OXIDATIVE STRESS MARKERS IN WESTAFRICAN DWARF AND KALAWAD GOATS AS AFFECTED BY THE EARLY RAINY SEASON

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ABSTRACT

Superoxide dismutase (SOD) and malondialdehyde (MDA) are vital oxidative stress markers involved in regulating metabolism, immunity and homeostasis in animals to maintain health and productivity across changing environment. Thus, this study was undertaken to evaluate oxidative stress markers in westafrican dwarf and kalawad goats as affected by the early rainy season. The SOD and MDA levels of 16 non-gravid does consisting of eight West African Dwarf and eight KALAWAD goats managed intensively for a period of three months (May, June, and July), during the early rainy (hot-wet) season was investigated. Animals were fed Pennisetum purpureum and supplemented with concentrate at 2% body weight dry matter basis. Blood samples were collected twice a month for serum hormonal assay using ELISA kits. Data were analyzed using method of least square analysis of variance in a 2×3 factorial arrangement with the effects of breed and month of sampling as the independent variables while the SOD and MDA levels are the dependent variables. Results showed that breed had no significant effects (P>0.05) on both SOD and MDA levels. Superoxide dismutase level decreases as the month of sampling progressed with May having the highest mean value followed by June and July with the lowest mean values respectively (2.41±0.58 vs 0.62±0.12 vs 0.60±0.16 U/L). The study concluded that SOD was higher in the two breeds in the month of May but the highest value was recorded in the KALAWAD goats which indicate that both breeds have high antioxidant levels with the KALAWAD tending to have the highest.

Keywords: **oxidative stress, markers, goats, early rainy, season**

INTRODUCTION

An imbalance between the activities that produce and those that scavenge radicals, brought on by an increase in pro-oxidant production and/or a decrease in antioxidant defense, is known as oxidative stress. (Bernabucci *et al*., 2002). Reactive oxygen metabolites (ROM) are free radicals of an organism that constitute approximately 1-2% of the body and have essential functions such as protein phosphorylation, cell maturation, apoptosis, oocyte maturation, steroidogenesis, cell immunity, ovulation, implantation, blastocyst formation, luteolysis, acrosome reactions, fertilization, and luteal maintenance during pregnancy (Celi *et al*., 2012). Oxidative stress is produced under heat stress, especially in tropical locations, when there is a rapid formation of free radicals and ROS and/or a weakened antioxidant system. This affects several biological aspects of livestock (Celi, 2011). As a season progresses, so do the quantity and quality of animal feed that is available, as well as the climate. Oxidative stress biomarkers are also known to be significantly impacted by changes in ambient temperature. Therefore, temperature is a confounding factor that may result in difficulties in the interpretation of oxidative stress biomarkers response patterns. According to Kumar *et al*. (2007), cattle and buffalo exposed to heat have higher concentrations of erythrocyte TBARS. The levels of oxidative stress indicators in small ruminant animals are still poorly understood, particularly in tropical regions where climate change is causing changes in climatic factors. Therefore, this study was aimed at assessing the effect of early rainy season on oxidative stress biomarkers in WAD and *KALAWAD* goats.

MATERIALS AND METHODS

The study was carried out between 1st May to 31st July, 2023 at the Institute of Food Security Environmental Resources and Agricultural Research (IFSERAR) Farm, Federal University of

Agriculture, Abeokuta. The region lies between latitudes 7º18′2′N and 7º18′30′N; and longitude3º22′10′E and 3º22′41′E. The site is within the rain forest vegetation zone of South-Western Nigeria and the climate is humid. The mean annual rainfall of the area is 1,330 mm with a mean annual temperature of 29.3º C and relative humidity of 80 % respectively. Temperatures are fairly uniform with daytime values of 28–30 °C during the early rainy season of the year (April–June) and late rainy season (July–September) and 30–34 °C during the early dry season (October–December) and late dry season (January–March) with the lowest night temperature of around 24 °C during the harmattan period between December and February. Relative humidity is high during the rainy season with values between 63 % and 96 % as compared to the dry season (55–84 %). The temperature of the soil ranges from 24.5 to 31.0 °C [source: FUNAAB, (2012)].

Experimental Animals and Management

A total of 16 mature non-gravid does consisting of 8 WAD and *KALAWAD* each which were experimental animals within the institute's herd that had acclimatized to the environment were used for the study. Does used for this study were between 2-3 years of age with liveweight 15-35kg. The goats were managed intensively and fed *Pennisetum purpureum* grass on cut and carry basis supplemented with concentrate at 2% body weight dry matter basis. Water was given ad-libitum.

Blood Collection

About 5mL of blood samples were collected from the experimental goats twice a month through the jugular venipuncture using a vacutainer needle into free EDTA tubes. Blood samples were centrifuged at 2,000-4,000 rev/min to obtain the serum and then stored at -20℃ in the freezer until the samples were analyzed for oxidative stress markers.

Statistical Analysis and experimental design

Data obtained was analyzed using the least square method analysis of variance (ANOVA) experimental design is a 2x3 factorial arrangement with the breed and months of sampling as the independent variables and the oxidative stress markers; Superoxide dismutase and malondialdehyde (SOD& MDA) as the independent variables.

RESULTS AND DISCUSSION

Effects of breed, month of sampling and breed by month of sampling interaction on oxidative stress markers in West African Dwarf and KALAWAD goats

Table 1: Analysis of variance of the effects of breed, month of sampling and breed*month of sampling interaction on oxidative stress markers

Source of variation	df	Mean squares	
		MDA (mol/L)	SOD (U/L)
Breed	1	1.90^{ns}	0.64^{ns}
Month	2	7.12^{ns}	33.49***
Breed*Month	5	4.58^{ns}	14.03***
Error	88	4.96	1.25

***(P<0.001), ns= not-significant (P>0.05), df= degree of freedom

The Results of the analysis of variance of the effect of breed, month of sampling and breed by month of sampling interaction on oxidative stress markers in Table 1showed that month of sampling and breed and month of sampling interaction had a high significant effect (P<0.001) on superoxide dismutase level while breed had no significant effect (P>0.05). On the other hand, all the main effects had no significant effect (P>0.05) on malondialdehyde.

