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Effects of Sodium Selenite and Turmeric Powder on Thyroid Hormones and Plasma Lipids of Broiler Chickens Reared under Heat Stress Condition

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Abstract: In a randomized complete block design with 2*3 factorial arrengment and 3 replicates in each treatment, a study was conducted to evaluate the effect of two levels of selenium (Se) (0.0, 0.3 mg /kg diet) and three levels of turmeric powder (TP) (0, 5, 10 g/kg diet) on thyroid hormones and plasma lipids of 180 day-old Ross (Ross 308 strain) broiler chickens reared under heat stress condition. The treatments were defined as T1= control diet, T2 = control diet + 5 g TP/kg, T3 = control diet + 10 g TP/kg, T4 = control diet + 0.3 mg Se/kg, T5 = control diet + 5 g TP/kg + 0.3 mg Se/kg and T6 = control diet + 10 g TP/kg + 0.3 mg Se/kg. Chickens were subjected to heat stress condition (35 C°) for two weeks (d 28 to d 42). The results showed that Levels of Se and TP had a significant ($P<0.05$) effect on T_3 and T_4 hormones concentration. Supplementation the diets with Se and (or) TP significantly decreased T_3 hormone concentration, however, the interaction of Se and TP was not significant. Interaction between Se and TP decreased plasma cholesterol and triglyceride concentration. It was concluded that, in heat stress condition Se and TP could have a beneficial effect on health condition and plasma lipid of broiler chickens.

Key words: Birds · Antioxidants · Cholesterol · Thyroid hormone

INTODUCTION

Heat stress is a major concern for poultry industry, especially in the hot region of the world. Heat stress affects on feed intake, growth performance, carcass composition, mortality, respiratory alkalosis and thyroid activity of chickens [1]. The addition of electrolyte salts, antioxidant vitamin (vitamin E, C), some of minerals (Se, Zn) and natural material with antioxidant properties such as turmeric in broiler chicken diets has been recommended as a way to minimized the deleterious effects of heat stress [2]. Selenium (Se) is an essential element that regulates a major component of the antioxidant defense mechanism, plays important roles in immune function and health and performance of broiler chickens. A concentration of 0.15 mg of Se/kg of diet is recommended for broiler chickens throughout the growth period. The maximum allowable level of Se supplementation is 0.3 mg/kg [3].

Several studies have suggested that there is a positive correlation between selenium level of diet and plasma T_3 concentration and a negative correlation between selenium level of diet and plasma T_4 concentration [4, 5]. Ryu *et al.* [6] showed that sodium selenite had no significant effect on plasma lipid up to 8 ppm.

The rhizome of turmeric has a rich history in India as spice, food preservative and coloring agent and has been used for centuries in traditional medicine [7]. The researches indicate that turmeric and its active compound, curcumin, are unique antioxidants [8], antimutagenic [9] and hypocholesterolemic [10]. Emadi and Kermanshahi [11] indicated that turmeric powder significantly increased activity of LDH and AST enzymes and decreased ALT and ALP enzymes. Kermanshahi and Riasi [12], Subba Rao *et al.* and [13] Akila *et al.* [14] showed that using of turmeric powder in poultry diet decreased plasma lipid concentration.

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The present study was undertaken to evaluate the effect of two antioxidants (sodium selenite and turmeric powder) on thyroid hormones and plasma lipids of broiler chickens reared under heat stress condition.

MATERIAL AND METHODS

Day-old chickens (180 males and females of Ross-308 strain) were fed with 6 treatments. The treatments were defined as T1= control diet based corn and soybean meal without supplementation (Table 1), T2 = control diet + 5 g TP/kg, T3 = control diet + 10 g TP/kg, T4 = control diet + 0.3 mg Se/kg, T5 = control diet + 5 g TP/kg + 0.3 mg Se/kg and T6 = control diet + 10 g TP/kg + 0.3 mg Se/kg. Turmeric powder was substituted with wheat bran in the diets.

Chickens were randomly allocated to the 6 treatment groups, 3 replicates and 10 birds in each replicate (5 males and 5 females) with a mean group weight of 40 ± 1.2 g. The birds were placed in electric battery brooders. During the experiment, light was provided continuously (24 hours) and relative humidity inside the house was 42%. Birds were provided with known amounts of feed *ad libitum* and refusals were measured and recorded daily. Routine vaccination and health care was given when it was necessary. The Chicks were kept in 30°C until 28 days of age and then were subjected to heat stress (35°C) during the two last weeks. Feed and water were provided *ad libitum*.

