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Effect of Varying Levels of Turmeric Rhizome Powder on Some Blood Parameters of Broiler Chickens Fed Corn-Soybean Meal Based Diets

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Abstract: An experiment was conducted to study the effect of Turmeric Rhizome Powder (TRP) on some blood parameters in broiler chickens. A corn-soybean meal based diet containing levels of TRP (0.00, 0.25, 0.50 and 0.75%) in a completely randomized design with 4 treatments and 5 replicates of 10 birds each were fed to 200 day-old Ross male broiler chickens from 0-49 days of age. For measuring blood parameters (albumin, total protein, total cholesterol, HDL and LDL-cholesterol and triglyceride) at 21, 35, and 42 and red blood cells, hemoglobin and hematocrit value at 21 and 42 days of age, serum blood samples from each replicate of treatments were collected. Inclusion of TRP into the diets significantly increased total cholesterol, HDL-cholesterol and haemoglobin and decreased LDL-cholesterol, VLDL-cholesterol and red blood cells at 42 days of age ($p<0.05$). TRP also significantly decreased blood albumin ($p<0.05$). Under the condition of this study, it was concluded that TRP might have some positive effects on health status of the broiler chickens.

Key words: Turmeric, blood parameters, broiler chickens

Introduction

The rhizome of *Curcuma longa* (turmeric) has been widely used as a spice and colouring agent in many foods. Consumption of turmeric has been associated with various beneficial effects on human health (Ammon and Wahl, 1991). In tropical regions of Asia, turmeric has also been used as a traditional remedy for the treatment of inflammation and other disease (Ammon and Wahl, 1991). Curcuminoids, curcumin and its structurally related compounds comprise the phenolic yellowish pigment of turmeric. It has been reported that 2.71-5.18 g $100g^{-1}$ curcuminoids is present in commercially available turmeric powders (Hiserod *et al*., 1996) and that 0.34-0.47 g $100g^{-1}$ is present in curry powders (Kamikura and Tonaka, 1983). Dietary curcuminoids have been associated with anti oxidative (Asai *et al*., 1999; Quiles *et al*., 1998) and anti carcinogenic (Srimal, 1997; Miquel *et al*., 2002) activities. In recent years, much attention has been focused on the apoptotic action of curcumin (Han *et al*., 1999; Khar *et al*., 1999; Kuo *et al*., 1996) with respect to lipid metabolism. Several reports have shown that dietary curcuminoids reduce serum and liver cholesterol in cholesterol-fed rats (Babu and Srinivasan, 1997; Rao *et al*., 1970). However, there have been few reports dealing with the effects of dietary curcuminoids on triglyceride (Hiserod *et al*., 1996) and fatty acid metabolism. At the present study, the effect of Turmeric Rhizome Powder (TRP) as feed additive is evaluated on some blood parameters in broiler chickens.

Materials and Methods

Diets: Four levels of 0.00, 0.25, 0.50 and 0.75% TRP were included into the starter (021), grower (21-42) and finisher diets (42-49 days of age) were tested (Table 1). All diets met the National Research Council (NRC, 1994) recommendations for broilers.

Birds and housing: 200 day-old Ross male broiler chickens were used for this experiment. Each experimental diet as treatment was tested with five replicate cages of ten chickens. Birds were maintained under continuous light and the environmental temperature in the barn that was initially established on 31°C was gradually reduced to 20°C by week 7. Feed and water were provided *ad libitum* during starter, grower and finisher periods.

Data collection: At 21, 35 and 42 days of age, one chicken randomly selected from each replicate of treatments and blood samples (five samples for each treatments) were collected from wing vein by Terumo Syringe with needle 0.7*32mm. Blood samples were centrifuged and serum was separated and then stored at-20°C until assayed for measuring blood parameters using appropriate laboratory kits (Friedewald *et al*., 1972; Gordon and Amer, 1977).

