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Effect of age, sex and hemoglobin type on adaptive and blood biochemical characteristics in Red Sokoto Goats

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ABSTRACT:

This study was conducted to evaluate the effect of haemoglobin (Hb) types, sex and age on adaptive and blood biochemical characteristics of Red Sokoto goats. Ninety four (94) goats were sampled from two locations: Dei-dei and Gwagwalada grazing reserved, Abuja. Data were collected on adaptive characteristics {heart rate (HR) and rectal temperature(RT) and adaptive coefficient (AC) was calculated from the HR and RT} and blood biochemical characteristics{ haemoglobin (Hb) types, Hb-concentration (Hb-conc), Potassium concentration (K-conc) and albumin concentration (alb-conc)}. The effects of haemoglobin type, sex and age on the adaptive and blood biochemical characteristics of the goats was analyzed by general linear model (GLM) procedure of SAS. The results showed that the mean RT of the sampled goats was 38.9°C with very minimal variations (CV=0.5). The mean HR of the goats was 76.1bpm, with min and max HR of 70 and 80bpm. The mean albumin, Hb and K concentration were 38.4g/l, 8.9g/dl and 4.0Mmol/l, respectively. The variation of Hb type with adaptive and blood biochemical characteristics was significant ($P<0.05$) except Hb concentration. Higher HR was observed in goats with Hb AA and AB. Age and sex had significant effect ($P<0.05$; $P<0.01$) on HR, AC and albumin concentration of the goats. Although there was no trend in the variation of HR and AC with age, but HR and AC were higher in the older goats than the younger, however the albumin concentration significantly decreased with progressive increase in age of the goats.

Keywords:

Adaptive coefficient, heart rate, rectal temperature, blood biochemical characteristics.

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INTRODUCTION

In recent years, advances in the field of biotechnology have opened up a completely new area at molecular levels with the introduction of techniques such as routine electrophoresis employed for detection of polymorphism at protein and enzyme loci as well as other serological and immunogenetic procedures for the measurement of variations (Salako *et al.,* 2007). Data obtain from this type of study could be useful as genetic markers for important economic characteristics and could aid significantly in selection of superior animals for breeding purposes.

Haemoglobin typing is very important as different Hb types may have selective advantage in different geographical regions (Ndamukong, 1995). Economic pressures of various kinds are forcing the production of livestock into climatic environments that are increasingly more remote from the considered ideal for optimal production and feed utilization.

Thermal stress, which is one of the major factors that affect the productivity of many farm animals can be reflected in an easily observable changes in pulse rate, respiration rate, and rectal temperature, although the whole body reacts to thermal stress by an elaborate series of chain reactions (Ahmed, 2004). The most obvious index of thermal stress is body temperature response. Deviation from normal rectal temperature indicates that the animal is under stress, that its homeothermic mechanisms are overtaxed Ahmed, 2004).

Adaptive characteristics of animals serve as a key to managing any livestock operation. Adaptive traits such as rectal temperature, heart rate, and flank movement have been documented to have some significant effect on genetic variations. Every normal animal has a range of individual adaptive traits in relation to a specific physiological pattern.

Because study of environmental physiology involves so many variables and scientific discipline, much is being published on this subject especially as related to farm animals. Comprehensive reviews have appeared under the authorship of Alderson, 1992, Derman and Noakes, 1994, Tambuwal *et al.,* (2002), Otoikhian *et al.,* 2009, chukwuka *et al.,* 2010, Opara *et al.,* 2010, Gurcan *et al.,* 2010 and a lot of others. Research results reported in this paper is intended to supplement data reviewed by authors listed. Eventually, accumulated data will permit specific recommendation on breeding, feeding and management of farm animals.

This study therefore aimed at studying the effects of Haemoglobin type, sex and age on adaptive and blood biochemical characteristics of Red Sokoto goats.

MATERIALS AND METHODS

Location

The study was conducted at the Federal Capital Territory Abuja, located within the Northern guinea Savanna zone of Nigeria. It is laying between latitudes 8.25° and 9.0° N of the equator and Longitude 6.45° and 7.39° E of the Greenwich Meridian. (Presentation Copyright@ falling Rain Genomics, 1996-2010).

Data collection

Ninety four (94) goats were sampled from two locations: Dei-dei and Gwagwalada grazing reserve, Abuja. Data were collected on the adaptive and blood biochemical traits. The adaptive traits were Heart rate (HR), Rectal temperature(RT) and Adaptive coefficient (AC) while the blood biochemical characteristics were haemoglobin (Hb) types, Hb-concentration (Hb-conc), Potassium concentration (K-conc) and albumin concentration (alb-conc).

METHODS OF MEASUREMENTS

Adaptive Traits

Heart Rate (HR)

Heart rate was taken by placing stethoscope on femoral artery of the hind limb of the goat to count the number of beat per minute.

