

Serum Immunoglobulins and Lipid Profile of Sheep as Affected by Selenium and Vitamin E Administration

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Abstract: The effects of selenium and vitamin E administration on serum levels of immunoglobulins and lipid profile of sheep was investigated. The 30 ewes of Yankasa breed were used for the study. The animals were allowed access to grazing most of the day, maize offal was provided as supplementary feed. The ewes were randomly assigned into 3 groups (n = 10). Animals in group 1 served as control and were administered 1 mL normal saline. Animals in group 2 were administered 90 mg Tocopherol acetate (Vitamin E) while group 3 received injection containing a combination of 100 mg tocopherol acetate and 1.97 mg sodium selenite. Two doses of the injections were administered 14 days apart (subcutaneously). The results indicate higher ($p < 0.05$) serum values of immunoglobulin G (10.02, 11.51 and 12.85) and immunoglobulin M (4.50, 5.65 and 6.82) in response to a combination of selenium and vitamin E. The mean values of immunoglobulin A (1.35, 1.97 and 1.70) was however similar ($p > 0.05$) for all groups. Mean CD4 count values was also enhanced ($p < 0.05$) following administration of a combination of selenium and vitamin E (449, 462 and 498). Mean serum values of total cholesterol (3.12, 3.05 and 3.00), high density lipoprotein cholesterol (1.57, 1.42 and 1.67), low density lipoprotein cholesterol (1.46, 1.42 and 1.1) and triglycerides (0.17, 0.27 and 0.42) were similar ($p > 0.05$) for all groups. It can be concluded that supplementation with selenium and vitamin E resulted in increased serum concentration of immunoglobulin G and immunoglobulin M indicating improved immunological status of Yankasa sheep. Supplementation with selenium and vitamin E can be applied in pregnant animals to improve colostrum immunoglobulin concentration which has the potential to enhance immunological status and performance of newborn animals.

Key words: Immunoglobulins, lipid profile, selenium, vitamin E, lipoprotein, colostrum

INTRODUCTION

Oxidative stress occurs at the cellular level when reactive metabolites of oxygen are produced faster than they can be safely removed by antioxidant defense mechanisms. These reactive oxygen species are produced during normal metabolism and can accumulate rapidly in actively reproducing cells. Vitamin E functions as an intra-cellular antioxidant scavenging for free reactive oxygen and lipid hydroperoxides and converting them to non-reactive forms, thus, maintaining the integrity of membrane phospholipids against oxidative damage and peroxidation. Selenium on the other hand, functions as cofactor of the Glutathione Peroxidase (GSH-Px) enzyme systems responsible for regulating extra and intra-cellular hydroperoxidase (Smith and Akinbamijo, 2000). Oxidative stress results in macromolecular damage and is implicated in various disease states such as atherosclerosis,

diabetes, cancer, neuro degeneration and aging (Ray *et al.*, 2012). Protection of the body against free radicals is provided by some enzymes concerned solely with the detoxification of these radicals. Superoxide Dismutase (SOD), Glutathione Peroxidase (GPX) and catalase are the key enzymatic antioxidants of this defense system by which the free radicals that are produced during metabolic reactions are detoxified (Jeeva *et al.*, 2015).

Diseases associated with selenium deficiency have been widely documented and include white muscle disease, poor reproduction, reduced daily gain and immune function. Soil selenium concentration in the study area have been reported to be below the critical level of 0.5 mg/kg (Oklo *et al.*, 2017). Selenium deficiency has also been reported in legumes and crop residue in the area (Ogebe *et al.*, 1995). Evidence in many species indicates that vitamin E is an essential nutrient for the normal

function of the immune system (Habibian *et al.*, 2014). vitamin E and selenium has been implicated in stimulation of cellular and humoral immune responses (Sayed-Ahmed *et al.*, 2015). Selenium deficiency plays a role in numerous, economically important livestock diseases, problems that include impaired fertility, abortion, retained placenta and neonatal weakness. Administration of Se improves daily weight gain of lambs and reproductive performance in ewes (El-Shahat and Abdel monem, 2011). Similarly, Moeni and Jalilan reported positive influence of selenium and vitamin E on passive immune response of pregnant ewes. The adverse effect of selenium deficiency resulting in decreased IgG and IgM had been documented (Suchy *et al.*, 2014). The objective of this study is to evaluate the effects of selenium and vitamin E administration on serum levels of immunoglobulins and lipid profile of Yankasa sheep.

MATERIALS AND METHODS

Experiment site: This study was conducted in the livestock farm of the Department of Animal Science, College of Agriculture, Lafia, Nasarawa state. The location lies within latitude 08°33' N and longitude 08°33'E at an attitude of 181.53 m (570 ft) above sea level with an annual rainfall of 1311.75 cm.

Animals and management: The 30 post pubertal Yankasa ewes (1-1½ years of age) weighing 22.5-26.1 kg were used for the study. The animals were allowed access to grazing most of the day. Maize offal was provided as supplementary feed and minerals salt lick and clean drinking water provided *ad libitum*. All animals were given prophylactic treatment against ecto and endo parasites by using ivermectin (50 µg/kg subcutaneously).

Experimental procedure: The animals were kept for a stabilization period of 14 days before commencement of the experiment. The Ewes were divided into 3 groups with 10 ewes per group. Animals in group 1 serve as control and were administered 1 mL normal saline, animals in group 2 were administered injections of 90 mg tocopherol acetate (vitamin E), manufactured by Laborate Pharmaceutical (India). Ewes in group 3 received injections containing 100 mg tocopheryl acetate (vitamin E) and 1.97 mg sodium selenite (Bremer Pharma GMBH) Germany. All injections were administered subcutaneously. Two doses of the injections was administered 14 days apart.