Statistical analysis: All data were analyzed using the GLM procedure of SAS software (SAS, 1997) for analysis of variance. Significant differences among treatments were identified at 5% level by Duncan's multiple range tests (Duncan, 1955).

Table 1: Composition of experimental diets of broiler chickens during 0-49 days of age ingredients (%)

	Starter (0-21 days)				Grower (21-42 days)				Finisher (42-49 days)			
Corn	56.77	56.77	56.77	56.77	63.81	63.81	63.81	63.81	71.52	71.52	71.52	71.52
Soybean meal	32.06	32.06	32.06	32.06	30.13	30.13	30.13	30.13	24.33	24.33	24.33	24.33
Fish meal	4.47	4.47	4.47	4.47	-	-	-	-	-	-	-	-
Turmeric (TRP)[1]	0.00	0.25	0.50	0.75	0.00	0.25	0.50	0.75	0.00	0.25	0.50	0.75
Wheat bran	0.75	0.50	0.25	0.00	0.75	0.50	0.25	0.00	0.75	0.50	0.25	0.00
Dicalcium phosphate	0.93	0.93	0.93	0.93	1.03	1.03	1.03	1.03	0.81	0.81	0.81	0.81
Limestone	1.09	1.09	1.09	1.09	1.24	1.24	1.24	1.24	1.16	1.16	1.16	1.16
Vit. Min. Premix[2]	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.34	0.34	0.34	0.34	0.31	0.31	0.31	0.31	0.23	0.23	0.23	0.23
Veg. oil	3.00	3.00	3.00	3.00	2.20	2.20	2.20	2.20	0.69	0.69	0.69	0.69
DL- Methionine	0.09	0.09	0.09	0.09	0.03	0.03	0.03	0.03	-	-	-	-
Calculated analysis												
ME (kcal/kg)	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00	2900.00
CP (%)	20.84	20.84	20.84	20.84	18.12	18.12	18.12	18.12	16.31	16.31	16.31	16.31
Ca (%)	0.91	0.91	0.91	0.91	0.82	0.82	0.82	0.82	0.72	0.72	0.72	0.72
Avail. P (%)	0.41	0.41	0.41	0.41	0.32	0.32	0.32	0.32	0.27	0.27	0.27	0.27
Na. (%)	0.18	0.18	0.18	0.18	0.14	0.14	0.14	0.14	0.11	0.11	0.11	0.11
Arg. (%)	1.40	1.40	1.40	1.40	1.20	1.20	1.20	1.20	1.05	1.05	1.05	1.05
Lys. (%)	1.24	1.24	1.24	1.24	0.98	0.98	0.98	0.98	0.85	0.85	0.85	0.85
Met. + Cys. (%)	0.82	0.82	0.82	0.82	0.65	0.65	0.65	0.65	0.57	0.57	0.57	0.57

[1]Turmeric rhizome powder [2]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; calcium pantothenate, 40 mg; niacin, 22 mg; choline, 840 mg; biotin, 30 µg; thiamine, 4 mg; zinc sulphate, 60 mg; manganese oxide, 60 mg

Table 2: Effect of turmeric rhizome powder on total cholesterol, HDL, LDL and VLDL-cholesterol of broilers

	Total cholesterol (mg/dl)			HDL-cholesterol (mg/dl)			LDL-cholesterol (mg/dl)			VLDL-cholesterol (mg/dl)		
TRP (%)	21 d	35 d	42 d	21 d	35 d	42 d	21 d	35 d	42 d	21 d	35 d	42 d
0.00	130.0	132.2	122.6^{b}	161.0	165.2	147.4^{c}	62.80	65.6	60.2^{a}	22.1	23.6	20.8^{a}
0.25	119.8	133.8	152.4^{a}	165.8	166.0	149.8^{b}	62.72	60.4	56.2^{ab}	21.2	23.1	18.20^{ab}
0.50	130.0	133.4	155.6^{a}	166.8	171.2	151.8^{ab}	62.20	51.4	51.4^{ab}	20.5	22.6	17.9^{b}
0.75	121.2	133.0	130.4^{ab}	173.6	174.0	154.6^{a}	51.68	50.2	48.4^{b}	18.7	19.2	16.9^{b}
p value	0.8617	0.9994	0.0385	0.6837	0.8543	0.0031	0.2894	0.1914	0.0494	0.3586	0.4583	0.0453
± SEM	4.32	5.02	4.82	4.08	4.63	0.60	2.60	3.08	1.60	0.74	1.18	0.50