Rectal Temperature (RT)

This was taken using clinical thermometer which was inserted into the rectum of the goat and left for 45-50 seconds. It was then removed and the temperature level was read. The values read were recorded, and the process was repeated for the other goats.

Blood Biochemical Characteristics

Blood samples were taken from each of the experimental goats through the jugular vein. 5 mls of the blood was taken from each goat, from which 2 mls was put into heparinized vacutainer tubes containing anticoagulant ethylene diamine tetra acetic acid (EDTA). The remaining 3 mls of the blood was put into sterile vacutainer tubes (without anticoagulant). The samples were labeled accordingly. The blood samples in the sterile vacutainer tube were centrifuged in order to have a clear layer of serum. This serum was pipetted into another sterile bottle and store in a refrigerator. The blood samples were taken to the Haematological laboratory of Ahmadu Bello Teaching Hospital from where the analysis of blood biochemical characteristics was carried out.

A spectrometer with wavelength capability of 600-650 nm (Zenway 5041 colorimeter) was used to analyzed for the albumin concentration, while the K concentration was analysed using Corning flame photometer 410. Electrophoresis and Cyanmethaemoglobin method was used to analyzed for Hb-types and Hb-conc, respectively.

Data Analysis

The adaptability of the goats were measured by determining the adaptive coefficient from the values of the Rectal Temperature (RT) and Heart Rate (HR) as thus

Adaptive coefficient (AC) = (RT/38.33) + (HR/23.00)

The effects of haemoglobin types, sex and age on the adaptive and blood biochemical characteristics of the goats were determined by general linear model (GLM) procedure of SAS, (2005).

RESULTS AND DISCUSSION

Rectal Temperature (RT) is directly affected by the surrounding and ambient temperature, and high ambient temperature has a negative effect on productivity of the animal. Chukwuka *et al., (*2010) reported that negative effect of high ambient temperature is direct in the form of stress suffered by the animal and the diversion of energy from the purpose of production to regulation of body temperature and indirectly by affecting the availability of feed resources upon which production is dependent. In this study, the mean RT of the goats was 38.9°C with minimum and maximum body temperature of 38.1 and 39.4 °C (Table 1). These values were within the reference range of previous study of goats in thermal neutral condition (Otoikhian *et al.,* 2009) and this indicate that the goats used for this research showed no clinical signs of stress during the research period. The body temperature of the goats exhibited minimal variations (CV=0.5%), thus implying that goats are homoeothermic animals, they can maintain near constant body temperature under wide range of environmental conditions.

The Heart Rate (HR) is the pulse that helps to know the beating rate of the heart which is measured

Table 1: Summary Statistics of the measured characteristics in Red Sokoto Goats

Characteristics	N	Mean±SE	CV(%)	Min	Max
Rectal Temperature (°C)	94	38.9±0.02	0.5	38.1	39.4
Heart Rate (bpm)	94	76.1±0.39	3.8	70.0	81.0
Adaptive coefficient	94	4.3±0.02	5.0	4.1	4.6
Albumin concentration (g/l)	94	38.4±0.34	8.5	31.0	48.0
Hemoglobin concentration (g/dl)	94	8.9±0.16	17.1	4.0	12.7
Potassium concentration (Mmol/l)	94	4.0±0.06	14.7	3.0	5.8

in beats per minute (bpm) using stethoscope (Otoikhian *et al.,* 2009). The mean HR of the goats used in this study was 76.1bpm, with the min and max HR of 70 and 80bpm. This is slightly higher than the range of 70-75bpm reported by Derman and Noaks (1994) in goats. The minor difference observed in the values of the HR may be explained by differences in geographical conditions, season or climate and physiological conditions of the sample goats.

Rectal temperature and heart rate have been shown to be good indicators of the thermal stress and may be used to assess thermal adversity of the environment (Al- Haidary, 2004).

The Adaptive Coefficient (AC) (which is the function of RT and HR) signifies the level of adaptability of the goats to the environments varied significantly ($P<0.05$) with Hb types, sex and age of the goats. The goats with Hb AA and AB had higher AC than those with BB and AC; likewise the bucks had higher AC than the does.

Potassium is one of the intracellular elements that regulate the intracellular density of the cell. The amount of K-concentration is fairly high at intracellular membranes (Gurcan *et al.,* 2010). The values of K-concentration reported by Opara *et al., (*2010) for WAD bucks and does were 17.8 and 6.9mmol/l, respectively. These values were higher than the mean value of 4.0mmol/l observed in this study; this is probably due to differences in breed and physiological conditions of the sampled animals. Researchers had identified the existence of different type of K in different species of animals, and that in sheep for instance, there are two types of K which is high and low K with the low K type dominant over the high K type (Soysal *et al.,* 2003). Also Gurcan *et al.,* (2010) reported a range of 4.23 to 11.69mmol/l for low K type in animals.

The concentration of albumin in this study (38.4g/dl) was slightly higher than the 34.5g/dl reported by Opara *et al.,* (2010).

