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Haematological and Serum Characteristics of Broiler Birds Fed Diets Supplemented with Varying Levels of Selenium Powder*

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Abstract
The haematology and serum components of broiler chickens fed diets supplemented with selenium powder was investigated. A total of one hundred and fifty day old broilers were randomly allotted to three dietary treatments with ten birds per replicate in a completely randomized design. Treatment 1 was control with no Selenium supplementation, Treatments 2 and 3 had 0.3mg/kg 0.5mg/kg Selenium supplementation respectively. Birds were vaccinated as schedule and acclimatized to rearing and feeding regime before data collection commenced. Result indicated differences ($P<0.05$) in the final bodyweight and total weight gain of the experimental birds. Feed conversion ratio of birds on high selenium (0.5mg) was superior that its counterparts in control and 0.3mg supplementation. The heamatological and serum characteristics were not significantly affected ($P<0.05$) across the treatments except the differential count of the blood. The activity of the blood enzymes measured increase with selenium supplementation whereas the cholesterol level fall significantly in birds fed selenium supplemented diets. The study showed that all the dietary inclusion satisfactory as feed for broiler chicken without any deleterious effect on performance and blood profile. Inclusion level of 0.5mm/kg of selenium appeared to have better overall performance when fed to broiler chicken.
Keywords: selenium, broilers, haematology, serum

1. Introduction

Heat stress causes a negative impact on growth and immunity due to induced alterations in physiological, hormonal, and molecular status as well as lipid peroxidation (Donker *et al*., 1990). According to Baziz et al. (1996) feed intake and growth of broilers have been estimated to decrease about 3.6 and 1.5%, respectively, per degree increase in temperature between 22^0C and 32^0C. Research has shown that supplementing broiler diets with antioxidants alleviated metabolic changes and lipid peroxidation caused by heat stress (Sahin et al., 2002).

Poultry nutrition research on the use of organic and inorganic Selenium sources has yielded significant improvements in growth performance (Surai and Dvorska, 2000) and antioxidant capacity (Surai, 2002) of broiler chickens. Improvement in antioxidant capacity is attributed to inducible Selenium dependent antioxidant enzymes (Surai, 2002). Selenium is an integral component of glutathione peroxidase (EC 1.11.1.9; GSHPx). GSHPx, in alliance with vitamin E, forms part of the cell's defence against reactive metabolites of oxygen which are produced excessively under stress conditions (Surai, 2002).

Selenium was initially thought to be toxic to animals, but Schwarz and Foltz (1957) reported that Se prevented liver necrosis in rats. In 1973, Rotruck et al. reported that Se is required for proper function of the glutathione peroxidase enzymes, which are antioxidant enzymes that destroy free radicals produced during normal metabolic activity. Two years later, Cantor et al. (1975a,b) reported that Selenium is necessary in the diets of poultry to protect them from exudative diathesis and pancreatic fibrosis. These reports established Selenium as a dietary essential nutrient for poultry. The Se requirement for broilers throughout the growth period is 0.15 ppm (NRC, 1994), and this requirement often can be met by natural feedstuffs in the diet. However, due to the considerable regional variation in Selenium content of natural feedstuffs, it is common practice in the United States to supplement broiler diets with Selenium. The maximum allowable level of Se supplementation is 0.30 ppm (AAFCO,2003). The Selenium supplement that primarily has been used in animal diets is the inorganic form, sodium selenite (SS; Na2SeO3).

Recently however, there has been interest in the use of organic forms of Se, such as selenocysteine, selenomethionine (SM), or Se-enriched yeast (SY), as supplemental sources of Se. Therefore, the objectives of this experiment were to determine the effect of inorganic sources of Se on growth performance, carcass traits, Se concentration in the breast and plasma, and plasma glutathione peroxidase activity (pGPX3) in broilers chickens.

1.1 Materials and Methods

Experimental site: The experiment was carried out at the poutry unit of the Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, which is located on longitude $4^0$5' east of the Greenwich meridian and latitude $8^0$7' north of the equator in the derived savannah zone of Nigeria.

Experimental diets: The birds were randomly allotted to three dietary treatments with ten birds per replicate in a completely randomized design. The treatments were A (control – no Selenium supplementation), B (0.3mg/kg Selenium supplementation) and C (0.5mg/kg Selenium supplementation). Table 3.1 shows the gross composition of the diets.

