

SEXUAL DIMORPHISM IN OXIDATIVE STRESS INDICATORS OF WEST AFRICAN DWARF SHEEP

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Abstract

An investigation was conducted on oxidative status of male and female West African dwarf Lambs. Sixteen rams and ewes each, aged 8-12 months old were used for this study carried out in July and August in Ibadan, Nigeria. The average body weights were 12.08 ± 3.26 and 12.76 kg for ewes and rams respectively. Fastened blood samples were collected from all animals and assayed for serum lipid peroxidation, total antioxidant activity, catalase and superoxide dismutase using standard procedures. The result obtained indicated that rams had apparently higher total antioxidant activity and significantly higher serum catalase activity than ewes, while serum lipid peroxidation and superoxide dismutase were statistically similar in both sexes. This indicates that rams have better antioxidant activity than ewes.

Introduction

Base feeding of sheep in Nigeria is pasture with very little or no concentrates supplements. During the dry season, animals are often in deficit due to scarce pastures which could lead to a variety of production and health problems. The inevitability of exposure of sheep to extreme hot and cold environmental weather conditions, makes oxidative stress associated with extreme environmental conditions and appropriate field of investigation to explore adaptive physiological measures of the body (Maan and Kataria, 2012). Oxidative stress results from increased production of freeradicals and reactive oxygen species, and a decrease in antioxidant defense (Trevisan *et al.*, 2001 ; Williams *et al.*, 2002). Ganaie *et al.* (2013) reported that oxidation is essential to nearly all cells in the body to provide energy for vital functions. Approximately 95 to 98% of the oxygen consumed is reduced to water during aerobic metabolism, but the remaining fraction may be converted to oxidative by-products-reactive oxygen species (ROS), that may damage the DNA of genes and contribute to degenerative changes (Ganaie *et al.*, 2013). Studies have shown that antioxidants are uniquely different from each other and each have a specific function in the body. Levels of ROS are determined by production and by the rate of ROS degradation and/or inactivation, an appropriate balance is important for maintaining cellular homeostasis (Covarrubias *et al.*, 2008). Although low levels of ROS are essential in many biochemical processes, accumulation of ROS may damage biological macromolecules i.e. lipids, proteins, carbohydrates and DNA (Kumar *et al.*, 2011). External factors such as oxygen exposure (resuscitation; Kumar *et al.*, 2010)

heat, trauma, ultrasound, infections, radiations, toxins etc. can lead to increased free radicals and other ROS and may lead to oxidative stress (Halliwell *et al.*, 1992).

ROS are produced in all cells, depending on the intensity of aerobic metabolism, especially in activated neutrophils, monocytes, smooth muscle cells and in endothelial cells (Nanda *et al.*, 2007). Disequilibrium between ROS production and inactivation leads to oxidative stress. The organism has enzymatic (e.g. superoxide dismutase, catalase, glutathione peroxidase) and non-enzymatic (e.g. vitamin E) antioxidant mechanisms that work as scavenger for this harmful ROS.

Altan *et al.*, (2003) have demonstrated that heat stress increased lipid peroxidation which was associated with production of large number of free radicals which are capable of initiating peroxidation of polyunsaturated fatty acids. Ralhan *et al.* (2004) also reported that lipid peroxidation is significantly increased during reticulo-ruminal impaction in buffaloes.

A major threat to homeostasis and therefore to the integrity of aerobic organisms arises from chemical species possessing one or more unpaired electrons in their outer orbital, called free radicals (Halliwell and Gutteridge, 1997). Oxygen free radicals can develop during several steps of normal metabolic events. Although free radicals have the potential to damage the organism, their generation is inevitable for some metabolic processes. There is limited documentation on oxidative stress markers in Nigerian sheep population. Thus, investigation was carried out on influence of sexual dimorphism in oxidative status of West African dwarf Sheep.

