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Effect of supplementation of organic zinc on serum biochemistry in broiler breeders

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Abstract

A biological trial was conducted to assess the effect of feeding zinc on blood biochemical constituents in broiler breeders. One hundred twenty eight adult healthy broiler breeders were used and these were randomly divided into four groups. The treatments were control (basal diet) and treatment groups were fed with supplementary organic zinc as 20 ppm (T₁), 40 ppm (T₂) and 60 ppm (T₃). The blood sample were collected and plasma biochemical constituents were analysed. In male broilers, higher dose of zinc (T₃) fed group showed significantly (P<0.05) higher in serum calcium, enzymes like Alkaline phosphatase, aspartate transaminase and reduced total cholesterol and total protein and there was no significant (P>0.05) difference serum phosphorus, triglycerides, alanine transaminase and uric acid. In case of female broilers feeding zinc T₃ treatment group showed significantly (P<0.05) higher level of calcium, phosphorus, total protein, ALP, AST and increased the total cholesterol content. There was no significant difference was noticed in Alanine transaminase and uric acid level. In conclusion, supplementing the diet of broiler breeder chickens with zinc caused significant increase in serum plasma and cholesterol contents in this study. Therefore, zinc can be used as efficient feed additive for enhanced physiological status of birds.

Keywords: Broiler breeder, cholesterol, triglycerides, zinc

Introduction

Zinc is important component of many metalloenzyme concerned with numerous biochemical functions in body. The plasma zinc concentration is a valid and useful indicator of the size of exchangeable pool of zinc. A reduction in the plasma zinc level reflects a loss of zinc from its target organs (bones and liver) and an increased risk to the development of metabolic and clinical signs of zinc deficiency (King, 1990) [5]. Zinc plays a major role in control of appetite, enhanced immune function, reduced reactive oxygen species (ROS). Similarly, Zinc plays an important role in the breeders as the affects the secretion of various reproductive hormones, testicular development and differentiation and in turn affecting the reproductive performance. Hence, the present study assessed the effect of supplementation of organic Zn on the serum biochemical constituents in the broiler breeders.

Material and method

Selection and feeding management of birds

The experiment with organic zinc was carried out for 8 weeks using 32 males and 96 females of Caribro Vishal adult breeders. The birds are randomly divided into four groups, in each group carrying 24 female and 8 male. The treatment groups were control (basal diet), T₁ was supplemented with 20 ppm zinc methionine, T₂ with 40 mg ppm and T₃ 60 ppm in addition to basal diet. The birds were maintained under uniform standard managerial conditions in individual cages. In this study organic form of zinc as zinc methionine (Mintrex® Zn, Novus Pvt. Ltd.,) was used.

Sample collection and analysis

Blood was collected in both male and female birds randomly and serum was separated. The plasma samples were collected and analysed for total protein, calcium, total cholesterol, triglycerides uric acid and transaminase enzymes activities such as alanine transaminase, aspartate transaminase and alkaline phosphatase were analysed using kit protocol (Corel Clinical Systems, Goa).

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Statistical analysis

The data obtained for various parameters were subjected to statistical analysis using statistical package for social sciences (SPSS) version 20.0. The means were compared for significant using Tukey's multiple range test.

Result and Discussion

The total protein showed significant difference ($P < 0.05$) in both males and females due to zinc supplementation (Table 2). The higher level of total protein (4.66 mg/dl) in birds fed with higher dose of zinc (T_3). This result was in accordance with the finding of Kucuk *et al.* (2003) [4], who observed higher serum protein concentration with zinc supplemented groups in heat stressed broilers. Elevated protein level was related to hormonal regulation of protein metabolism. Cellular protein was increased due to hormones.

Total cholesterol content revealed significant difference between treatment groups. The supplementary zinc at higher doses (T_3) has increased ($P < 0.05$) the total cholesterol content (123.53mg/dl) than the other three groups. In contrary, Kucuk *et al.* (2003) [4] reported that Zn reduced the serum cholesterol level in heat stressed broilers. However, the present study was conducted in broiler breeders where an increase in cholesterol content might be due to stimulatory effect of Zn on steroid hormones secretions. The cholesterol are precursor molecules for steroid secretion and hence, their concentration might showed a higher level. Highest total cholesterol content in males also showed similar trend as T_3 group had higher (97.12mg/dl) level than the other group. The result was in accordance with the findings of Al-Daraji and Amen (2011) [1], who reported that feeding different doses of zinc in broiler breeders diet (50, 75 and 100 mg/kg) resulted in significantly ($p < 0.05$) increase blood plasma cholesterol, calcium, phosphorus, Protein and ALP concentration and mallard duck (Levengood *et al.*, 2000) [6]. Higher level of blood plasma cholesterol concentration may be attributed to the factors that affect plasma cholesterol concentration-feed back control of body cholesterol. Data on plasma triglycerides showed a significantly ($p < 0.05$) higher value in T_3 group (120.88 IU/L) than the remaining three groups. However, this effect was observed only in male breeders not in the females.