Experimental Animals and Procedures

A total of one hundred and fifty day old broilers were randomly allotted to three dietary treatments with ten birds per replicate in a completely randomized design. During the experiment, the temperature of the house was 32.3 ±3°C. The treatments were A (control – no Selenium supplementation), B (0.3mg/kg Selenium supplementation) and C (0.5mg/kg Selenium supplementation).

Data collection

Haematological indices: At the end of 7 weeks of experiment, blood samples were collected from the birds for hematological analysis. Packed Cell Volume (PCV) was determined by spinning about 75µl of each blood sample in heparinised capillary tube in a haematocrit centrifuge for about 5 minutes and read on haematocrit reader as described by Benson *et al*. (1989) while erythrocyte (RBC) and leucocyte (WBC) counts were determined using haemocytometer method as described by Lamb (1981). The haemoglobin (Hb) concentration and the blood constants: mean cell haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were determined using cyanethaemoglobin method and appropriate formula respectively as described by Jain (1986) while the differential white blood counts (neutrophils, eosinophils, basophils, lymphocytes and monocytes) were determined as described by Lamb (1981).

Serum analysis: The serum total proteins was determined by the Biuret method of Reinhold (1953) using a commercial kit (Randox Laboratories Ltd, U.K.), while albumin value was obtained by bromocresol green method Doumas and Bigg (1971). The globulin and albumin/globulin ratio were determined according to the method of Coles (1986). The serum creatinine and urea nitrogen were estimated by deproteinisation and Urease-Berthelot colorimetric methods,s respectively, using a commercial kit (Randox Laboratories Ltd., U.K.) the free cholesterol was determined by nonane extraction and enzymatic colorimetric methods respectively using commercial test kits (Quimica Clinica Applicada,S.A.), while the serum enzymes Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) were obtained using the Randox Laboratories Ltd, UK test kits. Six (6) birds were randomly selected from each replicate and sacrificed for carcass quality evaluation. Minerals evaluation were carried out by wet ashing of A.O.A.C. (1990) and read in spectrophotometer.

Statistical analysis

All data collected were subjected to statistical analysis of variance (ANOVA) procedure of SAS, (2010) software package, where significant difference occurs among the means, Duncan's multiple range test of sample package was employed to separate the means.

1.1.2 Results and Discussion

The result of the Heamatological Characteristics of broiler birds fed diets supplemented with different levels of Selenium Powder are presented in Table 3. There were no significant differences ($p>0.05$) in packed cell volume, heamoglobin, red blood cell and white blood cell while there were significant differences ($p<0.05$) in heterophyl and lymphocytes. Diet 2 has the highest number of heterophyl but diet 1 is significantly different from diet 3. *In vitro,* selenium has been shown to decrease replication of the virus in T lymphocytes (Hori *et al*., 1997). *In vivo,* selenium supplementation can increase GSH-Px activity in HIV infected patients (Delmas-Beauvieux *et al*., 1996) and has been promoted as a supportive therapy (Schrauzer and Sacher, 1994).

The result of the Serum Characteristics of broiler birds fed diets supplemented with different levels of Selenium Powder are presented in Table 4. There were no significant differences ($p>0.05$) Total protein, Albumin, Urea and Creatine. While significant differences ($p<0.05$) in Aspartate Transaminase, Alanine Transaminase, Cholesterol, Triglygeride, High Density Lipoprotein, Very Low Density Lipoprotein and Low Density Lipoprotein.

Diet 3 had the highest Aspartate Transaminase followed by diet 2 while diet 1 had the lowest. For Alanine Transaminase, Diet 3 and 2 are not significantly different but diet 1 has the lowest value. Diet 1 has the

highest value for cholesterol followed by while diet 2 and diet three with the lowest but diet 2 and 3 were not significantly different. For Triglyceride, diet three had the highest value followed by diet 2 and the least was diet 1 though diet 2 and 1 are not significantly different. Diet 1 has the highest value of Very High Density Lipoprotein followed by diet 2 while the least was diet 3 though diet 2 and 3 are not significantly different. Diet 1 has the highest Low Density Lipoprotein followed by diet 3 while diet 2 had the lowest but diet 2 and 3 are not significantly different. Diet 3 has the highest value of Low Density Lipoprotein while diet 2 is intermediate between diet 1 and 2 and diet 1 has the lowest value.

Moreover, selenium aid in the reduction of cholesterol. The diet 1, 2 and 3 contains 81.06, 65.87 and 63.43mg/kg respectively so also the high density lipoprotein decrease with increase in the level of selenium and low density lipoprotein increases with the increasing level of selenium in the diet. Diet 3 shows a very wide significance in the level of triglycerides in the chicken with 208.51mg/kg compare with diet 1 and diet 2 respectively. Harper *et al* (1977) observed that food has major influence in the different components of blood.

