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Interrelationship studies between heat stress traits, blood andserum biochemical indices of extensively managed Nigerian Sheep

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Abstract: *The exposure of sheep to elevated ambient temperatures induces an increase in the dissipation of excess body heat, in order to overcome this excessive environmental heat load. Dissipation of excess body heat is emitted by evaporation of water from the respiratory tract and skin surface via panting and sweating.The following heat stress traits were measured; body temperature, rectal temperature, pulse rate and respiratory rate after the sunrise and before the sunset. While blood and serum biochemical indices measured were blood glucose, total serum protein, globulin, cholesterol and triglycerides. No significant relationship($P>0.05$) was recorded between heat stress traits and blood biochemical indices studied. However, we observed a positively significant ($P<0.01$) relationship betweenblood and serum biochemical indices studied. Similarly, a positively significant ($P<0.01$) relationship was observed between heat stress traits examined.*
Keywords: *Ambient, temperature,blood biochemical indices, heat stress, traits, sheep.*

I. Introduction

Livestock performance is affected by heat stress because an animal having difficulty in dissipating excess body heat to its environment. Thisheat if not dissipated will decrease animal production by lowering feed intake, lactation, growth, gestation/conception, embryogenesis, morbidity among others. Environmental heat stress affects the maintenance energy because the body may be at higher temperature resulting in greater metabolic action and also energy is used to increase heat dissipation (Morrison, 1983). Metabolic heat includes that which is necessary for maintenance plus increments for physical exercise, growth, lactation, and gestation and feeding. High rates of these activities will result in more heat gain from metabolism (Fuquay, 1981).

Heat stress is caused by those factors that decrease heat transfer from an animal to its environment, which would include high air temperature, high air humidity, low air movement and thermal radiation load. Air temperature is usually the primary cause of heat stress, although other factors may intensify the stress (Morrison 1983).There are great challenges concerning the welfare of animal in many tropical countriesvis a vis production performances. Recent developments in housing and management practice of farm animals under intensive systemsreflect the increase concerns aboutanimal welfare and production efficiency. There is much knowledge regarding the interaction between heat stress and livestock productivity under intensive management systems. Environmental heat stress load is a major constraint on animal productivity in the tropical belt and arid areas (Silanikove, 1992). The effect of heat stress is also substantial in the subtropical-Mediterranean zones.

In tropical and sub-tropical areas, indigenous sheep tend to breed throughout the year, although the sexual activity is largely influenced by environmental heat stress (Marai*et al*., 2004). In such regions, a high ambient temperature is the major constraint on animal productivity (Marai*et al*., 1995and Shelton, 2000). This effect is aggravated when heat stress load is accompanied by high ambient humidity (Marai*et al.*, 1997 and Abdel-Hafez, 2002). Exposure of sheep to elevated temperatures results in decrease of body weight, average daily gain (ADG), growth rate and body total solids which is reflected by impaired reproduction (Marai*et al*., 1995; Shelton, 2000 and Abdel-Hafez, 2002). The possible mechanisms involved in inducing the biological changes in heat-stressed sheep could have definite applications. However, there is very little discussion in the scientific literature regarding the interrelationships between heat stress traits and biochemical indices of sheep under extensively managed system. In this wise, this study intends to unravel the interrelationship existing between heat stress traits and blood biochemical indices of Nigerian sheep.

II. Materials and method

2.1 Animals and sampling

One hundred and sixty-one (161) sheep were sampled from four geographical locations in Nigeria namely South-West (Ogun), North-West (Kaduna, Sokoto, Kano, Katsina, Kebbi), North-East (Bauchi and Borno) and North-Central (Jos). Four extant breeds of sheep (Balami, Yankassa, Uda and West African Dwarf) were sampled and 40 animals were sampled per breed except Balami where 41 were sampled. The data set were comprised of 49 (South-West), 53 (North-West), 34 (North-East) and 25 (North-Central) regions of Nigeria. 10ml of blood was collected via the jugular vein into anti-coagulant EDTA bottle except for serum biochemical indices whose blood was allow to clot to separate the serum by centrifugation of the blood at 1000 revolution/min.and was immediately refrigerated. The animals originated from different herds and were reared under the traditional extensive system where they grazed during the day on natural pasture containing forages such as stylo (*Stylosanthesgracilis*), leucaena (*Leucaenaleucocephala*) and guinea grass (*Panicum maximum*), crop residues and scavenged on kitchen wastes whenever available.

2.2 Physiological Indices/heat tolerant traits and Serum biochemical references measurement

Digital thermometer was used to measured body temperature via the fore limb armpit of the Sheep. Rectal temperature was measured with the digital thermometer placed about 2 cm into the rectum, while pulse rate was measured in beats per minute using a stethoscope placed on the 4th half intercostal space. Respiratory rate was measured in breaths per minute by counting the number of flank movements (breaths) per minute using a stop watch and stethoscope. The heat stress traits were measured after the sun rise and before the sun set.The following blood and serum biochemical indices were measured according to Jain (1986); blood glucose (BG), total serum protein (TSP), triglycerides (TGS), cholesterol (CHOL) and globulin (GLB).