At 28 and 42 days of old, four birds (two male and two female) of each replicate were randomly selected and blood samples were taken from the wing vine into heparinized syringes. The sample were immediately centrifuged (2083g) and plasma frozen (-20°C) until analysis. Concentration of cholesterol, triglyceride and thyroid hormones (T_3 and T_4) determined by using the laboratory kits.

A randomized complete block design was used for statistical analysis. Data for all parameters were subjected to an analysis of variance using a mixed statistical linear model for which repeated measurements were also taken into account. The model was fit using SAS programmer [15].

RESULTS

Thyroid Hormones: The effect of experimental diets on thyroid hormones concentration is shown in table 2. At age 28 and 42d, control diet had highest concentration of T_3 hormone (132.8 and 108.7 ng/ml espectively) as compared with other treatments ($P<0.05$).

Table 1: Dietary composition of basal starter, grower and finisher broiler diets (g/kg DM).

Ingredients	Starter (1-14 d)	Grower (15-28 d)	Finisher (29-42 d)
Corn	593	618	659
Soybean meal	310	296	263
Fish meal	48	25	18
Sunflower oil	5	17	21
Wheat bran	10	10	10
Turmeric powder	0	0	0
DL- Methionine	2.225	2.225	2
Lysine-HCl	1.5	1.75	1.75
Dicalcium phosphate	16.25	16	9
Oyster shell	8	8	9.5
Vitamin premix[1]	2.5	2.5	2.5
Mineral premix[2]	2.5	2.5	2.5
Salt	1	1	1
Calculated analysis			
ME kcal/kg	2900	2993	3000
Crude protein %	22	20.1	19
Methionine %	0.48	0.446	0.44
Lysine %	1.38	1.25	1.13
Methionine + Cystine %	0.92	0.88	0.85
Tryptophan %	0.28	0.21	0.19
Calcium %	1.03	0.9	0.85
Phosphorus %	0.5	0.45	0.4

1: Supplied per kilogram of diet: Vitamin A, 10000 IU; Vitamin D_3, 9790 IU; Vitamin E, 121 IU; B_{12}, 20 µg; riboflavin, 4.4 mg; biotin, 30µg; thiamine, 4mg

2: Calcium pantothenate, 40 mg, niacin, 22mg; choline, 840mg; zinc sulphate, 60mg; mangaese oxide, 60mg; and selenium. 0mg.

Table 2: Effect of experimental diets on thyroid hormones concentration the broiler chickens at 28 and 42 d of age.

	T_3 hormone (ng/ml)		T_4 hormone (ng/ml)	
Treatments	28 d	42 d	28 d	42 d
T1 (0 mg Se, 0 g TP)	132.8^{a}	108.7^{a}	2.9	3.6^{bc}
T2 (0 mg Se, 5g TP)	87.5^{b}	92.0^{ab}	2.1	3.1^{cd}
T3 (0 mg Se, 10 g TP)	96.6^{b}	76.2^{b}	2.3	4.2^{a}
T4 (0.3 mg Se, 0 g TP)	62.7^{c}	86.0^{b}	2.4	4.2^{ab}
T5 (0.3mg Se, 5 g TP)	63.3^{c}	36.8^{c}	2.4	2.9^{d}
T6 (0.3 mg Se, 10 g TP)	62.3^{c}	46.7^{c}	2.3	3.7^{abc}
± SEM	10.9	10.0	0.5	0.4

a-dValues in the same column and variables with no common superscript differ significantly. :P<0.05

Table 3: Effect of experimental diets on plasma lipid concentration the broiler chickens at 28 and 42 d of age.

