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EFFECTS OF SEASON AND DIURNAL PERIOD ON THE BODY PHYSIOLOGY OF NIGERIAN SHEEP BREEDS

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Target Audience: Breeders, sheep producers

ABSTRACT

Eight 2-year-old adult ewes each belonging to Balami, Ouda, WAD and Balami X WAD were used in an experiment to determine the effects of dry and rainy seasons, and diurnal (morning and afternoon) period on the rectal temperature (RT), Pulse rate (PR) and respiration rate (RR) of Nigerian sheep breeds.

The highest climatic values were recorded mostly during the dry season, in the afternoon hours from: ambient temperature (31.56°C), radiation intensity (1.16Kcalcm^{-2}), maximum temperature (31.87°C), minimum temperature (21.87°C), dry bulb temperature (31.87°C), wet bulb temperature (23.27°C) and wind velocity (11.13kmhr^{-2}). However, the relative humidity had the highest (84.0%) value during the rainy season, in the morning hours. Most of the climatic variables were positively correlated to ambient temperature, except the relative humidity which had negative correlation (-0.08) with ambient temperature.

The results obtained suggested that season and diurnal period produced significant ($P<0.05$) influences on RT, PR and RR, mostly in Balami and Ouda, with the highest physiological values obtained during the dry season, in the afternoon hours.

Balami X WAD produced the narrowest RT (38.13-38.60°C), and lowest PR (70.07 beats/min.) and RR (33.22 breaths/min.). WAD ranked second in producing low PR (75.44 beats/min.) and RR (37.46 breaths/min.). On the contrary, season and diurnal period elevated the physiological parameters especially the PR (78.02 and 81.54 beats/min.) and RR (58.72 and 58.80 breaths/min.) of Balami and Ouda respectively.

This study suggests that Balami X WAD followed by WAD are the Nigerian sheep breeds better adapted to the humid tropical climate.

Keywords: Season, diurnal period, physiological responses, Nigerian sheep breeds, humid climate.

INTRODUCTION

The aim of this study was to ascertain the seasonal changes in body

physiology (rectal temperature, pulse and respiration rates) of Nigerian major breeds of sheep and to clearly identify the critical thermal threshold at which vital physiological processes are influenced in humid tropical climate. Information on the acclimatisation of sheep to warm wet climate is scarce. Degan (1) studied body temperature in semi-arid climate. He observed that sheep are not different from goats when confronted with thermal stress and they make effective use of their homeostatic mechanism for survival and production. Performance indices of the West African Dwarf goat under an improved management system in the sub-humid zone of Nigeria was reported (2). They noticed that there were strong similarities in performance of the breed in the humid and sub-humid zones of Nigeria. However, the needed information on the adaptability of Nigerian breeds of sheep to different seasons and diurnal period in the humid climate were lacking, hence this investigation was carried out.

MATERIALS AND METHODS

This study was undertaken on 8 adult ewes each belonging to Balami, Ouda, West African Dwarf (WAD) breeds and Balami X WAD crossbreed of sheep. Rectal temperature, pulse and respiration rates of these animals were recorded before feeding and watering in the morning at 6.30 a.m. and in the afternoon at 3.30 p.m. after resting for 1 hour in the shed, at fortnightly intervals from April 1999 to March 2000.

Rectal temperature was determined with a caliberated clinical rectal thermometer by inserting it through the rectum at a predetermined depth of 8cm. The pulse rate was observed with a standard clinical stethoscope by placing it at the ventral wall of the chest. Respiratory rate was determined by either counting the flank movements during cold weather or the "*Dilator naris lateralis*" muscle of the nose during the hot weather (3).

The animals were sent out for grazing during the period under study. The periods under investigation were divided into two distinct seasons: the rainy (April – October) and the dry (November – March) seasons; and also morning and afternoon hours in accordance with the procedures of Nwakalor *et al.*, (4), and Umesiobi and Iloeje (5) respectively.

