APHW -69

Influence of Supplemental Selenium and α–Tocopherol on Egg Production and Blood Profiles of Laying Chickens

F. O. Jemiseye, O. A. Ogunwole, B. S. Adedeji, A. O. Mosuro, T. V. Abokede and I. A. Oludoyi
Agricultural Biochemistry & Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria
Corresponding author: F.O. Jemiseye; E-mail: jemiseyefo@gmail.com, Telephone: 08037064917

Abstract
Effect of dietary supplement of selenium and α–tocopherol on performance and blood profile of laying hen was assessed in this trial. ISA brown pullets (n=192) at week 52 (late laying phase) of life were randomly assigned to six experimental diets: T1: Basal diet, T2: Basal diet with 0.5 mg/kg selenium, T3: Basal diet with 1.0 mg/kg selenium, T4: Basal diet with 1.5 mg/kg selenium, T5: Basal diet with 20 mg/kg α–tocopherol, T6: Basal diet with 40 mg/kg α–tocopherol. Each treatment was replicated four times with eight birds per replicate. The design of the experiment was a completely randomized design. Performance parameters were not significantly affected ($p>0.05$) by supplemental selenium and α–tocopherol. Laying hens on T6 had significantly higher ($p<0.05$) packed cell volume (34.95%), red blood cells ($2.79x10^6$IU/L), haemoglobin (11.81 g/100mL), lymphocytes (79.75%), and heterophil / lymphocytes ratio (0.143) than those on the control diet. Similarly, hens on T6 had significantly higher ($P<0.05$) serum total cholesterol (90.51mg/dL), high density lipoprotein (23.31 mg/dL), low density lipoprotein (35.54 mg/dL), calcium (14.57%) and phosphorus (4.39%) but lower triglyceride (31.66 mg/dL) compared to those on other dietary treatments. However, serum glucose (mg/dL) of hens on T6 (92.71) was similar to those on T4 (92.69) but lower when compared to those on T1 (90.05). Therefore, supplemental α–tocopherol could positively influence hen blood profile at the late laying phase.

Keywords: Laying chickens, supplemental α–tocopherol and minerals, haematology, serum biochemical indices

Introduction

The productivity, health status and reproductive efficiency of animal were correlated with the blood parameters (Abdel-Fattah *et al*., 2013) Failure to maintain the health status of laying chickens may cause great economic loss (Lin and Chang, 2006). Animals with good blood composition are likely to show good performance (Isaac *et al*., 2013). Haematological studies are useful in the diagnosis of many diseases, good indicator of physiological status of animal as well as investigation of the extent of damage to blood (Onyeyili *et al*,. 1992; Khan and Zafar, 2005; Togun *et al*., 2007). Oxidative stress is known to be an important contributing factor in many chronic diseases (Mahima *et al*., 2013) in laying chickens.

Vitamin E (α-Tocopherol) is an important lipid-soluble antioxidant. It performs its functions as antioxidant in the glutathione peroxidase pathway (Wefers and Sies, 1988) and it protects cell membranes from oxidation by reacting with lipid radicals produced in the peroxidation chain reaction (Herrera and Barbas, 2001; Traber and Atkinson, 2007). Vitamin E is effective in ensuring adequate stability of the diet and in protecting the bird's immune system and thereby improving performance (Bou *et al*., 2004). Selenium (Se) is an important natural antioxidant which is essential in many metabolic processes in living organisms. Selenium has beneficial effects on both the innate and adaptive (cell-mediated and antibody-mediated) immune responses.

However, poultry cannot synthesize vitamin E and selenium, their requirements must be given from dietary sources (Puthpongsiriporn *et al*., 2001). There is dearth of information on the effect of combined or sole dietary supplementation of vitamin E and/or selenium on the blood profile of laying hens at the late laying phase. Therefore, this study was aimed at evaluating the effect of dietary selenium and vitamin E supplementation on egg production and blood profile of laying hens at the late laying phase.

Materials and Methods

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan. ISA brown hens (n=192) at week 52 of life were initially raised on a basal diets for two weeks and subsequently assigned to six experimental diets in a completely randomized design model. Each treatment was replicated four times with eight hens per replicate. The experiment lasted 20 weeks.

Eggs were collected daily and recorded; hen day egg production was calculated by number of eggs laid divided by number of chicken at the period of data collection. Feed intake was calculated by subtracting left over from feed offered to the hens. Eggs were weighed with sensitive scale to obtain egg weight and egg mass was calculated from the percent hen day egg production and average egg weight. At week 56 of laying, blood was collected from two birds per replicate via jugular vein into heparinized test tubes

for haematology and another without EDTA for serum analyses. Haematological parameters; packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC) and differential counts were determined (Schalm *et al.,* 1975).