[a,b,c]In each column, means with different superscripts are significantly different ($p<0.05$), TRP, turmeric rhizome powder; d, days of age

Table 3: Effect of turmeric rhizome powder on triglyceride, total protein and albumin of broilers

	Triglyceride (mg/dl)			Total protein (mg/dl)			Albumin (mg/dl)		
TRP (%)	21 d	35 d	42 d	21 d	35 d	42 d	21 d	35 d	42 d
0.00	106.60	102.40	82.60	4.38	4.50	4.24	1.50	1.50	1.52^{b}
0.25	96.60	113.80	81.00	4.16	4.48	4.44	1.44	1.52	1.78^{a}
0.50	102.60	112.80	79.40	4.19	4.52	4.32	1.50	1.32	1.50^{a}
0.75	105.40	106.20	79.6	4.26	4.46	4.14	1.52	1.28	1.34^{a}
P value	0.7432	0.8716	0.7810	0.845	0.9404	0.0672	0.0810	0.0979	0.0006
± SEM	3.860	6.280	2.440	0.105	0.039	0.041	0.034	0.043	0.032

[a,b] In each column, means with different superscripts are significantly different ($p<0.05$), TRP, turmeric rhizome powder; d, days of age

Results and Discussion

The effect of different levels of TRP on blood parameters in broiler chickens are shown in Table 2, 3 and 4. Turmeric supplementation into the basal diets significantly increased total cholesterol and HDL-cholesterol and significantly decreased LDL-cholesterol at 42 days of age of chickens ($p<0.05$). The different levels of TRP at 21, 35 and 42 days of age did not significantly affect total triglyceride, total protein and hematocrit value of the chickens. TRP significantly decreased albumin and red blood cells ($p<0.05$) and increased haemoglobin of chickens at 42 days of age ($p<0.05$). The use of TRP at 42 days of age linearly decreased red blood cells of the chickens at 0.50% level but 0.75% level was similar to that of control group. Inclusion of TRP into the basal diets at 42 days of age significantly increased blood haemoglobin ($p<0.05$). Increasing effect of TRP on blood haemoglobin of the chickens possibly reflects the better efficacy of blood for oxygen providing and transferring in the circulatory system. The different levels of TRP at 21, 35 and 42 days of age had no significant effect on total triglyceride of the chickens. Hepatic Triglyceride (TG) concentration reduced with curcuminoid intake of rats because the intestinal digestibility of TG was not affected by curcuminoid supplementation to the diet. These effects apparently were not due to inhibition of TG digestion or absorption as reported previously (Asai *et al.*, 1999;

Table 4: Effect of turmeric rhizome powder on red blood cells, haemoglobin and hematocrit value of broilers

	Red blood cells per ml		Haemoglobin (g/dl)		Hematocrit value (%)	
TRP (%)	21 d	42 d	21 d	42 d	21 d	42 d
0.00	2262000	2418000[b]	11.6	12.12[b]	30.36	32.1
0.25	2399000	2414000[b]	11.56	12.12[b]	29.84	32
0.50	2403500	2040000[a]	11.6	12.66[a]	30.48	33.1
0.75	2419400	2390300[b]	12.2	12.24[b]	32.04	32.2
p value	0.4192	0.0191	0.0886	0.0376	0.2209	0.1266
±SEM	31.8	37.1	0.106	0.070	0.41	0.19

