Haematological and biochemical profile of Friesian x Bunaji heifers supplemented with inorganic selenium and vitamin E

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Abstract *Corresponding author: neyuachi@gmail.com. +2348065611639

A study was conducted using twenty Friesian x Bunaji heifers to evaluate the effect of supplementing inorganic feed grade Selenium and Vitamin E on the haematological and biochemical profile. The study consists of four treatments with five animals per Treatment in a Completely Randomized Design (CRD). Treatment 1 served as Control without Selenium or Vitamin E supplementation. Treatment 2 was supplemented with 3 mg of feed grade Selenium. Treatment 3 with 20 mg of feed grade Vitamin E. Treatment 4 had a combination of 3 mg feed grade Selenium and 20 mg of Vitamin E. Two sets of blood samples were taken from the animal via jugular venipuncture using a 10 mL syringe fitted with a needle into sample bottles for haematological and biochemical analysis. Neutrophils (19.78 - 29.88%) were similar ($p < 0.05$) and Se supplementation recording the highest value. Packed cell volume (19.14 - 22.22%), Haemoglobin, Red blood cells, White blood cells, Eosinophil, Monocytes, Basophil and Lymphocytes analyzed were similar ($p > 0.05$). It was observed that there were similarities ($p > 0.05$) in Glucose, Serum protein, globulin, urea N, albumin, MDA protein, AST, ALT and ALP analyzed except for GSH-Px (22.38 - 24.70 μ /ml). Glutathione peroxidase was higher ($p < 0.05$) in Friesian x Bunaji heifers supplemented with vitamin E and lowest with no supplementation. All parameters analyzed were within the normal range for apparently healthy cattle thereby suggesting that Selenium and Vitamin E as antioxidant are effective in scavenging for free radicals and reducing oxidative damage.

Keywords; Haematology, Biochemical, Selenium, Vitamin E, Friesian x Bunaji

Introduction

During the last 10 years, understanding of the importance of selenium and vitamin E for dairy cattle has increased tremendously. Scientific experiments have established that vitamin E and Selenium (Se) can influence the function of certain immune cells, reduce calf mortality and morbidity, and improve reproductive and mammary gland health in adult dairy cows. 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 (Sinclair *et al.*, 2000). The health of the cows can be evaluated and

depends on haematologic and biochemical profile of blood. Haematology is highly informative as a diagnostic tool in bovine medicine, not solely, but in combination with clinical examination or other diagnostic procedures (Roland *et al.*, 2014). Testing of physiological parameters is essential to monitoring the health status of dairy herds. The most popular blood diagnostic test is the blood count determination, which includes erythrocyte, leukocyte and thrombocyte counts, as well as hemoglobin content, hematocrit value and red blood cell parameters. The content of blood components varies depending on factors that inhibit or stimulate the circulatory system. The main function of blood is to maintain the body's

Haematological and biochemical profile of Friesian x Bunaji heifers

physiological balance, while the haematological blood indicators are the main determinant of the animals' environmental adaptation and thus their welfare (Anderson *et al.*, 1999, Sattar and Mirza, 2009). Biochemical tests evaluate the body's internal condition, the function of different organs (including kidneys and the liver) and the course of metabolic changes in the body (Scamell, 2006). Vitamins and minerals perform vital roles in the growth and reproductive health of animals. Therefore, the objective of this study was to evaluate the effect of supplementing inorganic feed grade selenium and vitamin E on haematological and biochemical profile of Friesian x Bunaji heifers.

Materials and methods

Study location

The studies were conducted at the Dairy Research Programme Farm of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika-Zaria, Nigeria. Shika is located in the Northern Guinea Savanna and lies on latitudes 11° 06' 40" N and longitudes 7° 43' 21" E at an elevation of 644m above sea level, with an annual maximum and minimum temperature of 31.0 ± 3.2 °C and 18.0 ± 3.7 °C, respectively. Shika has an average annual rainfall of 1100 mm, usually lasting from May to October with a mean relative humidity of 72 %. The dry season lasts from November to April with the mean daily temperature, ranging from 15 – 36 °C and mean relative humidity ranging from 20 – 37 % (IAR, 2017).

Experimental design and management of animals

A total of twenty Friesian x Bunaji heifers animals were used for the study. The study consists of four Treatments with five animals per Treatment in a Completely Randomized Design (CRD). Treatment I