Between the physiological measurements, radiation intensity, wind velocity, wet bulb and dry bulb temperatures, and maximum and minimum temperatures were read from Gunbelanni, 3-cup anaemometer, a motor-aspirated psychrometer, and a maximum and minimum thermometers respectively at the Metereological Station, near the site of the experiment at Federal University of Technology, Owe.

The relationships between the climatic and physiological parameters were

variance was used to test for significant effects between the various parameters (7). Significant means were separated using Duncan Multiple Range Test procedure (8)

RESULTS AND DISCUSSION

The seasonal and diurnal climatic conditions of the experimental site is presented in Table 1. The effects of season and diurnal period on the rectal temperature, pulse and respiration rates of the Nigerian sheep breeds are shown in Table 2. Mean square values for effects of season, rectal temperature diurnal period, breed and interactions on the body physiology of sheep are summarised in Table 3. Correlations of certain climatic factors with the body physiological responses of sheep are extrapolated in Table 4.

Table 1: Seasional and diurnal climatic condition of the experimental site

	SEASON AND DIURNAL PERIOD OF THE YEAR							
	RAIN				DRY			
	Morning		Afternoon		Morning		Afternoon	
Climatic Variables	Mean	± SE	Mean	±SE	Mean	± SE	Mean	±SE
Ambient air Temperature (C)	20.18[a]	0.09	25.62[b]	0.06	27.49[c]	0.16	31.56[d]	0.39
Radiationintensity (Kcal cm-2)	0.90[a]	0.003	0.824[b]	0.003	0.92[c]	0.004	1.16[d]	0.002
Maximun temperature (C)	26.70[a]	0.22	2946[b]	0.11	28.68[c]	0.19	31.81[d]	**0.05**
Minimum temperature (C)	15.32[a]	0.10	18.53[b]	0.13	19.50[c]	0.11	21.87[d]	**0.04**
Dry bulb temperature (C)	20.68[a]	0.08	25.03	0.03	27.85[c]	0.04	31.27[d]	0.08
Wet bulb temperature (C)	18.58[a]	0.08	20.23[b]	0.75	22.97[c]	0.17	23.81[d]	0.19
Relative hmidity(%)	84.0[a]	0.34	82.10[b]	0.45	65.36[c]	0.59	52.55[d]	0.61
Wind Velocity(Km/hr)	7.80[a]	0.18	4.79[b]	0.68	4.25b[c]	0.80	11.13[d]	0.30

The lowest ambient air temperature (20.18°C) was recorded at 6.30 am (morning hours) in the rainy season with the highest value (31.56°C) recorded at 3.30 pm (afternoon hours), during the dry season. However, the lowest maximum temperature (26.70°C) read at 6.30 a.m. in the rainy season and highest (31.87°C) at 3.30 p.m., during the dry season seemed to be related to the dry-bulb thermometer reading which also had its lowest (20.68°C) and the highest (31.27°C) values at 6.30 a.m. in the rainy season and 3.30 p.m., during the dry period respectively. On the other hand, the minimum temperature correlated to the wet bulb thermometer. The minimum temperature (15.32°C) and the wet bulb thermometer (18.58°C) were recorded at 6.30 a.m. during the rainy season with 21.87°C and 23.81°C being their respective highest values observed at 3.30 p.m. in the dry season (Table 1).

Table 2: Effect of Season and diurnal period on the rectal temperature, pulse and respiration rates of Nigerian breeds of sheep.

