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Effect of selenium supplementation on growth, haematological and serum biochemical profile of rabbit bucks

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Target Audience: *Animal Scientists, Rabbit farmers, additive suppliers*

Abstract

A study was conducted to determine growth, haematological and serum biochemical profile of rabbit's bucks fed graded levels of selenium. A total of 20 mixed breed of rabbits aged between 6–8 weeks with an average weight of 756g were randomly assigned to four (4) dietary treatments with five (5) bucks per treatment with each rabbit as replicate in a completely randomized design. The rabbits were fed (0.0 mg/kg, 0.2 mg/kg, 0.4 mg/kg and 0.6 mg/kg) for a period of twelve weeks. The growth parameters were taken on weekly basis and blood samples were taken from ear vein via venipuncture from three bucks selected randomly from each treatment for haematological and blood chemistry in laboratory at twelfth week. The data collected were analysed using General Linear Model Procedure of SAS. The growth performance showed that those fed 0.4 mg/kg selenium had higher values except for feed conversion ratio (FCR) for those on 0 mg/kg selenium had the best FCR. The packed cell volume was significantly (P<0.05) higher at 0, 0.2 and 0.4 mg/kg selenium compared to 0.6 mg/kg inclusion level. It was observed that lymphocyte count for rabbit bucks on 0.0 and 0.6 mg/kg were significantly (P<0.05) higher than those on 0.2 mg/ and 0.4 mg/kg. Aspartate transaminase (16.00-39.33IU/l) and alkaline phosphatase (102.00-286.00) were significantly (P<0.05) higher at 0.2 mg/kg selenium. It was observed that selenium inclusion improved growth parameters at 0.4 mg/kg addition while selenium inclusion increased alkaline phosphatase and Aspartate transaminase in blood serum biochemical profile of rabbit bucks.

Keywords: Selenium, Supplementation, Bucks, Rabbit, Haematology

Description of Problems

Rabbits have a potential as meat-producing animals in the tropics, particularly on small scale production and a potential in alleviating poverty by minimizing the problem of animal protein supply in developing countries as it is considered a cheap alternative source of animal protein. Growth performance of rabbits in researches from tropical countries is generally in the range of 10-20g per day, in contrast to 35-40g per day commonly observed in temperate regions (1). Daily body weight gains vary from 8-13g compared with values of 42g/day/rabbit obtainable in temperature climates (2). This weight gains depend on the breeds, age and type of forage/concentrate fed of rabbits used in the tropics (2)

Selenium has a biological importance that is common to vitamin E. Selenium is an essential compound of glutathione peroxide, the enzymes involved in the detoxification of hydrogen peroxide and lipid hydro peroxides. Moreover, selenium is a composition of selenoproteins and is involved in immune and neuro-psychological functions in the nutrition of animals (3). Selenium deficiency plays a role in many economically important livestock diseases and has been implicated in problems like impaired fertility, abortion, retained placenta and neonatal weakness (4). Therefore, its supplementation in rabbits feed is very important because the inadequate intake of selenium is manifested through numerous biochemical changes. These includes reduced

glutathione peroxidase activities in blood tissues, increased activity of aspartate aminotransferase (AST) in the serum due to muscular damage, increased production of reactive forms of oxygen and final products of lipid peroxidation in blood and tissues (5). The aim of this study was to determine the effect of selenium dietary supplementation at graded levels on the growth performance, haematology and serum biochemistry of rabbit bucks.

Materials and Methods

Experimental site

The study was conducted at the National Animal Production Research Institute (NAPRI), Shika, Zaria. Shika lies within the Northern guinea savannah zone of Nigeria and located on latitude 11^0 12'N and longitude 7^0 33' E with an altitude of 691m above sea level. Annual rainfall range is between 1100-1200 mm, while mean temperature is about 24.4^0C (14.5-39.3 ^{0}C), with the lowest temperature occurring during the early harmattan season (November-January), while, the highest temperatures are experienced during late harmattan season between February-April (6)

Procurement and processing of test ingredients

The concentrate was compounded at Zaria feed mill, feed grade selenium was sourced from Hi-Nutrients International Limited, Lagos, Nigeria and was incorporated into the compounded feed.

Experimental animal, design and management

A total of 20 mixed breed rabbit bucks aged 6-8 weeks of average weight 756 grams were used in this study. The rabbits were purchased from National Veterinary Research Institute, Vom. The offspring purchased were obtained from crosses between New Zealand White and Dutch breeds. Rabbits were weighed with a Mettler Toledo XP6002S Top Pan Balance.