The plasma calcium content showed significant difference ($P < 0.05$) among the groups, with higher dose exhibiting

higher calcium content in both breeders. The T_3 group showed higher calcium level (26.34 mg/dl) than control and T_1 (22.86 and 23.25 mg/dl) in females. Similarly, in male breeders higher calcium level was noticed in T_3 group (12.06 mg/dl) than control and T_1 (9.18 and 10.00 mg/dl) groups. Plasma phosphorus showed significance difference among the treatment groups in both breeders. Higher phosphorus content was observed in T_3 group (7.15mg/dl) and lowest level (4.99mg/dl) in control group, whereas T_1 and T_2 exhibited intermediate response in both male and female broiler breeders. The higher calcium and phosphorus levels in supplemented group might be due to increase in mineral transporter production and reduced mineral antagonistic action as the organic nature of the mineral. The uric acid did not showed ($P > 0.05$) any supplementary effect.

The plasma ALP activity showed significant difference ($p < 0.05$) among the treatments. Higher ALP activity was noticed in T_3 group (4.22KA) than the other three groups (Table 4) in both male and female broiler breeders. This was in accordance with finding of Anshan (1993) [2], that supplementation zinc as different source to broiler chicks showed significantly higher ALP than control group. There was no significant difference was notice on serum ALT and uric acid among the dietary treatments. Like ALP, the plasma AST activity showed similar trend as T_3 group showed higher activity (168.53IU/L) when compared to other three groups. This is in accordance with the result of Fu-Yu *et al.* (2007) [3], who reported that feeding Zn to HF bull's treatment showed significantly increased serum AST levels.

Table 1: Chemical composition of the male and female experimental diet.

Nutrient composition (as fed basis)	Male	Female
Crude protein (%) ²	14.0	16.0
ME (kcal/kg) ³	2750	2800
Calcium (%) ²	1.00	3.50
Total phosphorus (%) ²	0.70	0.75
Lysine (%) ³	0.80	0.95
Methionine (%) ³	0.40	0.45

¹Constant includes 0.15% vitamin premixes, 0.015% B-complex, 0.05% choline chloride, 0.05% toxin binder and 0.005% coccidiostat.

Table 2: Effect of zinc supplementation on the plasma protein, cholesterol and triglycerides levels in broiler breeders.

Group	Total protein (g/dl)		Total cholesterol (mg/dl)		Triglycerides (mg/dl)	
	Male	Females	Male	Females	Male	Females
C	4.05 ^b ±0.12	4.96 ^b ±0.09	70.34 ^b ±1.87	77.36 ^b ±4.92	104.22 ^b ±2.76	186.85±8.54
T1	4.22 ^b ±0.10	4.61 ^b ±0.10	69.42 ^b ±1.67	102.23 ^{ab} ±10.13	96.81 ^b ±3.39	169.10±10.31
T2	4.21 ^b ±0.10	4.74 ^b ±0.17	60.47 ^b ±3.15	115.71 ^a ±15.80	107.49 ^b ±2.94	191.25±6.05
T3	4.66 ^a ±0.17	5.18 ^a ±0.15	97.12 ^a ±7.19	123.53 ^a ±7.34	120.88 ^a ±7.04	175.30±9.05
P-value	0.013	0.025	0.001	0.018	0.004	0.258

Table 3: Effect of zinc supplementation on the plasma calcium, phosphorus and uric acid levels in broiler breeders.

Group	Calcium (mg/dl)		Phosphorus (mg/dl)		Uric acid (mg/dl)	
	Male	Females	Male	Females	Male	Females
C	9.18 ^b ±0.79	22.86 ^b ±0.64	4.99 ^c ±0.03	5.40 ^b ±0.35	6.19±0.20	5.58±0.15
T1	10.00 ^b ±0.39	23.25 ^b ±0.96	5.76 ^b ±0.24	5.63 ^{ab} ±0.15	6.02±0.55	6.04±0.53
T2	10.37 ^{ab} ±0.70	23.79 ^b ±0.87	6.39 ^b ±0.36	5.49 ^{ab} ±0.15	6.37±0.27	6.36±0.27
T3	12.06 ^a ±0.53	26.34 ^a ±0.62	7.15 ^a ±0.23	6.14 ^a ±0.17	6.42±0.42	6.31±0.34
P-value	0.019	0.016	0.001	0.104	0.246	0.383

Table 4: Effect of zinc supplementation on the plasma transaminase and alkaline phosphatase activity in broiler breeders.

Group	ALP (KA)		ALT (U/L)		AST (U/L)	
	Male	Females	Male	Females	Male	Females
C	2.69 ^b ±0.30	3.34 ^b ±0.32	17.67±2.22	18.85±1.84	107.60 ^b ±5.46	118.00 ^b ±2.55
T1	3.30 ^b ±0.45	3.39 ^b ±0.24	19.41±2.94	16.31±1.43	85.48 ^b ±3.34	124.91 ^b ±4.43
T2	2.88 ^b ±0.27	3.43 ^b ±0.18	21.16±3.36	20.40±3.82	105.96 ^b ±6.64	133.83 ^b ±8.64
T3	4.67 ^a ±0.66	4.22 ^a ±0.10	19.04±1.98	19.16±2.94	140.55 ^a ±12.22	168.53 ^a ±20.99
P-value	0.015	0.025	0.123	0.746	0.001	0.020

Conclusion

Supplementation of organic zinc as zinc-methionine (60ppm) to basal diet improved the plasma protein, calcium, phosphorus and total cholesterol contents broiler breeders.

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