The least square means of superoxide dismutase as affected by month of sampling as shown in Table 2 revealed that superoxide dismutase level decreases as the month of sampling progressed with May having the highest mean value followed by June and July with the lowest mean values respectively (2.41±0.58 vs 0.62±0.12 vs 0.60±0.16 U/L).

The least square means of effect of breed on both superoxide dismutase and malondialdehyde levels as shown in Table 3 revealed that malondialdehyde level was higher in the *KALAWAD* than in the

WAD goats (5.12±0.32 vs 4.83±0.31µmol/L), and also, superoxide dismutase level was higher in the *KALAWAD* than in the WAD goats (1.34±0.34 vs 1.17±0.32). However, malondialdehyde and superoxide dismutase level as affected by breed differ insignificantly (P>0.05)

The least square means of effect of breed and month of sampling interaction as shown in Table 4 revealed that superoxide dismutase level decreases across the month of sampling in both breeds. In the WAD, the highest mean value was recorded in the month of May then a rapid decrease in the month of June and a slight increase in the month of July, while in the *KALAWAD*, the highest mean value was recorded in the month of May, followed by a rapid decrease in the month of June and July having the lowest mean value.

Table 2: Effect of month of sampling on oxidative stress markers

Month of sampling	No of observation	LSM ± SEM	
		MDA (µmol/L)	SOD (U/L)
May	32	4.44 ± 0.43	2.41 ± 0.58[a]
June	31	5.19 ± 0.43	0.62 ± 0.12[b]
July	27	5.34 ± 0.43	0.60 ± 0.16[b]

[a,b]Means in the same column with different superscript differ significantly (P<0.05)
LSM±SEM = Least square means ± Standard error of mean
SOD = Superoxide dismutase, MDA = Malondialdehyde

Table 3: oxidative stress markers as affected by breed

Breed	No of observation	LSM ± SEM	
		MDA (µmol/L)	SOD (U/L)
WAD	46	4.81 ± 0.31	1.17 ± 0.32
KALAWAD	44	5.12 ± 0.32	1.34 ± 0.34

Means in the same column without superscript does not differ significantly (P>0.05)
LSM±SEM= Least square means ± Standard error of mean
SOD= Superoxide dismutase, MDA= Malondialdehyde

Table 4: Effect of month of sampling and breed interaction on oxidative stress markers

Oxidative stress markers	No of Observation	LSM ± SEM					
		WAD			KALAWAD		
		May	June	July	May	June	July
Superoxide dismutase (U/L)	90	2.18 ± 0.84[ab]	0.51 ± 0.15[c]	0.77 ± 0.30[bc]	2.65 ± 0.82[a]	0.75 ± 1.90[bc]	0.40 ± 0.10[c]
Melondialdehyde ((µmol/L)	90	4.07 ± 0.36	5.41 ± 0.68	5.02 ± 0.47	4.80 ± 0.53	5.00 ± 0.40	5.70 ± 0.74

[a,b,c]Means in the same row with different superscript differ significantly (P<0.05)
LSM±SEM= Least square means ± Standard error of mean

The significant month of sampling effect in this study corroborates the work of Yusuf *et al.,* (2017), who reported and concluded that the antioxidant capacity of WAD goats was greater in the early rainy season. Thus, during the early rainy season, the month of May tends to confer a higher antioxidant capacity on the goats and, consequently, good immune responses. The higher level of SOD in the early rainy season could also be attributed to the higher quality of grasses available during early rainy season. Seasonal variations affect the availability of nutrients from the soil to the forage species (Ezenwa *et al.,* 1995). The nutritional values of forage species tend to be high in the early wet season (Buxton, 1996). This is because of the association between forage nutrient content and the amount of moisture found in the soil in which the forage plants grow (McDowell *et al.,* 1983). The high level of

superoxide dismutase in both breeds reared during the early rainy season, as revealed in the first month (May), indicates the absence of oxidative stress. Further rapid decrease in SOD level throughout the remaining months of the early rainy season (June & July) shows the setting in of oxidative stress. SOD plays a crucial role in the defense against ROS by converting the highly reactive superoxide radicals into less harmful hydrogen peroxide. Dysfunction or decreased activity of SODs can lead to an accumulation of superoxide radicals, contributing to oxidative stress. Also, an increase in the malondialdehyde (TBARs) level noticed during the early rainy season according to Yusuf *et al*. (2017) can be attributed to the lack of specificity of the TBARs assay because no increase was observed for SOD in this period. According to Alessio (2000), TBARs can react with unsaturated and saturated non-functional aldehydes, carbohydrates and prostaglandins, which would affect its stability. TBARS primarily consist of malondialdehyde (MDA), a highly reactive and toxic aldehyde. Measuring malondialdehyde levels is a common approach to assess lipid peroxidation and, consequently, the extent of oxidative damage to cell membranes.
Elevated malondialdehyde levels are indicative of increase lipid peroxidation and oxidative stress (Lovell *et al.,* 1995).

CONCLUSION

It can therefore be concluded from the study that, Superoxide dismutase was higher in the two breeds in the month of May but the highest value was recorded in the KALAWAD goat which indicates that both breeds have a high antioxidant levels with the KALAWAD tending to have the highest. Hence, both breeds could be used for breeding purpose owing to their lower predisposing factor to oxidative stress during the rainy season.

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