[a,b] In each column, means with different superscripts are significantly different ($p<0.05$), TRP, turmeric rhizome powder; d, days of age

Babu and Srinivasan, 1997; Rao *et al.*, 1970). Liver cholesterol concentration was also reduced with curcuminoid intake. Babu and Srinivasan (1997) have suggested that such a cholesterol-lowering effect could be mediated by the stimulation of hepatic cholesterol-7-hydroxylase activity. VLDL concentration in the blood was lower than that of control group. Lowering effect of TRP in a dose response on blood LDL and VLDL-cholesterol of the broilers seen in this study suggest that dietary TRP may alter TG metabolism in the liver and/or the VLDL clearance in the peripheral tissues without affecting intestinal absorption of TG. Curcumin (Rao *et al.*, 1970; Buba and Srinivasan, 1997) and turmeric extract (Deshpande *et al.*, 1997, Ramirez-Tortosa *et al.*, 1999) exhibit hypocholesterolemic effects, particularly in cholesterol-fed animals. In contrast with these reports, in this study without cholesterol supplementation, the blood cholesterol concentration was not affected by the curcuminoid supplementation although its constituents, HDL-cholesterol, increased but LDL and VLDL-cholesterol decreased. In previous study by Kermanshahi and Riasi (2006) they showed the similar results when TRP was included at the levels of 0.0-0.2% into the wheat-soybean meal based diets containing animal-vegetable fat blend in laying hens. They also showed that total blood cholesterol and triglyceride levels were significantly decreased in a dose response. In other reports (Asai *et al.*, 1999; Babu and Srinivasan, 1997; Rao *et al.*, 1970) it is indicated that the blood cholesterol levels of animals fed a cholesterol free diet were not affected by curcumin supplementation and suggested the hypocholestrolemic effect of curcuminoids seems to be limited in cholesterol-fed, hypocholestrolemic animals. TRP significantly increased cholesterol and HDL-cholesterol and significantly decreased LDL-cholesterol at 42 days of age of chickens ($p<0.05$). HDL and LDL-cholesterol are formed when cholesterol and fats get together in circulatory system. Turmeric extract along with saturated fat and cholesterol in rabbits (Ramirez-Tortosa *et al.*, 1999) significantly decreased the blood cholesterol level and the susceptibility of the LDL to oxidation. They suggested that curcumin antioxidants are active one step above that of action vitamin E. It seems that the turmeric extract has a vitamin E-sparing effect, since the levels of this vitamin in the serum of the rabbits receiving extracts were even higher than those found in the animals receiving a diet enriched with vitamin E. Miquel *et al.* (2002) suggested that curcumin and related anti-oxidants may complement the well established anti-atherogenic action of tocopherol (Meydani, 1999). They concluded that curcumin antioxidants might be especially useful as anti-atherogenic agents in those processes linked to a marked increase in blood lipid peroxidation such as myocardial infraction (Santos *et al.*, 1989). Witting *et al.* (1999) stated that if arterial LDL lipid oxidation causes atherosclerosis, co-antioxidants may be anti-atherosclerotic. Further work by Ramirez-Bosca *et al.* (1997) on healthy men and women which received the above daily doses of curcumin extract during 60 days showed that both men and women with initial levels of HDL- and LDL-peroxides had a 25-50% reduction in these peroxides on the 60th day of treatment. It is also reported that the administration of curcumin to rats, decreased the blood levels of LDL and VLDL cholesterol, triglycerides and phospholipids (Babu and Srinivasan, 1997). These results are in agreement with the result of this study suggesting the use of turmeric rhizome powder and its extract might be useful in the management of cardiovascular disease in which atherosclerosis is important.

Under the condition of this study, it was concluded that the administration of turmeric rhizome powder as herbal additive may improve some of the components of the chicken's blood and possibly improve the health status of the chickens. Further studies with different doses of TRP would be helpful to clarify the nutritional and therapeutic importance of turmeric and curcuminoids.

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