The rabbits were grouped into four dietary treatments with five rabbit bucks in each of the treatments in a completely randomized design (CRD) and each rabbit served as a replicate. Each rabbit was housed in a metal cage, measuring 60 x 60 cm dimension and well ventilated. Each cage was equipped with two round bottom earthen pot, one for feed and one as drinker. Glucose and antibiotic were administered in water to the rabbits as anti-stress and Ivermectin injection (broad-spectrum antiparasitic) was used to treat the rabbits against external and internal parasites. Routine management operations such as regular cleaning and disinfection of pens, cages, feeders, waterers and treatment of sick rabbits were carried out throughout the research period.

Experimental diets

The percentage composition of concentrate composition of experimental diets is presented in Table 1. Concentrate was offered *ad libitum* and much later dry forage (groundnut haulms) was offered *ad libitum* to all the rabbits. The forage was withheld between 7 a.m. and 5 p.m (about 10 hours/day) so that the rabbit would consume much of the concentrate, thereafter consume less of the forage. The inclusion levels of selenium were: 0, 0.2mg/kg, 0.4mg/kg and 0.6mg/kg of feed.

Growth performance

The parameters taken were initial body weight while body weights, feed intake were monitored weekly. Weight gain and feed conversion ratio were calculated. Body weight was measured in grams using a weighing scale (Mettler Toledo XP6002S Top Pan Balance).

Blood collection and analysis

Two (2 ml) of blood samples each for haematology and serum biochemistry were collected through the marginal ear venipuncture using 25 gauge hypodermic needle from three individual rabbit bucks, selected randomly from each treatment group,

at twelfth week. The same animals were used for haematology and serum biochemistry. Prior to sampling, the ear vein was palpated and then pierced with a needle (23GXII / 4: Jorita Jet- China). Samples for haematology were taken into ethylenediaminetetraacetic acid (EDTA) impregnated sample bottles which were used for haematology while samples for serum biochemistry were taken into tubes that contained no anticoagulant. Packed cell volume (PCV) was determined by micro haematocrit method. Blood protein was determined by refractometer method, while complete RBC and WBC count were carried out using Neubauer haematocytometer (7).

The Alanine Transaminase (ALT), Aspartate Transaminase (AST), Alkaline Phosphatase (ALP) and Glutathione peroxidase where assayed using the Audiocomb Serum Auto-analyser (Bayer Express Plus, Bayer Germany, Serial Number 15950) in the Chemical Pathology Laboratory, Ahmadu Bello University Teaching Hospital (ABUTH), Shika.

Alkaline Phosphatase (ALP), Alanine Transaminase (ALT) and Aspartate Transaminase (AST) Assay: In a cuvette, 10 µl of sample was mixed with 500 µl of the reagent. The initial absorbance was read at 405 nm and subsequently over 3 minutes. The mean absorbance per minute was used in the calculation: ALP, ALT and AST activities (IU/l) = 2742 × ΔA 405 nm/min; Where: 2742 = Extinction coefficient; ΔA 405 nm/min = change in absorbance per minute for the homogenate sample.

For Glutathione Peroxidase Assay, the serum sample was diluted with cumene hydroperoxide and added to 10 Standard wells set on the microtiter coated plate. Standard dilution with 100 µl and 50 µl was added to the first and the second well, respectively and then mixed.

The model:

$Y_{ij} = \mu + T_i + e_{ij}$

Where;

Y_{ij} = The observation on the j^{th} buck in i^{th} selenium levels

μ = overall mean;

T_i = Effect of i^{th} selenium levels

e_{ij} = random error (All error terms were assumed to be random, normally distributed and independent with expectation equal to zero).

Data analysis

All data collected were analysed using General Linear Model Procedure of (8). Significant differences among means were compared using Dunnett's Test.

Results and Discussion

Table 2 shows the result of the growth performance of rabbits fed different levels of selenium. There were significant ($P<0.05$) differences in the final live weight, average daily feed intake and average daily weight gain, for rabbit bucks fed diets with 0.4 mg/kg selenium while feed conversion ratio was significantly ($P<0.05$) better at 0 mg/kg selenium inclusion rate. The findings showed that final live weight, average daily feed intake and average daily weight gain showed better performance when 0.4 mg/kg selenium was included in the diet of rabbit bucks. Feed conversion ratio was low at 0 mg/kg selenium inclusion which was the best. This result is similar with the findings of (9) who recorded 5.02g/day weight gain for rabbit bucks in control group of selenium inclusion. Therefore, it can be suggested that dietary selenium supplementation, has a potent trophic and morphogenic actions in rabbit bucks (10).

