



Seasonal Variation in Haematological and Oxidative Status of West African Dwarf Sheep

Atte, P.O. and Opoola, E.

Department of Animal Science, Faculty of Agriculture. Ahmadu Bello University, Zaria

Abstracts

This experiment was conducted to evaluate the seasonal variation in haematological and oxidative status of West African dwarf (WAD) sheep. Twenty-four WAD sheep were used. The study was carried out during the different season. Haematological and oxidative parameters were determined according to standard procedure. Season had no significant effect on PCV, MCHC, MCV, neutrophil and monocyte counts. The PCV values ranged between 29.25% in wet and 27.69% in dry season. The haemoglobin value for dry season was 13.40g/dl while the wet season was 9.21g/dl. The red blood cell was significantly ($P<0.05$) higher in dry season ($14.45 \times 10^6/\mu\text{l/ml}$) than wet season ($10.25 \times 10^6/\mu\text{l/ml}$). MCH was significantly ($P<0.05$) higher (14.53 Pg) in the dry compared to wet season (11.40Pg). Higher value of WBC was recorded in the dry ($11.54 \times 10^3/\mu\text{l/ml}$) compared to wet season ($7.45 \times 10^3/\mu\text{l/ml}$). Lymphocytes was significantly ($P<0.05$) higher in the dry (45.58%) than in the wet season (38.12%). The eosinophil value (1.75%) was higher during the wet than the dry season (0.27%). Catalase value was higher during the dry season (6.5U/ml) compared to wet season (3.74U/ml). The SOD (90.40U/ml), GSH (8.65U/ml) and GPx (104.45 U/ml) values were all higher during the dry compared to wet season (78.80U/ml, 4.12U/ml and 99.30U/ml) respectively. It was concluded that WAD sheep had better antioxidant defense mechanism during the dry season compared to wet season and was recommended that efforts should be made to improve antioxidant protection of sheep during the wet season so that higher oxidative state can be achieved in both seasons.

Keywords: Haematology, Oxidative status, Season, Variation and West African Dwarf sheep.

Introduction

Small ruminants, especially sheep, are important species for the livestock sector and economic development of the nation (Rahman *et al.*, 2018). The rural families' rear sheep for economic support and for their ability to better adaptation, fertility, good quality meat and skin, wool production and resistance to diseases with low care under adverse agro-climatic condition (Rahman *et al.*, 2018). The health status of sheep is a major determinant of the efficiency of its production, monitoring their health is therefore, fundamental prior to addressing anomalies that might adversely affect them (Ozung *et al.*, 2011). Haematological values are influenced by varieties of physiological factors which include nutritional status, sex, age, breed, altitude, pregnancy, lactation, physical

activity, water balance and season (Olayemi *et al.*, 2015). The physiological and pathological condition of animal can be accessed through the evaluation of haematological and biochemical parameters of blood. High environmental temperature has been identified as a factor which alters physiological parameters of animals (Arfuso *et al.*, 2016). Haematological parameters; Pack Cell Volume (PCV), Haemoglobin concentration (Hb), leucocyte counts (WBC) and Total Protein (TP) values are important for evaluation of normal physiological status of animal and for evaluation of the management practice, nutrition and diagnosis of health condition and are also good indices of livestock adaptability to prevailing environmental conditions (Casella *et al.*, 2016).

Oxidative stress is an imbalance between radical generating and radical-scavenging activities resulting from increased production of oxidants or decrease in antioxidant production or defense (Bernabucci *et al.*, 2002). Reactive oxygen metabolites (ROM) are free radicals of an organism which constitute about 1-2% of the body and they perform vital functions such as protein phosphorylation, cell maturation, apoptosis, oocyte maturation, steroid-ogenesis, cell immunity, ovulation, implantation, blastocyst formation, luteolysis, acrosome reactions, fertilization, and luteal maintenance during pregnancy (Celi, 2011). Although, their levels tends to increase at certain pathological conditions, which can also cause damage of biological macromolecules and disrupt typical metabolism and physiology (Trevisan *et al.*, 2001). In the tropics most especially, during heat stress, rapid production of free radicals and ROS or reduced antioxidant mechanism result in the production of oxidative stress, which affects numerous biological features of live (Celi, 2011).