Data were subjected to analyses of variance (SAS, 2003) and means were separated using Duncan multiple range test option of the same software at $\alpha_{0.05}$.Basal diet was supplemented with selenium and α–tocopherol as follows:T1 = Basal diet, T2 = Basal diet with 0.5 mg selenium/kg, T3 = Basal diet with 1.0 mg selenium/kg, T4= Basal diet with 1.5mg selenium/kg, T5 = Basal diet with 20 mg α–tocopherol/kg, T6 = Basal diet with 40 mg α–tocopherol/kg*).* Feed and water were supplied *ad libitum* to pullets. The composition of the basal experimental diet is shown in Table 1.

Table 1: Composition of experimental basal diet

Ingredient	%
Corn	50.00
Wheat offal	11.00
Soya bean meal	22.00
PKC	11.25
Dicalcium phosphate	1.30
Salt	0.30
Methionine	0.15
Lysine	0.15
Vitamin/mineral premix	0.30
Mycofix	0.15
Biotronine	0.30
Oyster shell	3
Total	100
Calculated nutrients	
ME (Kcal/Kg)	2736.01
Protein (%)	17.23
Calcium (%)	4.18
Phosphorus (%)	0.17
Methionine (%)	0.51
Lysine (%)	0.87

Premix* - Vitamin A–10,000,000 IU, Vitamin D3–500 IU, Vitamin E–40,000 mg, Vitamin K–2,000 mg, Vitamin B1–1,500 mg, Vitamin B2–4,000 mg, Vitamin B6–40,000 mg, Vitamin B12–200 mg, Niacin–40,000 mg, Panthothenic–10,000 mg, Folic– 1,000 mg, Biotin–100 mg, Choline chloride–300,000 mg, Manganese–80,000 mg, Zinc–60,000 mg, Iron–40,000 mg, Copper–80,000 mg, Iodine–800 mg, Selenium–200 mg, Cobalt–300 mg, Antioxidant–100,000 mg

Results and discussion

Performance of laying birds fed supplemental selenium and α–tocopherol at the late laying phase is presented in Table 2. Varied dietary inclusion of supplemental selenium and α–tocopherol had no significant effects ($p>0.05$) on all performance parameters examined. However, supplemental α–tocopherol at 20 mg/kg numerically increased hen day egg production percentage from 65.03% in control diet to 72.59% in 20 mg/kg α–tocopherol supplemented diet. This result contradicts the report of Sahin *et al.* (2001) that higher levels of α–tocopherol resulted in a higher feed intake and higher dietary selenium inclusions caused an improvement in feed intake.

The haematological parameters of laying hens fed supplemental selenium and α–tocopherol at the late laying phase is shown in Table 3. Hens fed T6 (40 mg/kg α – tocopherol) had significantly increased ($p<0.05$) PCV, RBC, Hb, MCH, MCHC, MCV and WBC compared to control and other treatments. Lymphcytes, heterophils and Heterophil / lymphocyte indices of hens on T6 were significantly higher ($p<0.05$) than in the control and other dietary treatments. Vitamin E is the major chain-breaking antioxidant in lipid phases such as cellular membrane or low density lipoproteins (Tappel, 1968; Gey, 1998). Vitamin E, therefore, acts as the primary antioxidant by quenching lipid peroxyl radicals.

The serum biochemical parameters of hens fed supplemental selenium and vitamin Eat the late laying phase is shown in Table 4. Increased HDL has been attributed to better health condition (Gordon, 1998). Cholesterol (mg/dL), high density lipoprotein (mg/dL) and low density lipoprotein (mg/dL) in birds on T6 were significantly higher (90.51, 23.31 and 35.54) and lower in control (T1)

(88.89), and other diets (22.06 and 33.05). The reduced low density lipoprotein level observed in T1 (33.05 mg/dl) however may be attributed to the decreased cholesterol in the serum.