served as Control without Selenium or Vitamin E supplementation. Treatment II was supplemented with 3 mg of feed grade Selenium. Treatment III with 20 mg of feed grade Vitamin E. Treatment IV received a combination of 3 mg feed grade Selenium and 20 mg of Vitamin E. The animals were grazed on free range pastures and supplemented a concentrate diet consisting of 48 % Cotton Seed Cake, 13.7 % wheat bran, 35.3 % maize, 2 % bone meal, 1 % common salt, 88 % dry matter, 15 % crude protein and 55 % total digestible nutrients after grazing. Water was provided *ad-libitum*. All the experimental animals were ear-tagged for identification. The animals were dipped once a week during the dry season and twice a week during the wet season for effective control of ectoparasites. Twenty Friesian x Bunaji heifers weighing between 150 – 200kg were used for this study; the animals were allotted to four treatments with five animals per treatment. The four Treatments included: Treatment 1 served as the Control without supplementation of either Selenium or Vitamin E. Treatment 2 was supplemented with 3 mg of feed grade Selenium. Treatment 3 was administered 20 mg of feed grade Vitamin E. Treatment 4 received a combination of 3 mg feed grade Selenium and 20 mg of Vitamin E. All the experimental animals were on the four Treatments for a period of 120 days, which were supplemented on weekly interval.

Blood sample collection

Two sets of blood samples were taken from the animal via jugular venipuncture using a 10 mL syringe fitted with a needle. Ten mL blood samples collected were put in the heparin free bottles as anticoagulant for the determination of haematological parameters. Blood samples for serum analysis were collected into EDTA free bottles and allowed to coagulate at room temperature. The supernatant sera were then

harvested and stored in a freezer for subsequent biochemical analysis.

Chemical analysis

Packed cell volume (PCV) and haemoglobin (Hb) concentration was determined following the Procedures outlined by Dacie and Lewis (2001). Red blood cells (RBC) and total white blood cells (WBC) were also determined as described by Jain, (1986). Serum total protein, serum urea N, globulin and creatinine was determined using the Method described by Ogunsami *et al.* (2002). The activity of the alanine transaminase (ALT), aspartate transaminase (AST) and alkaline phosphate (ALP) was analyzed using spectrophotometric linked reaction method (Cheesbrough, 2004). Glutathione peroxidase (GSH-Px), Se and Vitamin E was analyzed according to the procedure described by Ursini *et al.* (1985).

Statistical analysis

Data were analyzed using the General Linear Model of SAS (2002). Significant means were compared using Dunnett (1964).

Results and discussion

Table 1 shows the results of haematological parameters of Friesian x Bunaji heifers. Neutrophils (19.78 - 29.88%) were similar ($p < 0.05$) and Se supplementation recording the highest value. Packed cell volume (19.14 - 22.22%), Haemoglobin (8.60 - 19.12 g/dl), Red blood cells (4.46 - 5.36 $\times 10^{12}/l$), White blood cells (9.80 - 0.46 $\times 10^9/l$), Eosinophil (6.52 - 8.20%), Monocytes (1.72 - 2.78%), Basophil (0.76 - 1.00%) and Lymphocytes (60.12 - 67.72%) analyzed were similar ($p > 0.05$). Vitamins and minerals as antioxidants play an important role in the growth and reproductive performance of animals. Antioxidants have been defined as any substances that delay or inhibit oxidative damage to cellular molecule (Gutteridge *et*

al., 1994). Vitamin E and Selenium are essential nutrients that have complementary biological functions as antioxidants to minimize cellular damage caused by endogenous peroxides (Kolb *et al.*, 1997). Vitamin E and selenium are involved in related functions; therefore, a selenium deficiency could be partially compensated by an adequate intake of vitamin E and vice versa. There is a close link between selenium and vitamin E status and antioxidant status (Chauhan, 2014). The parameters measured in the present study were not significantly different ($p > 0.05$) except for neutrophils that was significantly different. All parameters however were within the normal range for apparently healthy cattle. The insignificant difference in most of the parameters observed in this study could be as a result of the relatively adaptive mechanism of the animals and an indication of their apparently healthy status. The significant difference ($p < 0.05$) observed with the neutrophils values in this study could be as a result of the favourable response of neutrophils activity, T-cell function, macrophage activity and antibody production with vitamin E supplementation (Politis *et al.*, 1995; Politics *et al.*, 1996; Reddy *et al.*, 1986). Selenium has a biological function related to vitamin E in that Se is an indispensable constituent of glutathione peroxidase, an enzyme involved in detoxification of hydrogen peroxide and lipid hydro peroxides. Moreover, Se is a component of selenoproteins and is involved in immune and neuropsychological function in the nutrition of animals (Meschy, 2000) which agrees with the findings of this study. Vitamin E prevents oxidative damage to sensitive membrane lipids by suppressing hydro peroxide formation (Chow, 2001) and protects cellular membranes thus maintaining membrane integrity and reducing oxidative stress (Hogan *et al.*, 1993).