The effect of selenium on haematological parameters of rabbit bucks fed different levels of selenium is presented in Table 3. Packed cell volume was significantly ($P<0.05$) higher at 0 mg/kg, 0.2 mg/kg and 0.4 mg/kg selenium inclusion level than 0.6 mg/kg inclusion level. White blood cell count was significantly

($P<0.05$) higher at 0 mg/kg and 0.2 mg/kg selenium but statistically ($P>0.05$) similar at 0.2, 0.4 and 0.6mg/kg inclusion levels. It was observed that lymphocyte count for rabbit bucks on 0 and 0.6 mg/kg was significantly ($P<0.05$) higher than that of rabbit bucks on 0.2 and 0.4 mg/kg feed which were both similar. However, haemoglobin, red blood cells, neutrophils, monocytes and eosinophils were similar ($P>0.05$) for all treatments.

Blood parameters of animal might be influenced by several factors such as breeds, age, sex, nutrition, management, and diseases (11). In this study, packed cell volume, white blood cell and lymphocytes showed significant differences by the inclusion of selenium in rabbit bucks' diet. The values obtained for packed cell volume (37.67 % to 42.00 %) and white blood cells (10.63×10^9 and 7.13×10^9) in this study showed that selenium improved blood metabolites that are involved in protecting the body against infectious diseases and foreign invader (12). The values obtained in this study are within the normal range for rabbits packed cell volume and white blood cells (33-50 %) and ($5\text{-}13 \times 10^9$) (13).

The result for lymphocytes agrees with the findings of (14) who recorded (79.00%) for rabbit does. In the current study, values for lymphocytes obtained fell within normal range (43 % to 80 %) for rabbits and is similar with the report of (11). Increase in WBC and lymphocyte values is are good indicators of immunity (10). The higher packed cell volume and lymphocytes in bucks under the treatment group in this study suggests that selenium may have improved the immune-competence. Packed cell volume or haematocrit is the percentage of the blood volume made up by erythrocytes. A decrease in haematocrit is anaemia. More specifically, anaemia can be a reduction in the numbers of red blood cells, the volume of red blood cells or the concentration of haemoglobin.

Table 4 shows the result of the effect of selenium on serum biochemical profile of rabbit bucks fed different levels of selenium. The glucose, total protein, albumin, globulin, alanine transaminase and Glutathione peroxidase (GSH-Px) were similar ($P>0.05$) in all the treatments. Aspartate transaminase was significantly ($P<0.05$) higher at 0.2 mg/kg selenium inclusion level in the diets while alkaline phosphatase at 0.2 mg/kg and 0.6 mg/kg selenium inclusion level was significantly ($P<0.05$) higher. Bucks on 0.2 mg/kg selenium had higher levels of serum aspartate transaminase, also, alkaline phosphatase was found to be higher for 0.2 mg/kg selenium treatment group. This result agrees with the findings of (13) who observed increased activities of aspartate transaminase in blood plasma of rats administered selenium injection. However, (1) observed decrease in aspartate transaminase and alkaline phosphatase concentrations in rabbits on 0.4 mg/kg dietary selenium supplementation contradicted the finding of this study. The higher aspartate transaminase and alkaline phosphatase for rabbits on 0.2 mg/kg inclusion rate may be due to an injury in either the liver or muscles of the bucks as these enzymes are known to be in higher circulation (15).

Conclusion and Applications

1. Selenium inclusion improved final weight, average daily feed intake and average daily gain at 0.4 mg/kg selenium inclusion while 0 mg/kg selenium had the best feed conversion ratio.
2. Selenium inclusion at 0.2 mg/kg selenium had higher packed cell volume as well the aspartate transaminase and alkaline phosphatase in blood serum biochemical profile of rabbit bucks.

Table 1: Composition of the Experimental Diet Fed to Rabbit Bucks

	Inclusion levels of selenium mg/kg diet			
Ingredients (%)	0.0	0.2	0.4	0.6
Maize	16.00	16.00	16.00	16.00
Maize offal	43.00	43.00	43.00	43.00
Brewers dried grain	6.50	6.50	6.50	6.50
Groundnut cake	8.00	8.00	8.00	8.00
Soya cake	11.70	11.70	11.70	11.70
Rice husk	10.90	10.90	10.90	10.90
Limestone	1.20	1.20	1.20	1.20
Bone meal	2.00	2.00	2.00	2.00
Common salt	0.25	0.25	0.25	0.25
Vitamin/mineral premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**1000**
Calculated analysis				
Crude Protein	15.05	15.05	15.05	15.05
Metabolizable Energy (kcal/kg)	2701	2701	2701	2701
Ether Extract	5.98	5.98	5.98	5.98
Crude fibre	11.28	11.28	11.28	11.28
Calcium	0.93	0.93	0.93	0.93
Available Phosphorus	0.32	0.32	0.32	0.32
Lysine	0.76	0.76	0.76	0.76
Methionine	0.30	0.30	0.30	0.30
Ash	3.22	3.22	3.22	3.22
Cysteine	0.22	0.22	0.22	0.22

