EFFECT OF SEASON CHANGES ON HAEMATOLOGIC PARAMETERS AND ERYTHROCYTE OSMOTIC FRAGILITY OF SAHEL BUCKS IN A TROPICAL SAVANNAH

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ABSTRACT

This study was aimed at evaluating the effect of seasonal change on haematologic parameters and erythrocyte osmotic fragility (EOF) as a biomarker of oxidative stress in male Sahel goats in the Northern Guinea Savannah zone of Nigeria. Blood samples were collected from ten (n=10) apparently healthy adult bucks in the peak of the cold-dry (CDS), hot-dry (HDS) and rainy (RAS) seasons. Meteorological parameters in the seasons indicated higher temperature-humidity index in the HDS (82.02), and RAS (82.83) compared with the CDS (75.25). The PCV and RBC of the bucks significantly increased ($P < 0.05$) during the HDS compared with the CDS. Similarly, during the HDS, the mean corpuscular volume (MCV) of the goats significantly decreased ($P < 0.05$) compared to values obtained in the RAS. However, there was no significant change ($P > 0.05$) in other erythrocytic and leucocytic parameters between seasons. The EOF test indicated that the erythrocytes of bucks were significantly more sensitive ($P < 0.05$) to hypotonic haemolysis during the HDS as compared to the CDS and RAS. In conclusion, heat stress during the HDS significantly affected some haematologic parameters and EOF as compared to the other season, and the HDS seems to be the most stressful season to Sahel bucks.

Key words: Sahel bucks, Hot-dry season, Haematologic parameters, Erythrocyte osmotic fragility.

INTRODUCTION

Worldwide, goats play vital roles in the economy, nutrition and religion of many poor livestock owners who earn their livelihood by rearing them in different terrain and seasons of the year (Habibu et al., 2014). The Sahel or Desert breed of goat is found in West Africa around the Sahel belt south of the Sahara. In the Northern Guinea Savannah zone of Nigeria, there are three distinct seasons namely: the cold-dry (CDS; harmattan), hot-dry (HDS) and rainy (RAS) seasons. These seasons have different combinationS of meteorological parameters and the animals must adjust to the periodic changes in these parameters in order to adapt and remain productive. High or low ambient temperature as an aftermath of seasonal changes is well known to induce stress, with negative consequences on haematological parameters and productivity of the livestock(Gaughan et al., 2013; Habibu et al., 2014; Minka and Ayo, 2014). Haematological changes in livestock are commonly used as important parameterS to evaluate the health status and adaptation (Yaqub et al., 2013). Stress-induced changes in immune status is well documented in livestock, with alterations in cell-mediated and humoral immunity having a significant impact on immune-competence which may render an animal more susceptible to infection (Carroll and Forsberg, 2007). However, there is little or no information on the influence of season on haematologic parameters and EOF (as a biomarker of oxidative stress) of Sahel goats. Such information, when available, may provide a base-line data on the adaption of Sahel goats to the Guinea Savannah zone of Nigeria, considering the fact that they are not indigenous to this zone.The aim of the study was to evaluate the changes in blood cellular components and EOF of Sahel bucks during the CDS, HDS and RAS in Zaria.

MATERIALS AND METHODS

The animals were sourced from the Small Ruminant Research Programme, National Animal Production Research Institute (NAPRI), Ahmadu Bello University (ABU), Shika, Zaria. Ten (n=10) apparently healthy Sahel goats aged between 1.5 to 3.5 years and with body weight ranging between 20-25 kg were used for the study. Animals on the farm were managed intensively and routinely screened for haemoparasites and helminths. Samples were collected from the bucksin the peak of the CDS, HDS and RAS that is; December, April and August, respectively. Blood collection was done via jugular venipuncture between the hours of 8:00 –9:00 a.m. Blood cellular components were determined as described by Dacie and Lewis (1991).Erythrocyte osmotic fragility was determined according to the method described by Oyewale (1992).

Meteorological parameters were collected from the Data Processing Unit, Institute of Agricultural Research, ABU, Zaria located about 5 km away from the experimental site. The temperature humidity index (THI) was calculated using the equation described by Ravagnolo *et al.* (2000). The values obtained were expressed as mean (± SEM) and subjected to one-way analysis of variance (ANOVA), followed by Turkey's post-hoc test. The statistical package used was GraphPad Prism version 4.0 for windows (2003) from GraphPad software, San Diego California, USA. Values of $P < 0.05$ were considered significant.

RESULTS

The highest mean value of ambient temperature (38.11 °C) was obtained during the HDS, while higher values THI values were recorded during the afternoon hours of the HDS and RAS. The THI in the morning (THIm) was lower than THI in the afternoon (THIa; Table 1). The HDS had significantly higher ($P < 0.05$) PCV and RBC than cold-dry season. The mean corpuscular volume (MCV) was significantly ($P < 0.05$) lower during the HDS compared with the RAS. The mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were not influenced by season. The leucocytic parameters were insignificantly ($P > 0.05$) influenced by season (Table 2). The percentage haemolysis was significantly higher ($P < 0.05$) in the HDS compared with both the CDS and RAS at NaCl concentrations of 0.9%, and with the CDS at NaCl concentration of 0.3% (Figure 1).