Haematological and oxidative stress analyses in farm animals are an essential part of clinical examination often pointing to a specific differential diagnosis or suggesting a prognosis. It is well recognized that physiological and haemato - chemical parameters are influenced by several factors including breed, age, reproductive status, housing, starvation, environmental factors, stress, transportation and season (Arfuso *et al.*, 2016). The harsh environmental conditions of the tropics which the animals are exposed to, further worsened by the seasonal fluctuations in quantity and quality of most of the feed resources available for them also imposes stress on them. The effect of these imbalances may aggravate the negative consequences on the overall wellbeing of the animal (Mohebbi-Fani *et al.*, 2012)

Sequel to these effects there is the need to establish appropriate physiological baseline values for livestock which could be used in the realistic evaluation of the management practice, nutrition and diagnosis of health condition as well as in determining the physiological status of animals. The present investigation was therefore planned on WAD sheep to reveal the variation in haematological and oxidative status during wet and dry seasons.

Materials and Methods

The experiment was carried out at the Small Ruminant Unit of Kabba College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University. Kabba is located within the Southern Guinea Savannah Zone on latitude 7⁰5'N, longitude 6⁰4'E and altitude of 640 m above sea level. It has an annual rainfall of 1500mm and rain starts between late April and early May to October. The dry season begins around the middle of November, with cool weather that ends in February. This is followed by relatively hot-dry weather between March and April just before the rain begins. The minimum daily temperature is from 14°C - 20°C during the cool season while the maximum daily temperature is from 29°C-40°C during the hot season. The mean relative humidity during dry and wet seasons is 21% and 72%, respectively.

Animal Management

Twenty-four clinical healthy sheep aged between 12 months - 18 months were used for this study. The animals were tagged for easy identification and 5 ml of blood was collected monthly from the jugular vein.

Haematological Evaluation

Blood sample (5 ml) was collected from the jugular vein using sterile syringe into labelled sample bottles containing 4.0 ml Ethylene Diamine Tetracetic Acid (EDTA). The samples were taken to the physiology laboratory for further analysis to evaluate the

following haematological parameters. Red Blood Cell (RBC), Packed Cell Volume (PCV), Haemoglobin (Hb) Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) and White blood cell (WBC). The PCV, RBC, Hb and WBC, Neutrophil, Lymphocytes, monocytes and Eosinophil were determined according to the methods of Coles (1986), while MCV, MCH and MCHC were calculated using the following formulae (AOAC, 2000).

$$\text{MCHC} = \frac{\text{Hb}}{\text{PCV}} \times 100$$

$$\text{MCH} = \frac{\text{Hb}}{\text{RBC}} \times 100$$

$$\text{MCV} = \frac{\text{PCV}}{\text{RBC}} \times 100$$

Oxidative Stress Evaluation

Catalase (CAT) was estimated by the method of Beers and Sizer (1952). The superoxide dismutase (SOD) was estimated by the method of Marklund and Marklund (1974) adopted by Soon and Tan (2002). Glutathione S-transferases (GSTs) was estimated by the method of Habig *et al.* (1974) and Glutathione peroxidase (GPx) activity was determined by the method of Rotruck *et al.* (1973).

Statistical Analyses

All data obtained were statistically analysed using the analysis of variance (ANOVA) procedure of SAS (2002) while the significant differences in means were separated using pair wise-difference.

Results and Discussion

Effect of Season on Haematological Parameters of West African Dwarf Sheep

The result of haematological values of WAD sheep investigated in this study are seen in Table 1. Result showed that the season of the year had no significant effect ($P > 0.05$) on

PCV, MCHC, MCV, neutrophil and monocyte counts. The PCV values observed in this present study was 29.25% for wet season and 27.69% for dry season. This aligned with the observation of Olayemi and colleagues who observed that season of the year had no significant effect ($P > 0.05$) on PCV concentration (Olayemi *et al.*, 2015). However, the PCV value obtained is within the recommended range value of 24 – 45% for healthy sheep (Babangida, 1999). The haemoglobin value for dry season (13.40g/dl) was significantly ($P < 0.05$) higher than the value recorded in the wet season (9.21g/dl). This agreed with the observation of Olayemi *et al.* (2015) and Nafisat *et al.* (2021).

