Indian J. Anim. Nutr. 2020. 37 (4): 392-396
doi: 10.5958/2231-6744.2020.00062.6

Indian Journal of Animal Nutrition

SHORT COMMUNICATION

Effect of Turmeric *(Curcuma longa)* Supplementation on Growth, Antioxidants and Immunity of Broilers

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ABSTRACT

To assess the effect of turmeric (*Curcuma longa)* supplementation on growth, antioxidants and immunity of broiler chickens, one hundred twenty day-old Vencobb broiler chicks were randomly distributed into three dietary treatments with four replicates containing 10 chicks each. Group I served as control (without any supplementation), whereas birds in groups II and III were supplemented with 0.5% and 1.0% *Curcuma longa powder* respectively and the trial was lasted for 5 weeks. Body weight was measured at the end of each week, whereas blood samples were collected at the end of the experiment to study the antioxidant enzymes status and immunity of birds. The results indicated that addition of *Curcuma longa* powder caused significant (P<0.05) increase in growth and antioxidant enzymes status of birds. The cellular immune response of broiler chickens to PHA-P and antibody titre to sheep red blood cells was significantly (P<0.05) higher in treated group than un-supplemented control birds. The present results confirmed the beneficial effects of dietary *Curcuma longa* powder to improve growth, antioxidant enzymes and immune status of broilers.

Key words: Antioxidants, Broilers, Growth, Immunity, Turmeric

Turmeric (*Curcuma longa*) is a perennial herb having antibacterial, anticoccidial, antioxidant, hypocholesteremic and hypolipidaemic properties (Qasem *et al.,* 2015). The active ingredients found in turmeric are curcumin, demethoxycurcumin, bisdemethoxycurcumin and tetrahydrocurcuminoids (Huang *et al.,* 1995). Turmeric is commonly used as spices in human food and has received considerable attention as feed additives in poultry nutrition. Supplementation of turmeric powder in broilers diets enhances their performance (Durrani *et al.,* 2006). However, Mehala and Moorthy (2008) showed that 0.1 and 0.2% turmeric powder used as feed additive had no significant effects on the performance of broiler chickens. Turmeric powder can be used as a potent immunomodulatory agent that can modulate the activation of immune cells (Ganesh and Bharat, 2007). Turmeric has a strong capability for scavenging superoxide radicals, hydrogen peroxide and inhibiting lipid peroxidation (Yarru *et al.,* 2009). Considering the importance of turmeric, the present study was envisaged to evaluate the effects of turmeric supplementation on growth, antioxidant enzymes and immunity status of broiler chicken.

An experiment was conducted on one hundred twenty day-old Vencobb broiler chicks, randomly distributed into three dietary treatments with four replicates containing 10 chicks each and fed as per BIS (2007). Birds were reared in deep litter system and were given feed and water *ad lib.* Broiler birds were fed pre starter feed (1-14 day), starter feed (15-24 day) and finisher feed (25-35day). The ground turmeric powder was procured from local market of Bhubaneswar, Odisha, India. Treatments were: group I (control), group II supplemented with 0.5% turmeric powder, group III supplemented with 1 % turmeric powder through the concentrate mixture. The experimental feed was analysed for proximate principles and P as per AOAC (1995). Calcium was measured according to the method of Talapatra *et al.* (1940). The ingredients and chemical composition of the experimental diets are presented in Table 1.

Birds were weighed individually with the help of electric pan weighing machine in each week up to the

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end of 5th week. At 5th week of experimental feeding, whole blood (2 ml) was collected from each bird into sterilized micro-centrifuge tube containing 0.30 ml of acid citrate dextrose (ACD, citric acid 8.0 g: sodium citrate 22.0 g and dextrose 25.0 g and volume made to 1 litre in distilled water) as anticoagulant. The blood samples were centrifuged at 3,000 rpm for 10 min at 4°C and plasma and buffy coat were separated. The resulting erythrocyte pellet was washed thrice with phosphate buffer saline (PBS; disodium hydrogen phosphate 13.65 g, sodium dihydrogen phosphate 2.43 g and sodium chloride 10 g dissolved in 800 ml distilled water, pH adjusted to 7.4 and volume made to 1litre) (Yagi *et al.,* 1989). RBC diluted to 1:1 in PBS was used for the estimation of haemoglobin. For the estimation of catalase, super oxide dismutase (SOD) and lipid peroxidation (LPO), 1 ml of the 1: 1 diluted RBCs in PBS were mixed with 9 ml of distilled water to prepare RBC haemolyzate of 1: 20 dilution. Lipid peroxidation in RBC hemolysate was determined by following Placer *et al*. (1966); wherein, the concentration of malonaldialdehyde (MDA) in nmol of MDA/mg haemoglobin was calculated using the extinction coefficient of 1.56×10^8 (Utley *et al.,* 1967). Catalase (CAT) was assayed in erythrocytes by the method of Bergmeyer (1983). Super oxide dismutase (SOD) activity of RBC haemolysate samples was measured using nitro blue tetrazolium as a substrate after suitable dilution according to Marklund and Marklund (1974) with certain modifications as suggested by Minami and Yoshikawa (1979).

