC and Samaru Farms

	Morning	Afternoon	Evening
AT			
Farm A	29.70 ± 0.12 ^x	37.7 ± 0.12 ^y	26.30 ± 0.29 ^x
Farm B	29.78 ± 0.41 ^x	36.10 ± 0.09 ^y	25.89 ± 0.89 ^z
THI			
Farm A	86.45 ± 0.05 ^x	89.67 ± 1.42 ^y	78.80 ± 0.00 ^x
Farm B	85.57 ± 0.41 ^x	89.67 ± 1.42 ^x	78.80 ± 0.30 ^y

Values with different superscripts (x, y) within the same row are statistically significant (P < 0.05).

Table 2: Results showing respiratory rate, heart rate, scrotal length and diurnal variation within and between the two breed of sheep

	Morning	Afternoon	Evening
RR			
Yankasa	90.12 ± 1.74 ^x	102.12 ± 1.80 ^y	88.8 ± 3.04 ^x
Sudan	94.28 ± 1.56 ^x	101.08 ± 1.8 ^y	88.8 ± 3.00 ^x
HR			
Yankasa	31.35 ± 1.33	73.4 ± 1.23 ^a	73.40 ± 1.79 ^a
Sudan	72.84 ± 1.10 ^x	78.65 ± 1.99 ^{b,y}	74.2 ± 1.13 ^{b,y}
SL			
Yankasa	15.67 ± 0.55 ^a	16.37 ± 0.54 ^a	16.10 ± 1.02 ^a
Sudan	21.63 ± 1.11 ^b	21.80 ± 1.20 ^b	22.10 ± 1.95 ^b

Superscript ^{a,b} alphabets were used to indicate significant differences between breeds and superscripts ^{x,y,z} alphabets were used to indicate significant differences or diurnal variation within and between the two breeds of sheep.

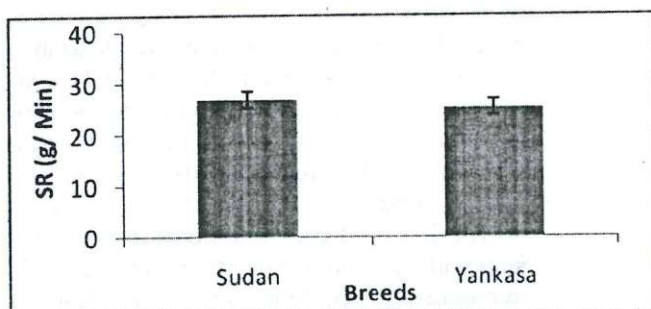


Figure: 1: Effect of the hot-dry season on sweating rate of Yankasa and Sudan Fat-tailed sheep. (P> 0.05)

Table 3 : Mean (±SEM) values of rectal, skin , hair and Eye temperatures in Yankasa and Sudan Long Fat-tailed Sheep during the morning, afternoon and evening hours.

	Morning	Afternoon	Evening
RT			
Yankasa	38.82 ± 0.07 ^x	39.26 ± 0.09 ^y	38.20 ± 0.16 ^z
Sudan	38.87 ± 0.06 ^x	39.25 ± 0.06 ^y	38.93 ± 0.09 ^x
ST			
Yankasa	37.22 ± 0.13 ^{a,x}	37.35 ± 0.14 ^y	34.08 ± 1.30 ^y
Sudan	36.58 ± 0.19 ^{b,x}	37.41 ± 0.16 ^y	35.69 ± 0.23 ^z
HT			
Yankasa	35.07 ± 0.22 ^x	73.73 ± 1.28 ^y	34.16 ± 0.26 ^x
Sudan	34.31 ± 0.40 ^x	78.73 ± 1.96 ^x	74.2 ± 1.13 ^y
ET			
Yankasa	36.69 ± 0.26 ^{a,x}	37.69 ± 0.25 ^{a,y}	37 ± 0.26 ^{a,x}
Sudan	34.05 ± 0.40 ^{b,x}	36.68 ± 0.23 ^{b,x}	35.54 ± 0.32 ^{b,y}

Superscripts ^{a,b} alphabets were used to indicate significant differences between breeds and superscripts ^{x,y,z} alphabets were used to indicate significant differences or diurnal variation within and between the two breeds of sheep.