Materials and Methods

Thirty two West African dwarf Sheep aged 8-12 months consisting of 16 ewes and rams each with an average weight of 12.08 ± 3.26 and 12.76 kg ewes and rams respectively were purchased, quarantined and acclimatized. The does were dry and all animals were of good conformation. The animals were managed in a semi intensive system, offered concentrate and free choice grazing. Blood sample were collected from the animals and serum obtained using standard procedures. Serum was assayed for lipid peroxidation, antioxidant activity, catalase and superoxide dismutase. Serum total antioxidant capacity activities was carried out according to Korecivic, (2001), superoxide dismutase (SOD) was estimated by the method of Marklund and Marklund (1974) adopted by Soon and Tan (2002) and catalase was estimated by Beers and Sizer (1952) method, serum lipid peroxidation was determined using thiobarbituric acid assay according to Ohkawa *et al.* (1979).

Data obtained in this study was subjected to T test using statistical analysis software.

Result and Discussion

The result obtained showed that all parameters assessed were not affected by sex differences, except catalase activity. Serum catalase of rams was significantly ($P < 0.05$) higher than ewes. Though, rams had apparently higher total antioxidant activity than ewes.

The trend of result showed that superoxide activity of ewes were slightly higher than rams, this could account for the slightly lower serum lipid peroxidation in ewes because SOD is the first line of defense in which superoxide are dismutated by SOD to hydrogen peroxide which is further converted to water and other lesser species by catalase. The role of superoxide dismutase is to accelerate the dismutation of the toxic superoxide produced during oxidative energy processes to hydrogen peroxide and molecular oxygen (Hajimohammadi *et al.*, 2015). The apparently higher antioxidant activity in rams could be attributed to its higher catalase activity which indicates higher scavenging of hydrogen peroxides.

One of the molecules contributing to oxidative stress is a large decrease in the reducing capacity of cellular redox couples (antioxidants). The importance of oxidative stress indications in lambs has been elicited by works of Kumar *et al.*, (2010) in which he described the excitation of antioxidant enzymes to newborn lambs in

response to hyperoxia due to resuscitation and within 24 hours of oxygen exposure, suggested that oxygen resuscitated lambs had evidence of systemic oxidative stress over time and cell membrane damage at 24 hrs compared with the room air resuscitated lambs. He indicated that fetal lung antioxidant enzymes; specifically SOD, catalase and glutathione peroxidase increases during the final 15 to 20% of intrauterine life (Frank and Sosenko, 1987), and lambs can induce antioxidant activity at 24hrs in the presence of maximal hyperoxia, suggesting the maturation of its pathways. Kumar *et al.*, (2010) reported that newborn lambs exposed to maximal oxygen had systemic oxidative stress, damage to cell membranes and higher activities of antioxidant enzymes in response to a pro oxidant situation. Kataria *et al.* (2010) reported that increase activity of serum catalase during hot environmental condition suggested the ability of the animals to provide defense against free radicals and oxidative stress. Environmental conditions associated variations in the catalase activities have been reported by researchers (Marti *et al.*, 2007). Kataria and Kataria (2012) reported effect of PPR on oxidative stress in sheep, the findings suggested the relevance of periodic assessment of oxidative status in ruminants for healthier management through supplementation of proper antioxidants as supportive treatment in PPR and in healthy in-contact animals. Rezapour and Taghinejad-Roudbaneh (2011) reported that late gestation imposed lots of stress of anti-oxidative system of ewes. This study has highlighted oxidative status in WAD sheep in Nigeria as a pointer to indications and reference for oxidative stress in Nigerian sheep populations and increase awareness for oxidative status in different physiological states, production, feeding and management systems.

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Table 1: Oxidative status of west african dwarf sheep

Parameters	Ewe	Ram	Level of significance
Total Antioxidant activity (mmol/litre)	7.07±6.19	12.34±10.33	0.18NS
Lipid peroxidation (x10 ³ TBARS/mgprotein)	1.79±1.37	1.97±1.79	0.87NS
Catalase (mmoles of H ₂ O ₂ consumed/min/mgprotein)	24.00±6.94 ^b	49.08±41.10 ^a	0.011**
Superoxide dismutase (U/g)	0.50±0.09	0.48±0.08	0.31NS

** Significant difference was observed, NS- No significantly different