Haematological and biochemical profile of Friesian x Bunaji heifers

Table 1: Effect of Selenium, Vitamin E and Selenium + Vitamin E on hematological parameters of Friesian x Bunaji heifers

Parameters	Control	Se	Vit-E	Se + Vit-E	SEM	P-value
Packed Cell Volume (%)	22.22	20.86	20.78	19.14	1.49	0.5552
Haemoglobin (g/dl)	8.98	9.46	8.60	19.12	0.42	0.5526
Red Blood Cell ($\times 10^{12}/l$)	5.36	5.14	5.01	4.46	0.39	0.4586
White Blood Cell ($\times 10^9/l$)	12.46	10.78	9.80	11.44	1.02	0.3372
Eosinophil (%)	8.18	8.20	6.92	6.52	0.79	0.3514
Monocytes (%)	2.50	1.72	1.74	2.78	0.46	0.2878
Basophil (%)	0.70	1.00	0.76	0.70	0.16	0.5337
Lymphocytes (%)	64.06	67.72	64.94	60.12	2.70	0.2928
Neutrophils (%)	25.14 ^{ab}	19.78 ^a	24.14 ^{ab}	29.88 ^b	1.61	0.0041

^{ab}Means within the same row having different superscript are significantly ($P > 0.05$) different. Se-Selenium, Vit-E-Vitamin E

Table 2 shows the effect of Se, vitamin E and Se + vitamin E on biochemical parameters of Friesian x Bunaji heifers. It was observed that there were similarities ($p > 0.05$) in Glucose, Serum protein, globulin, urea N, albumin, MDA protein, AST, ALT and ALP analyzed except for GSH-Px. Glutathione peroxidase (22.38 – 24.70 μml) was higher ($p < 0.05$) in Friesian x Bunaji heifers supplemented with vitamin E and lowest with no supplementation. The glutathione peroxidase (22.38 – 24.70 μml) obtained for Friesian x Bunaji heifers supplemented with Se, vitamin E and Se + vitamin E was within the normal range for apparently healthy cattle (Radkowska and Herbut, 2014). The increase in the GSH-Px values observed in the present study could be attributed to the positive relationship between Se and GSH-Px activity in the blood. Chorfi *et al.* (2011) reported that Se supplementation in the diets of heifers increased Se content and GSH-Px content in the blood. The increase would have been more pronounced if organic forms of Se was used compared to the inorganic form used in this study (Ran *et al.*, 2010; Chorfi *et al.*, 2011). The variation

produced between organic and inorganic forms of Se has been found to be about 20% for blood Se content and 16% for GSH-Px activity as reported by Weiss and Hogan (2005) although the inorganic form of Se was used for this study. The liver function enzymes observed in the present study had values within the normal ranges for apparently healthy animals (Radkowska and Herbut, 2014) thereby depicting there was neither deficiency nor toxicity. Selenium is bound to α and β -globulins, LDL (low density lipoprotein) and VLDL (very low density lipoprotein) and albumin (Schrauzer *et al.*, 2000). The albumin content observed in this study was within normal range in the blood of cattle as reported by (Dargatz *et al.*, 1996).

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Table 2: Effect of Selenium, Vitamin E and Selenium + Vitamin E on biochemical parameters of Friesian x Bunaji heifers

Parameters	Control	Se	Vit-E	Se + Vit-E	SEM	P-value
Glucose (g/dL)	46.20	43.02	49.38	51.40	2.74	0.1877
Total Protein (g/dL)	5.32	5.40	5.22	5.76	0.23	0.3848
Globulin (g/dL)	3.28	3.4	3.02	3.44	0.24	0.6516
Urea N (mg/dL)	3.06	3.58	3.84	3.8	0.23	0.1416
Albumin (g/dL)	2.34	2.52	2.28	2.48	0.13	0.5262
Creatine (mg/dL)	1.34	1.26	1.06	1.30	0.09	0.1969
MDA Protein (Mmols/mg)	11.98	12.22	11.84	11.98	0.27	0.8068
SOD (u/ml)	44.62	43.94	42.82	40.80	2.74	0.7758
AST (IU/L)	38.20	45.00	43.60	43.20	4.13	0.6772
ALT (IU/L)	15.80	16.40	15.00	16.20	1.10	0.8130
ALP (IU/L)	38.60	40.00	39.80	39.40	2.37	0.9762
GSH-Px (μ/ml)	22.38 ^b	24.24 ^{ab}	24.70 ^a	23.62 ^{ab}	0.55	0.0479

^{ab}Means within the same row having different superscript are significantly (P>0.05) different. Urea N -urea nitrogen, MDA -Malondialdehyde Protein, SOD-superoxide dismutase, AST -Aspartate transaminase, ALT -Alanine transaminase, ALP-Alkaline phosphate, GSH -Px-Glutathione peroxidase, Se-Selenium, Vit-E-Vitamin E.

Conclusions

It can be concluded that the haematological and biochemical profile of Friesian x Bunaji heifers were within the normal reference point suggesting that the animals were apparently healthy. It therefore affirmed that Selenium and Vitamin E has an important role to play in scavenging for free radicals and reducing oxidative stress.

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Haematological and biochemical profile of Friesian x Bunaji heifers

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Achi, Barje, Abdulrashid, Daudu and Achi

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Received: 19th September, 2018

Accepted: 21st December, 2018