	RECTAL TEMPERATURE				PULSE RATE				RESPIRATION RATE			
	RAIN		DRY		RAIN		DRY		RAIN		DRY	
Breeds	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Balami	38.29[a] +0.04	39.44[b] +0.04	39.32bc +0.04	39.70d +0.02	70.0a +0.23	80.55b +0.27	72.88c +0.21	78.02d +0.15	40.0a +0.51	55.58b +0.60	63.0c +0.65	76.29d +0.72.
Ouda	38.60[a]	39.03[b]	39.40c	39.90d	78.37a	79.76b	80.52bc	81.54d	43.40a	76.20b	46.61c	59.0d
WAD	38.13[a] +0.05	38.21[a] +0.44	38.30ab +0.04	39.70c +0.02	65.68a 0.23	70.0b +0.23	70.91c +0.26	75.44d 0.25	25.70a +0.35	35.0b +0.59	43.0c +0.58	46.12d +0.55
Balami X WAD	38.13 +0.05	38.14 +0.04	38.36b +0.05	38.60c +0.03	63.74a +0.22	65.58b 0.23	62.07d +0.20	70.07[d] 0.24	25.20a 0.35	29.51b +0.037	34.11c +0.56	44.05d. +0.58

a,b.c.d: Within each row of a parameter, figures differently supercripted are significantly ($P<0.05$) different.

Table 3. Mean Square(MS) values for effects of season, diurnal period, breed and interactions on the body physiology of sheep.

Source of variation	d.f	Rectal Temperature	Pulse Rate	Respiration Rate
Breed (B)	3	1.21	333.30*	339.04**
Season (S)	1	8.09*	1858.41*	914.22*
Diurnal (D)	1	324.10*	1190.11	847.05*
B X S	3	0.20	31.73	109.51
B X D	3	0.44	200.06	315.84
S X D	1	1.86*	900.20	494.95*

* ($p<0.05$)

**($p<0.05$)

Table 4: Correlations between the climatic factors and the body physiology of sheep

Parameters	Ambient temp. (°C)	Radiation intensity (Kcal cm^{-2})	Relative humidity(%)	Wind velocity (Km/hr)	Pulse rate (beats/min)	Respiration rate (breaths/min)
Ambient air temperature (C)						
Radiation intensity (Kcal cm-2)	0.004					
Relative humidity (%)			-0.08			
Wind velocity (Km/hr)				0.71		
Rectal temperature(C)	0.93	0.01	-0.95	0.60		
Pulse rate (beats/min)	0.99	0.01	-0.78	0.75	0.91	0.98
Respiration rate (breaths/min)	0.97	0.46	-0.74	0.86		0.85

The radiation intensity had its highest value (1.16 Kcal cm^{-2}) at 3.30 p.m. during the dry season with the lowest (0.90 Kcal cm^{-2}) value observed at 6.30 a.m. in the rainy season. The radiation intensity was weakly correlated to ambient temperature (r=0.004) as shown in Table 4. The relative humidity of 84% was recorded at 6.30 a.m. during the rainy season and 52.55% at 3.30 p.m. in the dry period. Relative humidity showed a strong negative

correlation with the ambient air temperature (-0.08). The highest wind velocity of 11.13 km/hr was observed at 3.30 p.m. during the dry season and the lowest value (4.25 km/hr) recorded at 6.30 a.m. in the dry season. Wind velocity was strongly correlated to ambient temperature (r=0.71).

Rectal Temperature:

The average rectal temperature (RT), ranged from 38.13 to 39.90°C (1.77°C) among these breeds of sheep. This range was widest from 38.13 to 39.70°C (1.57°C) in WAD and narrowest, 38.29 to 39.70°C (1.41°C) in Balami. The differences between breeds of sheep were not significant ($P>0.05$). However, significant ($P<0.05$) differences were observed between season (Table 3). It was highest (39.16°C) in dry and lowest (38.50°C) in rainy seasons respectively (see Table 2). The RT in the afternoon was higher (39.09°C) than those in the morning (38.57°C) hours. Significant ($P<0.05$) interactions were observed between season and diurnal period (Table 3). It was similar to those reported for different breeds of sheep (3, 9, 10).