At 5th weeks of age, ten birds from each dietary treatment group were injected intra-dermally in the right foot web with 100 micro gram of Phytohaemaglutinin-P (PHA-P) in 0.1 ml of normal saline (Edelman *et al.,* 1986). The thickness of foot web was measured using digital calliper before injection and 24h post injection and cutaneous basophilic hypersensitive (CBH) response was calculated using the formula:

$$\text{CBH response} = \frac{\text{Post injection skin thickness}}{\text{Pre - injection thickness}} \times 100$$

The humoral immunity was assessed from the antibody production against sheep red blood cell (SRBC) by using micro titration hemagglutination (HA) technique. Data obtained were subjected to one-way analysis of variance using Software Package for Social Sciences (SPSS) version 17.0 (2008) and comparison among treatment means was made by Duncan's multiple range test (Duncan, 1955) with significance level of $P<0.05$.

The composition and proximate analysis of

Table 1. Ingredients and chemical composition of basal diet

Particulars	Pre-starter (%) (1-14th day)	Starter (%) (15-21st day)	Finisher (%) (22-35th day)
Maize	52.00	53.00	56.0
Soyabean meal	43.0	40.0	36.0
Vegetable oil	2.0	4.0	5.0
Mineral mixture	2.5	2.5	2.5
Common salt	0.50	0.50	0.50
Chemical composition (% of DM)			
Crude protein	22.60	21.55	19.25
Ether extract	3.09	4.90	5.56
Crude fibre	4.74	4.82	5.77
Total ash	9.96	8.17	9.13
Nitrogen free extract*	59.61	60.56	60.29
Calcium	1.24	1.18	0.89
Phosphorus	0.57	0.62	0.51
Metabolisable energy (kcal/kg)*	2995	3140	3225

*Calculated value

Table 2. Weekly cumulative body weight changes (g) in experimental birds

Week	Treatments			P Value
	I	II	III	
Initial	42.60±0.72	43.10±0.55	44.20±0.61	0.139
1st	110.80±4.30	116.30±3.50	112.80±4.28	0.265
2nd	320.10±6.50	330.00±8.27	328.50±8.10	0.154
3rd	605.25±12.70	625.40±11.28	630.60±10.67	0.106
4th	1060.20[a]±32.84	1145.90[b]±29.70	1175.00[b]±34.30	0.039
5th	1620.30[a]±41.40	1785.15[b]±51.30	1770.65[b]±45.90	0.022

[a,b] Values bearing different superscripts in a row differ significantly (P<0.05)

different rations has been shown in Table 1. The crude protein content (%) of the broiler pre starter, starter and finisher ration was 22.60 21.55 and 19.25 respectively. The protein and energy requirement were as per the BIS (2007) requirement. The weekly body weight (g) gain of broiler birds was significantly (P<0.05) higher in treated groups than control. Birds supplemented with 0.5% turmeric showed similar body weight gain as compared to 1% turmeric treated birds (Table 2). The significant effect of turmeric on body weight gain corroborated with the findings of Mondal *et al.* (2015), who reported higher growth of broiler birds on turmeric supplementation at 0.5 and 1.0 % level. Kumari *et al*. (2007) reported that turmeric meal supplementation at the rate of 1.0 g/kg improved growth. AL-Sultan (2003) also reported higher body gain in birds fed diet contained turmeric at level of 0.5% than un-supplemented control birds. Contrary to this Kassu *et al*. (2016) and Mehala and Moorthy (2008) reported that supplementation of turmeric powder had no significant effect on the body weight. This difference might be due to different doses and strains of bird used in the experiments mentioned above. Improvement on the growth performance due to supplementation of turmeric meal both at 0.5% and 1% levels might be attributed to the antimicrobial, antifungal and antioxidant activities in broiler chickens that leads to improved utilisation of dietary nutrients (Radwan *et al.,* 2008).