The increased Hb could be due to acute dehydration during dry season this could then result in haemo - concentration and hence relatively higher values (Sejian and Srivastava, 2010). The red blood cell count was significantly ($P < 0.05$) higher in dry season ($14.45 \times 10^6 \mu\text{l/ml}$) than wet season ($10.25 \times 10^6 \mu\text{l/ml}$), this observation is contrary to the report of Olayemi and colleagues, they reported that there was no significant difference ($P > 0.05$) between dry and wet season values (Olayemi *et al.*, 2015). However, the observation in this present study aligned with the report of Nafisat *et al.* (2021), who observed that wet season value of RBC was lower ($6.62 \times 10^6 \mu\text{l/ml}$) than the dry season ($8.02 \times 10^6 \mu\text{l/ml}$) value. The difference in value may be attributed to difference in environment. The dry season value of MCH was significantly ($P < 0.05$) higher (14.53Pg) than the wet season (11.40Pg) value. This finding is in tandem with that of Olayemi *et al.* (2015) and Nafisat *et al.* (2021).

Season had a significant effect ($P < 0.05$) on the WBC counts. Higher values were recorded in the dry season ($11.54 \times 10^3 \mu\text{l/ml}$) compared to wet season ($7.45 \times 10^3 \mu\text{l/ml}$). This is in agreement with the report of Nafisat *et al.* (2021). Lymphocytes concentration was significantly ($P < 0.05$) higher in the dry

(45.58%) than in the wet season (38.12%). This is in line with the findings of Mohammad *et al.* (2017) and Nafisat *et al.* (2021). The relative lymphocytosis observed during the dry season may be due to the presence of allergens which are usually prevalent during the dry

dusty season; these initiate allergic reactions and hence cause a relative lymphocytosis (Mohammad *et al.*, 2017). The eosinophil value (1.75%) was higher during the wet season than the dry season (0.27%), this agreed with the report of Olayemi *et al.* (2015).

Table 1: Effect of Season on Haematological Parameters of West African Dwarf Sheep

Parameters	Season		SEM
	Wet	Dry	
Packed cell volume (%)	29.25	27.69	0.03
Haemoglobin (g/dl)	9.21 ^b	13.40 ^a	1.10
Red blood cell (10 ⁶ µl/ml)	10.25 ^b	14.45 ^a	1.46
MCH(pg)	11.40 ^b	14.53 ^a	0.69
MCHC (%)	32.72	34.52	0.02
MCV (fl)	26.33	27.34	0.01
White Blood Cell (10 ³ µl/ml)	7.45 ^b	11.54 ^a	0.68
Neutrophil (%)	16.25	17.32	0.01
Lymphocytes (%)	38.12 ^b	45.45 ^a	6.12
Monocytes (%)	2.10	1.86	0.01
Eosinophil (%)	0.25 ^b	2.70 ^a	0.11

^{ab}: means with different superscript in the same row are significantly (P<0.05) different

Effect of Season on Oxidative Stress Parameters of West African Dwarf Sheep

The result of oxidative parameters of West African Dwarf sheep investigated in this study is presented in Table 2. Result showed that the season of the year had significant effect (P<0.05) on all the parameters under investigation. The catalase value was higher during the dry season (6.5U/ml) compared to wet season (3.74U/ml). This is in agreement with the report of Karthik *et al.*, (2021) and Ghosh *et al.* (2013). They reported that catalase enzyme was higher in sheep during the summer compared to winter. This might be

as a result of high temperature during the summer (dry season) and heat stress predisposes oxidative stress by increasing the production of oxygen free radicals (Ghosh *et al.*, 2013). The SOD (90.40U/ml), GSH (8.65U/ml) and GPx (104.45 U/ml) values were all higher during the dry season compared to wet season (78.80U/ml, 4.12U/ml and 99.30U/ml) respectively. The higher concentration of SOD, GPx, and catalase observed during summer periods, might be related to the heat stress condition (Chaudhary *et al.*, 2015).

Table 2: Effect of Season on Oxidative Stress Parameters of West African Dwarf Sheep

Parameters	Season		SEM
	Wet	Dry	
Catalase (U/ml)	3.74	6.25	0.01
Superoxide dismutase(U/)	78.80	90.40	16.12
Glutathione-S-transferase (U/ml)	4.12	8.56	3.24
Glutathione peroxidase (U/ml)	99.30	104.45	6.68

^{ab}: means with different superscript in the same row are significantly (P<0.05) different



Conclusion and Recommendation

It was concluded from this study that WAD sheep had better antioxidant defence mechanism during the dry season compared to wet season. It was therefore, recommended that efforts should be made to improve antioxidant protection of sheep during the wet season for better output during this season of the year.

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