	Triglyceride (mg/dl)		Cholesterol (mg/ml)	
Treatments	28 d	42 d	28 d	42 d
T1 (0 mg Se, 0 g TP)	59.4^{a}	34.8^{ab}	120.0^{a}	126.2^{a}
T2 (0 mg Se, 5g TP)	45.7^{b}	38.0^{a}	118.2^{ab}	120.5^{ab}
T3 (0 mg Se, 10 g TP)	44.4^{b}	36.0^{ab}	99.5^{d}	119.2^{ab}
T4 (0.3 mg Se, 0 g TP)	29.7^{c}	33.5^{ab}	112.8^{abc}	116.3^{ab}
T5 (0.3mg Se, 5 g TP)	33.7^{b}	31.2^{b}	109.5^{bc}	113.0^{ab}
T6 (0.3 mg Se, 10 g TP)	43.7^{b}	35.3^{ab}	106.7^{cd}	105.3^{b}
± SEM	3.78	2.93	4.94	9.23

a-dValues in the same column and variables with no common superscript differ significantly. :P<0.05

Moreover, diets supplemented with 0.3 mg Se and 5 or 10 g TP had lowest T_3 hormone concentration. At 28 days of age, Se levels had significant effect on concentration of T_3 hormone (P<0.05) and effect of TP levels were significant on that in 42 days of age. At the 28 days, Se and TP supplementation in broiler diet had not significant effect on concentration of T_4 but effect of interaction between these two antioxidant had significant (P<0.05). Treatments including 0.3 mg Se and 5 g TP resulted of highest T_4 hormone concentration (4.25 ng/ml) and that difference with control diet was significant (P<0.05).

Plasma Lipids: The effect of experimental diets on plasma lipids concentration is shown in table 3.The experimental diets had significant effect on triglyceride concentrations (P<0.05) at two sampling times. The main effect of Se and TP on plasma triglyceride concentration was not significant, however the interaction of Se and TP significantly decreased plasma triglyceride At 28 and 42 day of age. Supplementation of diet with Se and (or) TP decreased cholesterol concentration (P<0.05). There was some differences between the treatments as plasma cholesterol concentration (P<0.05). At 28 day of age, the chicken received 10 g/kg TP had lower cholesterol concentration (99.5 mg/dl) than those the other treatments, while in 42 days of age, diet including 0.3 mg Se and 10 g TP /kg diet (T6) had the lowest cholesterol concentration (105.3 mg/dl). Interaction between Se and TP significantly (P<0.01) reduced the cholesterol concentration of chickens.

DISCUSSION

It is well known that thyroid hormones (T_3 & T_4) regulate basal metabolic rate and are essential for the maintenance of high and constant body temperature [16]. According to Chang *et al.* [4] reported a positive correlation between Se level of diet and plasma T_3 concentration and a negative correlation between Se and plasma T_4, but in the present study, supplementation the diets with Se and (or) TP significantly decreased T_3 hormone concentration, however the interaction of Se and TP was not significant. This discrepancy might be due to the levels of supplementation and heat stress condition applied in the present study. Heat stress reduced feed intake [17] and the restriction of feed may increased activity of D3 enzyme (outer ring deiodination). It is reported that D3 enzyme increases T_4 hormone and decreases T_3 hormone concentrations [16]. In addition to, the effect of thyroid hormones on protein and lipid metabolism is a biphasic nature, because in low physiological concentrations they are anabolic while at higher concentrations they are catabolic [16].

The interaction of Se and TP significantly decreased plasma triglyceride and cholesterol concentration. In 42 days of age, T6 (diet including 0.3 mg Se and 10 g TP /kg) had the lowest cholesterol concentration (105.3 mg/ml). This result may be related to effect of Se and TP on T_3 hormone concentration and its anabolic role on fat deposition [16]. Subba Rao *et al.* [13] reported that TP increased catabolism of triglyceride in rat. They suggested that dietary TP alter triglyceride metabolism in the liver and/or the VLDL clearance in the peripheral tissues without affecting intestinal absorption of triglycerides. Ryu *et al.* [6] who used 8 mg/kg Se in broiler diet reported that the cholesterol concentration was reduced. In agreement with our results, Hussein and Chandrasekhara [18] indicated that supplementation broiler diets with 2, 5 and 10 g/kg curcumin decreased the plasma cholesterol concentration. These finding may be related to the effect of TP on cholesterol α- 7 hydroxlyase enzyme activity and increased catabolism of plasma cholesterol [14].

In conclusion, supplementation of antioxidants compound such as selenium (sodium selenite) and turmeric powder in broiler diet under heat stress condition can reduce plasma lipid concentration. Interactions between two antioxidant had better effect.

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