Rectal temperature was significantly ($P<0.05$) correlated to climatic temperature and also to radiation intensity, relative humidity and wind velocity (see Table 4). However, there was a negative regression ($Y=26.92+0.09X$) between the rectal temperature and ambient temperature.

Pulse Rate:

Significant ($P<0.05$) differences were observed among breeds in pulse rate (PR) as shown in Table 3. Highest PR of 81.54 beats/minute was recorded in Ouda during the afternoon hours, in the dry season. This was followed by Balami (78.02 beats/min.), WAD (75.44 beats/min.) and Balami X WAD (70.07 beats/min.). Lowest PR (69.45 beats/min.) were recorded in the morning hours, during the rainy season, with the highest PR (76.27 beats/min.) noticed during the afternoon period, in the dry season (see Table 2).

On average basis, PR differed significantly ($P<0.05$) from 65.37 beats per minute to 80.05 beats per minute among these breeds. These reports agreed with the findings (11). However, these values were higher than those documented by Wilson (12) for Sahel goats and sheep which may be attributed to smaller body size.

Like RT, significant ($P<0.05$) differences were found between seasons in case of pulse rate (see Table 2). It was lowest (70.01 beats/min.) during the dry season and highest (73.93 beats/min.) in the rainy season. An inherent lower PR in dry season was also reported in sheep (13, 14, 15) which may be a concomitant effect of lower metabolic rate due to reduction in food intake during hotter season. On the other hand, increase in PR could be as a result of greater grazing activity in the pasture during the rainy season, mostly in the morning hours. Significant ($P<0.05$) differences

were also noticed between morning (72.78 beats/min.) and afternoon (70.86 beats/min.) hours values (Table 2). Breed of the animals significantly ($P<0.05$) influenced the responses of PR during the entire periods of study (Table 3).

The pulse and respiration rates, both showed strong correlations with rectal temperature (see Table 4). The regression analysis showed a negative relationship ($Y=35.99+1.36X$) between the pulse rate and the ambient air temperature.

Respiration rate:

Highly significant ($P<0.01$) differences were recorded between breeds in respiration rate (RR). It was highest (58.72 breaths/min.) in Balami and lowest (33.22 breaths/min.) in Balami X WAD. The range of RR observed in this study agreed with the reports of Iji *et al.,* (2) and (10).
Significant ($P<0.05$) differences were also observed between season and respiration rate. Respiration rate was highest (51.52 breaths/min.) in the dry season and lowest (41.32 breaths/min.) in rainy season. A marked respiratory response to a given heat load (with a corresponding increase in the relative humidity) found mostly in Balami and Ouda respectively, may be, in general, an indication of a poorly adapted animal (16, 17, 10). Differences between morning (40.13 breaths/min.) and afternoon (52.72 breaths/min.) values were significant ($P<0.05$). Interaction effects were observed between season, diurnal period and breed (Table 3).

There was a negative regression ($Y=-66.61+4.33X$) between respiration rate and ambient air temperature. However, the respiration rate was positively correlated ($P<0.05$) to the ambient air temperature, radiation intensity and wind velocity, except the relative humidity which showed negative relationship ($r=-0.74$) as tabulated in Table 4.

CONCLUSION

Results of this study suggest that season (rainy and dry seasons) and diurnal period (morning and afternoon hours) produced significant ($P<0.05$) effects on rectal temperature, pulse and respiration rates of Nigerian major breeds of sheep.

Balami X WAD had the narrowest rectal temperature (38.13 – 38.60°C) and lowest pulse rate (70.07 beats/min.) and respiration rate (33.22 breaths/min.). WAD ranked second in maintaining a low pulse rate (75.44 beats/min.) and respiration rate (37.46 breaths/min.). On the contrary, season and diurnal period significantly ($P<0.05$) affected the cardiovascular and respiratory characteristics of Balami and Ouda.

From this study, it can therefore, be concluded that Balami X WAD followed

by WAD are the Nigerian breeds of sheep better acclimatised to the humid tropical climate.

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