1.1.3 Conclusion

It could be concluded from this study that selenium supplementation have significant effect on improving the hematological and serum characteristics of broiler birds and thereby improving the quality and the general health of broiler chickens. The study showed that all the dietary inclusion satisfactory as feed for broiler chicken without any deleterious effect on performance and blood profile. Inclusion level of 0.5mm/kg of selenium appeared to have better overall performance when fed to broiler chicken. Supplementation up to 0.5mg/kg was superior to lower level in this study which suggests that broilers tolerate more than recommended allowance in literature and against the popular caveat about its toxicity. In further studies the effects of higher levels, inorganic Selenium and vitamin E on metabolic haematology and serum characteristics of broiler chicken should be investigated in order to better understand and exploit its physiological role in mans and animals health.

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Table 1: Gross Composition of Broiler Diets Supplemented with different levels of Selenium powder

Ingredients (kg)	Diet 1 Control	Diet 2 (0.3mg/kg)	Diet 3 (0.5mg/kg)
Maize	58.00	58.00	58.00
Groundnut Cake	21.00	21.00	21.00
Palm kernel cake	1.00	1.00	1.00
Fish meal	2.00	2.00	2.00
Soyabean meal	14.60	14.60	14.60
Bone meal	2.40	2.40	2.40
Premix (Broiler starter)	0.30	0.30	0.30
Salt	0.30	0.30	0.30
Lysine	0.30	0.30	0.30
Methionine	0.20	0.20	0.20
Selenium Powder (mg/kg)	0.00	0.30	0.50
Total	**100.00**	**100.00**	**100.00**
Calculated Nutrient			
Crude Protein (%)	23.00	23.00	23.00
Metabolisable Energy (kcal/kg ME)	3019.27	3019.27	3019.27
Crude fibre (%)	3.30	3.30	3.30

Table 2: Heamatological Characteristics of Broiler birds fed diets supplemented with different levels of Selenium Powder

Parameters	Diet 1 Control	Diet 2 (0.3mg/kg)	Diet 3 (0.5mg/kg)	Normal Range	SEM
Packed Cell Volume (PCV) (ml%)	29.33	29.33	27.33	26.0- 45.20	2.13
Heamoglobin (Hb) (g/dl)	9.11	9.78	9.78	7.50- 13.10	1.23
Red Blood cell (RBC)($x10^6mm^3$)	2.52	2.65	2.99	2.90 –4.10	0.15
White Blood cell (WBC) ($x10^3mm^3$)	15.13	16.65	18.42	9.76-31.00	2.34
Heterophyl ($x10^3mm^3$)	22.67^b	35.67^a	23.33^b		2.17
Lymphocytes ($x10^3mm^3$)	7.17^a	5.97^b	7.40^a	5.45-17.30	2.15

[ab] Means within the same row without common superscripts differ significantly ($p<0.05$)

Table 3: Serum Characteristics of Broiler birds fed diets supplemented with different levels of Selenium Powder

Parameters	Diet 1 Control	Diet 2 (0.3mg/kg)	Diet 3 (0.5mg/kg)	Normal Range	SEM
Total Protein (TP)	5.55	5.53	5.46	5.20-6.90	0.34
Albumin (Alb)	2.06	2.41	2.34	2.10-3.45	0.16
Urea (mg/dl) (UR)	1.10	1.13	1.02	1.50- 6.3	0.08
Creatinine (CRT)	0.40	0.41	0.39	0.90-1.85	0.01
Aspartate Transaminase (AST) (I.U./l)	93.01^c	171.70^b	178.70^a	88.0- 208.0	3.75
Alanine Transaminase (ALT) (I.U./l)	7.66^b	12.01^a	12.11^a	9.50- 37.2	2.31
Cholesterol (CHL) (mg/dl)	81.06^a	65.87^b	63.43^b	52.0-148.0	4.23
Triglyceride	156.46^b	160.88^b	208.51^a		6.82
High Density Lipoprotein	31.44^a	23.23^b	19.88^b		3.11
Very Low Density Lipoprotein	41.70^a	31.29^b	32.18^b		2.74
Low Density Lipoprotein	6.19^b	10.62^{ab}	17.44^a		1.82

[ab] Means within the same row without common superscripts differ significantly ($p<0.05$)

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