DISCUSSION

The goats experienced thermal stress particularly during the HDS since the ambient temperature was high and the value of THI obtained was higher than the thermo neutral zone established for goats (60-65; Hamzaoui *et al.*, 2013). In our study, a significant increase in PCV and RBC was observed during the HDS compared with the CDS as a result of thermal stress caused by high ambient temperature during the HDS. This agrees with the finding of other studies in goats (Hashem, 2014) and sheep (Fadare *et al.*, 2012) exposed to high ambient temperature. During thermal stress, severe dehydration has been reported in livestock, which ultimately leads to increased level of PCV, RBC and Hb, apparently in proportion to the thermoregulatory requirement of the exposed animal. Dehydration due to increased loss of plasma fluid through evaporative heat loss may be responsible for the high PCV and RBC observed during the HDS in the current study; this may be a thermoregulatory mechanism that assists the bucks to efficiently cool themselves. On the contrary, other studies have reported a decrease PCV, RBC and Hb during heat stress which is believed to be caused by excess water intake (Omran *et al.*, 2011). The current study also recorded a significant decrease in MCV during the HDS compared to the RAS, this agrees with findings of Mazullo *et al.*, (2014) in heat stressed cattle. The decrease in MCV during the HDS may indicate that the erythrocytes are old and are not replaced new ones which are usually larger in size and have larger MCV (Decie and Lewis, 1996). This may suggest a suppression of erythropoiesis by heat stress during the HDS. Although an increase in TLC, was recorded, decrease in lymphocyte and an increase in neutrophil counts during the HDS compared to the CDS and RAS, these changes were not statistically significant. Leucocyte counts in heat stressed animals have been reported to either increase (Omran*et al.*, 2011; Mazzullo *et al.*, 2014) or decrease (Fadare *et al.*, 2012) depending on the animal species and the adaptability of the animal to stressful environmental condition. In the current study, the sensitivity of the erythrocytes of goats to hypotonic haemolysis increased significantly during the HDS compared with the other seasons. When the upper limit of thermoneutral zone is exceeded, animals struggle to maintain homeothermy and by so doing experience heat stress (Chauhan *et al.*, 2014). This enhances production of free radicals and subsequently the occurrence of lipid peroxidation, which increases the susceptibility of erythrocyte membrane to haemolysis (Habibu *et al.*, 2014).

CONCLUSION

Season significantly influenced the haematologic parameters and EOF of Sahel bucks, resulting in an increase in PCV, RBC and EOF, but a decrease in MCV during the HDS. Therefore, the HDS is more stressful to the male Sahel goats than CDS and RAS. The leucocytic parameters were not significantly affected by seasonal changes, suggesting some level of adaptation in Sahel goats. The effect of heat stress during the HDS should be mitigated by providing shade, free access to water

and the use of antioxidant to improve the productivity of Sahel goats

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Table 1: Mean values of meteorological parameters in during the study period

Seasons	Month	Ambient temperature		RH (%)		THIm	THIa
		Minimum	Maximum	10:00h	16:00h		
CDS	December	16.53	32.32	20.63	15.65	60.11	75.25
HDS	April	22.26	38.11	31.56	20.70	66.77	82.02
RAS	July	20.03	30.87	85.19	70.87	67.24	82.83

Superscriptsa, b indicate significant difference ($P < 0.05$)

Table 2:Seasonal changes in haematological parameters of male Sahel goats.

Parameters	CDS	HDS	RAS
PCV (%)	27.20 ± 1.48^{b}	36.00 ± 2.42^{a}	31.30 ± 1.65
RBC ($10^6/\mu L$)	8.43 ± 0.45^{b}	10.89 ± 1.17^{a}	8.7 ± 0.42
HB (g/dL)	9.38 ± 0.55	9.56 ± 0.75	10.37 ± 0.34
MCV (fL)	20.26 ± 0.05	18.94 ± 1.27^{a}	21.6 ± 0.48^{b}
MCH (pg)	6.40 ± 0.05	6.58 ± 0.72	7.07 ± 0.28
MCHC (g/dL)	33.4 ± 0.16	32.89 ± 3.61	32.94 ± 1.64
WBC ($10^6/\mu L$)	10.28 ± 1.64	14.51 ± 1.53	13.40 ± 1.35
LYMPHOCYTE (%)	67.48 ± 4.6	58.64 ± 3.5	66.33 ± 6.39
NEUTROPHIL (%)	32.52 ± 4.6	41.36 ± 3.5	33.47 ± 6.39
N:L	0.44 ± 0.14	0.70 ± 0.15	0.53 ± 0.19

Figure 1:Seasonal changes in erythrocyte osmotic fragility of Sahel goats.