2.4. Statistical Analysis

The correlation analyses between heat stress and blood serum biochemical indices were estimated using PROC GLM of SAS version 9.1 (SAS, 2009).

III. Results

3.1Correlation between heat stresstraits and blood and serum biochemical indices of extensively managed Nigerian sheep

Table 1 shows no significant ($P>0.05$) relationship between heat stress traits and blood biochemical indices considered. The results obtained from this study observeda positively significant ($P<0.05$) relationship between blood glucose and total serum protein ($r = 0.435$), blood glucose and albumin showed a positive correlation ($r = 0.396$). A positively significant ($P<0.01$) relationship was also observed between albumin and total serum protein ($r = 0.901$). Globulin and total serum protein recorded a positive interrelationship($r = 0.757$). In the same trend, globulin also showed a positive interrelationship with albumin (0.407) (Table 1). Table 1 also showed a positively significant ($P<0.01$) relationship between globulin and cholesterol ($P<0.719$). Cholesterol recorded a positive correlation with triglycerides (0.362) (Table 1).

Similarly,a positively significant ($P<0.01$) relationship was recorded between pulse rate and respiratory rate ($r = 0.608$), pulse rate and body temperature ($r = 0.479$) demonstrated a positive interrelationship ($P0<0.1$) as shown in table 1. In the same trend, respiratory rate was observed to have a positively significant ($P<0.05$) relationship with body temperature (0.341). Finally,body temperature showed a positively significant ($P<0.01$) relationship with rectal temperature ($r = 0.633$). (Table 1)

Table 1.Correlation between heat stress traits and blood biochemical indices of extensively managed Nigerian sheep

	Blood glucose (Mg/dl)	Total protein (g/L)	Albumin (g/L)	Glob-ulin (g/L)	Choles-tereol Mg/dl	Trigly-cerides Mg/dl	Pulse rate (Bpm)	Resp.rate (Bpm)	Body temp. (^{O}C)
Total protein (g/L)	0.435*								
Albumin (g/L)	0.396*	0.901**							
Globulin (g/L)	0.312^{NS}	0.757**	0.407*						
Choleste-rol (Mg/dl)	0.362*	0.166 ^{NS}	0.690 ^{NS}	0.215 ^{NS}					
Triglycerides (Mg/dl)	0.280^{NS}	0.112 ^{NS}	0.043 ^{NS}	0.140 ^{NS}	0.719**				
Pulse rate (Bpm)	0.580^{NS}	0.329 ^{NS}	0.301 ^{NS}	0.230 ^{NS}	0.044 ^{NS}	0.212 ^{NS}			
Respirato-ry rate (Bpm)	0.900^{NS}	0.124 ^{NS}	0.163 ^{NS}	0.020 ^{NS}	0.052 ^{NS}	0.268 ^{NS}	0.608**		
Body temp.(^{O}C)	0.300^{NS}	0.100 ^{NS}	0.122 ^{NS}	0.041 ^{NS}	0.032 ^{NS}	0.180 ^{NS}	0.479**	0.341*	
Rectal temp.(^{O}C)	-0.290^{NS}	0.182 ^{NS}	0.146 ^{NS}	0.122^{NS}	-0.130 ^{NS}	0.29^{NS}	0.238 ^{NS}	0.180^{NS}	0.633**

NS: Non-significant
** Correlation significant (P<0.05)*
*** Correlation significant (P<0.01)*

IV. Discussions

The correlation analyses results shows that a positively significant relationship were observed between pulse rate, respiratory rate, rectal temperature and body temperature. This implies that alteration in any of the heat stress traits (respiratory rate, pulse rate, body temperature and rectal temperature) due to high ambient temperature, solar radiation/sunshine intensity, environmental heat load, extreme of weather and disease will elicit a corresponding change in other heat stress traits (respiratory rate, pulse rate, body temperature and rectal temperature) of extensively managed Nigerian sheep. This result is in agreement with the earlier findings of condition (Bianca, 1976; Bahga *et al*., 1984; Oladimeji *et al*.; 1996; West, 1999; Butswat *et al*., 2000). Oladimeji *et al*., 1996; West, 1999 and Butswat *et al*., 2000). Similarly, a positively significant relationship was observed between all blood biochemical indices studied, this implies a unit change in one index will trigger a spontaneous change in another where interrelationship exits. This change could be disease condition which could be triggered by high environmental heat stress load (Ju*et al*., 2011). Previous research showed that high environmental heat temperature predisposes animal to disease condition which may explains the immunosuppression that takes place in animals suffering from severe heat stress (Lindquist 1986 and Lacetera *et al*., 2006)

Conclusively, rectal temperature, respiratory rate and body temperature can be used as good assessment of heat stress in sheep especially in the hot humid tropics because they are excellent indicator of physiological response of examining heat stress modulation, thermo-regulatory mechanisms and adaptability to extremes of weather and thermal environment e.g disease condition, intense sunshine, solar radiation and cold. In view of the above farmer should endeavor to put in place adequate managemental measures to mitigate the effect of environmental heat stress load on extensively managed sheep in the hot humid tropics with view to enhancing production performance, health and attenuating economic loss.

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