Result reveled that SOD and CAT activity were significantly (P<0.05) higher in group II and III at 5th wks as compared to control group indicating that the supplementation of turmeric either 0.5 or 1% in the ration significantly improved the SOD and CAT activity (Table 3). The mean malondialdehyde (MDA) concentration was significantly (P<0.05) lower in supplemented birds than control indicating that turmeric prevents lipid peroxidation in poultry. Turmeric powder enhanced the antioxidant status of heat stressed broilers via improving the activity of glutathione peroxidase and superoxide dismutase and decreasing the concentration of MDA (Zeinali *et al.,* 2011). Similarly, Akbarian *et al.* (2015) reported that dietary supplementation with turmeric oil at 200 or 400 mg/kg for 38 days significantly increased erythrocyte CAT and SOD activities in chickens. The beneficial effect on the antioxidant system of the chicken by turmeric is most likely attributed to the phenolic compounds, mainly

Table 3. Antioxidant enzyme status of broiler birds

Parameters	Treatments			P Value
	I	II	III	
SOD (U/mg Hb)	28.70[a]±0.61	40.55[b]±2.60	41.70[b]±3.08	0.015
LPO (µmol MDA formed / mg Hb)	4.10[b]±0.15	2.60[a]±0.22	2.42[a]±0.20	0.012
Catalase (U/mg Hb)	10.92[a]±0.86	14.29[b]±0.90	16.62[bc]±0.53	0.020

[a,b,c]Means bearing different superscripts in the same row differ significantly (P<0.05)

Table 4. Immunity profile of experimental birds

Parameters	Treatments			P Value
	I	II	III	
CBHresponse (%)	127.55[a]±5.13	165.44[b]±3.69	182.35[c]±5.52	0.003
Log2 valueHA titre	0.74[a]±0.04	1.27[b]±0.08	1.55[c]±0.12	0.027

[abc] Values with different superscripts in a row differ significantly(P<0.05)

curcumin and xanthorrhizol (Rukayadi and Hwang, 2013). It has also been suggested that phenolic compounds can support antioxidant system possibly through the direct scavenging of free radicals or prevent the formation of free radicals by inhibiting enzymes (Thring *et al.,* 2011).

The cellular immune response of broiler birds in terms of cutaneous basophilic hypersensitive (CBH) against PHA-P was significantly (P<0.05) higher in turmeric fed groups. Similarly, the influence on primary antibody titer to sheep red blood cell (SRBC) was significantly (P<0.05) lower in group I (control) than that of other two turmeric fed groups (Table 3). Supplementation of 1% turmeric powder in the diet had significantly higher immunomodualatory action than 0.5% supplemented birds. Similar to our result, Kurkure *et al*. (2000) reported that dietary supplementation of 0.5 g/kg turmeric ameliorated the harmful effect of aflatoxin B1 on the body immune system, showing the humoral immune stimulatory potential in poultry. Churchill *et al.* (2000) showed that turmeric treatment increased the number of T and B cells, suggesting that turmeric modulates lymphocyte-mediated immune functions. Emadi and Kermanshahi (2007) found increased IgA, IgM and IgG concentration in chickens fed with turmeric powder at the level of 0.25%, 0.50% and 0.75% in the ration for 21 days. The immunomodulatory effect of turmeric was found to be associated with its anti-oxidant and anti-apoptotic actions (Saleem *et al.,* 2011). Similarly, Yarru *et al*. (2009) showed that 5.0 g/kg turmeric meal supplementation had beneficial effects on the stimulation of genes expression that involved in antioxidant and immune function in broiler chickens.

Supplementation of 0.5 and 1% turmeric powder improved the growth, immunity and antioxidant enzymes concentration of broiler chickens, best response being observed 1% level of turmeric powder supplementation in the ration.

ACKNOWLEDGMENT

The authors are thankful to the Vice Chancellor, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, India, for providing the necessary facilities to carry out this work.

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Received on 21-01-2021 and accepted on 01-03-2021