The variation of Hb type with adaptive and blood biochemical characteristics was significant ($P<0.05$) except Hb-concentration (Table 2). The relationship between Hb types and HR can be linked to the different

Table 2: Effect of hemoglobin type on adaptive and blood biochemical characteristics

Characteristics	Hemoglobin Type					
	AA	BB	AB	AC	SEM	LOS
Rectal Temperature (°C)	39.0^{a}	39.0^{a}	39.0^{a}	38.9^{b}	0.02	*
Heart Rate (bpm)	76.6^{a}	75.3^{b}	76.2^{a}	75.1^{b}	0.40	*
Adaptive coefficient	4.4^{a}	4.3^{b}	4.4^{a}	4.3^{b}	0.02	*
Albumin concentration (g/l)	37.6^{b}	39.2^{a}	38.6^{a}	38.8^{a}	0.34	*
Hemoglobin concentration (g/dl)	9.1	8.6	8.8	8.6	0.16	ns
Potassium concentration (Mmol/l)	3.8^{b}	3.9^{a}	4.0^{ab}	4.4^{a}	0.06	*
Number of observations	30	11	41	12	94	
^{ab}: means within the same row with different superscripts differ significantly($P<0.05$); ns:not significant;						

Table 3: Effect of Sex on adaptive and blood biochemical characteristics

Characteristics	Sex			
	Buck	Doe	SEM	LOS
Rectal Temperature (°C)	39.0	39.0	0.03	ns
Heart Rate (bpm)	78.5^{a}	75.0^{b}	0.49	**
Adaptive coefficient	4.4^{a}	4.3^{b}	0.02	**
Albumin concentration (g/l)	39.8^{a}	37.7^{b}	0.49	**
Hemoglobin concentration (g/dl)	9.1	8.7	0.26	ns
Potassium concentration (Mmol/l)	3.9	4.0	0.08	ns
Number of observations	30	64	94	
^{ab}: means within the same row with different superscripts differ significantly($P<0.01$); ns:not significant;				

Table 4: Effect of Age on adaptive and blood biochemical characteristics

Characteristics	Age of goat					
	12mon	18mon	24mon	30mon	SEM	LOS
Rectal Temperature (^oC)	39.0	39.0	39.0	39.0	0.02	ns
Heart Rate (bpm)	77.1^b	74.4^c	74.4^c	78.5^a	0.37	*
Adaptive coefficient	4.4^b	4.3^c	4.3^c	4.5^a	0.02	*
Albumin concentration (g/l)	39.2^a	37.4^b	36.7^c	36.5^c	0.32	*
Hemoglobin concentration (g/dl)	9.1	8.7	8.3	8.5	0.16	ns
Potassium concentration (Mmol/l)	4.0	4.0	4.0	4.0	0.06	ns
Number of observations	55	25	12	2	94	
^{ab}: means within the same row with different superscripts differ significantly(P<0.05); ns:not significant;						

levels of oxygen carrying capacity of the different Hb types. In this study, higher HR was observed in goats with Hb AA and AB, and Hb A is known to be the haemoglobin allele with highest affinity for oxygen. This is in line with the earlier report of Huisman *et al*., (1959) who relates the preponderance of Hb A to it greater affinity to oxygen. This could also explain the high adaptive coefficient observed on goats with Hb types AA and AB since adaptive coefficient is a function of HR and RT.

The variation of HR, AC and Albumin concentration with sex was highly significant (P<0.01; Table 3). The RT of the buck and does were similar however, the HR was higher in bucks (78.5bpm) than the does (75.0bpm) this is probably due to the high sexual activity of the bucks. There was no significant (P>0.05) difference between the bucks and does in Hb and K concentration. This is contrary to the study of opera *et al.,* (2010) who reported significant differences between WAD bucks and does in there Hb and K concentration. This is probably due to differences in breeds and location of the animal, Hb type had been reported to vary with breed and location (Ndamukong, 1995, Abdussamad *et al.,* 2004 Essien *et al*., 2011)

Age significantly (P<0.05) influence HR, AC and albumin concentration but had no significant influence on the RT, Hb and K concentration (Table 4). Although there was no trend in the variation of HR and AC with age, but it was observed that the HR AC was higher in the older goats than the younger, however the albumin concentration significantly decreased with progressive increase in age of the goats. The observed significant influence of age on albumin concentration is at variance with the earlier studies of Piccione *et al.*, (2009) and Opara *et al.,* (2010) who reported non-significant effect of age on albumin concentration of WAD goats.

CONCLUSION

- The mean body temperature (38.9°C) of the goats used was within the reference normal range for goats in thermal neutral condition and this indicates that the goats showed no clinical signs of stress during the research period.
- The albumin concentration, heart rate and adaptive coefficient of the goats had clear variation based on differences in haemoglobin type, sex and age of the animals.

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