**Biomix premix supplied per kg of diet: Vit.A, 10,000 iu; vit D_3, 2000 iu; vitamin E, 23 mg; vitamin K, 2mg, vit B_1, 1.8; vit B_2, 5.5 mg; Niacin, 27.5mg; pantothenic acid,7.5mg; vit B_{12}, 0.015mg: Folic acid, 0.75mg; Biotin, 0.06mg; chloride, 300mg; cobalt, 0.2; Copper, 3mg; Iodine 1mg; Iron, 20 mg; Manganese, 40 mg; selenium, 0.2 mg; Zinc, 30 mg; Antioxidant, 1.25mg.(Manufactured by: Bioorganics Nutrient System Limited, Ibafo Ogun State, Nigeria

Table 2: Growth Performance of Rabbit Bucks Fed Selenium Supplementation

	Selenium Inclusion Levels (mg/kg diet)					
Parameters	0	0.2	0.4	0.6	SEM	P-values
Initial weight (g)	756.00	755.00	756.00	755.00	0.50	0.22
Final weight (g)	1905.00^{c}	1750.00^{d}	2052.50^{a}	1960.30^{b}	0.41	<.01
Average daily feed intake (g)	80.02^{c}	72.33^{d}	96.72^{a}	89.64^{b}	0.01	<.01
Average daily gain (g)	12.77^{c}	11.06^{d}	14.40^{a}	13.39^{b}	0.03	<.01
Feed conversion ratio	6.27^{a}	6.63^{b}	6.72^{d}	6.69^{c}	0.01	<.01

^{abcd}: Means with different superscripts in the same row are significantly ($P<0.05$) different, SEM= Standard error of mean

Table 3: Haematological Parameters of Rabbit Bucks Fed Selenium Supplementation

Parameters	Selenium Inclusion Levels (mg/kg diet) 0.0	0.2	0.4	0.6	SEM	P-Value
Packed cell volume (%)	37.67^{ab}	42.00^{a}	41.00^{a}	34.00^{b}	1.72	0.04
Haemoglobin (g/dl)	12.77	14.00	13.60	11.33	0.63	0.07
White blood cells(x10^{9})	10.63^{a}	7.13^{ab}	6.00^{b}	4.73^{b}	1.14	0.03
Red blood cells (x10^{12})	6.53	7.17	6.90	5.80	0.41	0.18
Neutrophil (%)	10.00	16.67	10.00	12.67	1.62	0.06
Lymphocytes (%)	85.00^{a}	74.67^{b}	75.00^{b}	83.33^{a}	2.49	0.04
Monophils (%)	2.33	2.33	2.00	0.67	1.44	0.82
Eosinophils (%)	0.00	2.67	1.00	0.00	0.78	0.13
Basophils (%)	0.00	0.00	0.00	0.00	0.00	0.00

^{ab}: Means with different superscripts in the same row are significantly (P<0.05) different, SEM= Standard error of mean

Table 4: Serum Biochemical Profile of Rabbit Bucks fed Selenium

Parameters	Selenium Inclusion Levels (mg/kg diet) 0.0	0.2	0.4	0.6	SEM	P-Value
Glucose (mmol/l)	2.40	2.77	3.67	2.47	0.69	0.58
Total protein (g/dl)	60.00	56.67	67.33	56.67	5.94	0.57
Albumin (g/l)	28.00	29.33	39.67	26.00	3.76	0.12
Globulin (g/l)	32.00	27.33	27.67	30.67	2.75	0.59
Aspartate transaminase (IU/l)	16.00^{b}	39.33^{a}	22.00^{b}	23.00^{b}	2.26	0.01
Alanine transaminase (IU/l)	12.00	17.67	15.33	11.33	3.42	0.55
Alkaline Phosphatase (IU/l)	102.00^{c}	286.00^{a}	213.33^{b}	236.00^{b}	21.77	0.00
Glutathione peroxidase (µmol/l)	4.62	4.01	3.52	5.26	0.86	0.55

^{ab}: Means with different superscripts in the same row are significantly (P<0.05) different, SEM= Standard error of mean

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