Table 2. Performance of laying birds fed supplemental selenium and α – tocopherol

		Selenium (mg/kg)			α – tocopherol (mg/kg)		
Parameters	Control	0.5	1.0	1.5	20	40	SEM
Hen day egg production (%)	65.03	69.49	67.04	60.96	72.59	58.34	2.31
Feed intake (g)	109.67	108.19	109.50	109.51	109.65	108.76	0.19
Egg weight (g)	62.28	62.58	58.29	58.25	59.81	60.54	0.67
Egg mass	40.63	43.15	38.97	35.60	43.59	35.55	1.50

a,b Mean in the same row with different superscript are significantly different (p<0.05); T1 - Basal diet (Control), T2 - Basal diet+0.5 mg selenium/kg ,T3 - Basal diet +1.0 mg selenium/kg ,T4-Basal diet+1.5 mg selenium/kg,T5-Basal diet+20mg vitamin E/kg,T6 - Basal diet + 40 mg vitamin E/kg. SEM - Standard error of the mean,

Table 3: Haematological parameters of birds fed selenium and α – tocopherol supplementation

	Selenium (mg/kg)		α – tocopherol				
Parameters	Control	0.5	1.0	1.5	20	40	SEM
PCV(%)	30.95^{f}	31.35^{e}	33.99^{d}	34.51^{b}	34.09^{c}	34.95^{a}	0.38
RBC($x100^{6}$IU/L)	2.11^{f}	2.21^{e}	2.33^{d}	2.55^{b}	2.45^{c}	2.79^{a}	0.05
Hb(g/100mL)	10.35^{e}	11.55^{b}	10.99^{d}	11.59^{b}	11.05^{c}	11.81^{a}	0.12
WBC($X10^{6}$mm)	19.55^{e}	20.75^{d}	21.07^{c}	21.25^{b}	21.21^{b}	21.41^{a}	0.15
LYMP(%)	78.51^{e}	78.71^{d}	78.95^{c}	79.39^{b}	78.95^{c}	79.75^{a}	0.10
HET(%)	10.05^{f}	10.39^{e}	10.88^{d}	11.19^{b}	11.06^{c}	11.41^{a}	0.11
HET:LYMP	0.128^{f}	0.131^{e}	0.137^{d}	0.141^{b}	0.140^{c}	0.143^{a}	

a,b Mean in the same row with different superscript are significantly different (p<0.05); T1 - Basal diet (Control),T2 - Basal diet + 0.5 mg selenium/kg ,T3 - Basal diet + 1.0 mg selenium/kg,T4-Basal diet+1.5mg selenium/kg,T5-Basal diet + 20 mg vitamin E/kg,T6-Basal diet + 40 mg vitamin E/kg. SEM-Standard error of the mean, Packed cell volume (PCV) Haemoglobin, (RBC) Red blood cells, (Hb), Mean cell haemoglobin, (WBC) White blood cells, (LYMP) Lymphocyte, (HET) Heterophils

Table 4: Lipid and biochemical parameters of birds fed selenium and α–tocopherol supplementation

		Selenium (mg/kg)			α–tocopherol (mg/kg)		
Parameters	Control	0.5	1.0	1.5	20	40	SEM
CHO (mg/dL)	88.89^{f}	89.54^{e}	89.92^{d}	90.31^{b}	90.14^{c}	90.51^{a}	0.13
HDL (mg/dL)	22.06^{f}	22.52^{e}	23.04^{d}	23.20^{b}	23.14^{c}	23.31^{a}	0.11
LDL (mg/dL)	33.05^{f}	33.47^{d}	35.03^{c}	33.41^{e}	35.17^{b}	35.54^{a}	0.24
TG (mg/dL)	33.78^{a}	33.55^{c}	31.85^{d}	33.69^{b}	31.84^{d}	31.66^{e}	0.23
Glucose (mg/dL)	90.05^{e}	90.91^{d}	92.05^{c}	92.69^{a}	92.18^{b}	92.71^{a}	0.24
Ca (%)	13.05^{f}	13.31^{e}	14.13^{d}	14.33^{b}	14.22^{c}	14.57^{a}	0.13
P (%)	3.71^{f}	3.86^{e}	4.06^{d}	4.35^{b}	4.25^{c}	4.39^{a}	0.06

^{a,b} Mean in the same row with different superscript are significantly different (p<0.05).; T1 - Basal diet (Control),T2 - Basal diet + 0.5 mg selenium/kg,T3 - Basal diet + 1.0 mg selenium/kg, T4-Basal diet+1.5mg selenium/kg,T5 - Basal diet + 20 mg vitamin E/kg,T6 - Basal diet+40mg vitamin E/kg, (CHO) Cholesterol, (HDL) High density lipoprotein, (LDL) Low density lipoprotein, (TG) Triglyceride, (Ca) Calcium, (P) Phosphorus, SEM - Standard error of the mean,

Conclusion

Dietary supplemental selenium and α–tocopherol had no effect on performance of laying hens at the late laying phase. However, dietary supplementation of α–tocopherol at 40 mg/kg may be considered as a protective management practice in a layers diet, judging from the reduced effect on the measured blood indices.

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