Lipid profile: Triglycerides was determined using calorimetric enzymatic method with glycerophosphate

oxidase as described by Manafa *et al.* Standard commercial test kits manufactured by ERBA diagnostics, Mannheim GmbH, Germany was used. Total cholesterol was determined by calorimetric enzymatic end point using reagents manufactured by Agappe diagnostics Switzerland, GmbH. HDL Cholesterol was measured by phosphotungstic acid method using commercial test kits produced by Erba diagnostics.

Immunological parameters: Serum levels of IgG, IgM and IgA were determined using EMP-168 semi automatic analyzer. CD4 counts was evaluated using fast count machine.

Statistical analysis: The data were analyzed by analysis of variance using Statistical Package for Social Science (SPSS) Version 22.0. The separation of means was effected using Duncan's Multiple Range Test (DMRT) method while statement of significance were based on $p < 0.05$.

RESULTS AND DISCUSSION

Summary of effects of treatment on immunological parameters are shown on Table 1. Mean values of immunoglobulin G and immunoglobulin M are significantly higher ($p < 0.05$) in group treated with selenium and vitamin E compared to the control. However, the result indicate that treatment had no effect mean values of immunoglobulin A. Selenium and vitamin E administration resulted in significantly higher CD4 counts ($p < 0.05$).

The effects of treatment on lipid profile is shown on Table 2. The results indicate that administration of selenium and vitamin E had no significant effect on the serum concentration of total cholesterol. High density lipoprotein cholesterol, low density lipoprotein cholesterol and triglycerides ($p > 0.05$).

Administration of vitamin E and selenium resulted in a higher ($p < 0.05$) serum concentration of immunoglobulin G and immunoglobulin M whereas, the serum level of immunoglobulin A is similar for all groups. Selenium and vitamin E administration also induced higher ($p < 0.05$) levels of CD4 counts compared to that of other groups. Repeated vitamin E supplementation was reported to result in increased immunoglobulin G. concentration in pregnant ewes (Anugu *et al.*, 2013). Similarly selenium and vitamin E supplementation resulted in improved immune functions (Alhidary *et al.*, 2015). Higher serum IgG following administration of vitamin E and selenium had also been reported by Soliman (2015). This findings is very significant due to the fact that transfer of immunity from dam to neonates is hindered by placental barrier in

Table 1: Effects of selenium and vitamin E on serum levels of immunoglobulin of Yankasa sheep (mean±SEM)

Parameters	Treatments			Results
	Control	Vitamin E	Se+Vit. E	
IgG (g/L)	10.02±0.78 ^a	11.57±0.47 ^{ab}	12.85±0.93 ^b	*
IgM (g/L)	4.50±0.30 ^a	5.65±0.51 ^{ab}	6.82±0.40 ^b	*
IgA (g/L)	1.35±0.25	1.97±0.25	1.70±0.18	NS
CD ₄ counts (cell/mL)	449.50±44.05 ^a	462.50±33.96 ^a	698.00±34.36 ^b	*

^{a, b} Means within same row bearing different superscript are significantly different SEM = Standard Error or Mean, NS = Not Significant: *Significant (p<0.05); IgG = Immunoglobulin G, IgM-Immunoglobulin M, IgA-Immunoglobulin A

Table 2: Effects of selenium and vitamin E on serum lipid profile of Yankasa sheep (mean±SEM)

Parameters (mmole/L)	Treatments			Results
	Control	Vitamin E	Se+Vit. E	
Total cholesterol	3.12±0.25	3.05±0.16	3.00±0.18	NS
HDL-cholesterol	1.57±0.06	1.42±0.13	1.67±0.09	NS
LDL-cholesterol	1.46±0.28	1.42±0.09	1.13±0.20	NS
Triglycerides	0.17±0.04	0.27±0.07	0.42±0.16	NS

^{a, b} Means within same row bearing different superscript are significantly different (p<0.05), SEM = Standard Error of Mean, NS = Not Significant, HDL = High Density Lipoprotein, LDL = Low Density Lipoprotein

ruminants. The lambs therefore depends entirely on antibodies obtained via. colostrums. Inadequate transfer of passive immunity to lambs via, colostrum has significant effect on neonatal morbidity and mortality (Khan and Ahmad, 1997; Ahmad *et al.*, 2000). Ruminant placental structure does not allow passage of IgG from mother to fetus. The lambs are born with negligible serum concentration of IgG due to this placental barrier they therefore depend entirely on successful transfer of colostral IgG for provision of immunity in the early days of life (Moeini and Jalilan, 2014).

Mean values of total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol and triglycerides were not affected by selenium and vitamin E administration (p<0.05). This differ from the report of Gabryszuk *et al.* (2007) who observed a significant decrease in total cholesterol concentration and increased high density lipoprotein cholesterol in response to vitamin E and selenium supplementation in sheep. This variation in response may be accounted for by the differences in duration and dosage of selenium and vitamin E administered.

CONCLUSION

Selenium and vitamin E are integral components of the anti oxidant defense system, there by playing significant roles in the growth and health of humans and animals. Supplementation with selenium and vitamin E had

been reported to improve antioxidant status and immune functions. This study indicate that administration of combination of selenium and vitamin E resulted in increased serum concentration of immunoglobulin G, immunoglobulin M and CD4 counts indicating improved immunological status in Yankasa sheep. The serum lipid profile was not affected by selenium and vitamin E.

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