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Dietary supplementation of Turmeric Oil free Concentrate (TOC) on performance, immunity and oxidative stress in commercial broiler chicken

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Abstract

The present study was conducted on 252 broiler chicks reared in deep litter system and were randomly categorized into seven dietary treatments with six replicates for each treatment and six birds in each replicate. A standard corn-soy diet was prepared and seven experimental diets were prepared by mixing the TOC at 0, 0.25, 0.5, 0.75, 1.00, 1.25 and 1.5% levels. The results revealed that significantly higher body weight and feed intake was recorded in broilers fed 1.5% TOC supplemented diet, while significantly lowered feed conversion ratio was recorded in birds fed up to 1.25% TOC diets. The higher ($P<0.01$) humoral immunity was recorded in 1.00% and 1.25% TOC groups. Significantly greater cell mediated immune response and improved ($P<0.01$) activity of antioxidant enzymes viz., glutathione peroxidase, glutathione reductase and super oxide dismutase were recorded with all the levels of TOC. Simultaneously reduced ($P<0.01$) lipid peroxidation observed in TOC supplemented groups. Thus it was concluded that dietary supplementation of TOC up to 1.25% improved the performance, immunity and antioxidant enzyme activities in commercial broilers.

Keywords: Antioxidants, broilers, immunity, performance, turmeric oil free extract

Introduction

The demand for chicken and its products is expected to increase in the near future as the human population expands. Because of their rapid growth rates and aggressive raising behaviors, broilers are under a lot of pressure. Despite all management challenges, the broiler industry anticipates strong performance from the birds, who are housed in overcrowded hen houses with poor hygiene. To overcome this, sub-therapeutic antibiotic growth promoters (AGP) are employed to avoid illness. AGPs boost growth rate and productivity, lower production costs, improve feed efficacy, and reduce mortality by preventing infections. However, the reckless use of antibiotics resulted in residues in chicken meat and eggs, causing indirect negative health effects from antibiotic resistance. As a result, antibiotic growth promoters (AGP) are banned in many countries, and increased consumer awareness has encouraged poultry producers to employ natural or alternative feed additives to boost broiler performance. As an alternative to synthetic AGPs, the use of prebiotics, probiotics, essential oils, and a variety of medicinal herbs in chicken diets has been investigated to improve poultry production performance. Turmeric (*Curcuma longa*) is a promising herbal feed ingredient in poultry diets, belonging to the Zingiberaceae family. Numerous studies have shown that adding turmeric powder (TP) as such or pure form of curcuminoids (major phytochemical in TP) to broiler meals improves bird body weight, feed efficiency, immunity and alleviate the oxidative stress associated with various stressors^[1, 2].

Turmeric oil, derived from dried rhizomes, has strong anti-inflammatory, anti-diabetic, anti-cancer, anti-hyper lipidemic, anti-microbial, and hepato protective properties^[3, 4]. However, with the recent spike in interest in extracting turmeric oil from dried rhizomes, a substantial

quantity of a byproduct known as turmeric oil free concentrate (TOC) is being produced. Despite the fact that TP has already been studied extensively, there appear to be very few studies on the impact of adding TOC to commercial broiler diets on bird performance. As a result, the key objective of the current study is to determine how various dietary TOC levels affect performance, immunity and oxidative stress in commercial broilers.

Materials and Methods

This experiment was conducted at the Department of Poultry Science and Livestock Farm Complex, College of Veterinary Science, PVNRTVU, Korutla, Jagityal district, Telangana state.

Experiment was conducted on 252 broiler chicks (day-old), were purchased from M/s Tirumala Breeders Pvt. Ltd, Warangal and randomly categorized into Seven dietary treatments with Six replicates for each treatment group and Six birds in each replicate ($7 \times 6 \times 6$). The chicks were reared in deep litter system with optimum brooding conditions from day one to 42 d of age (marketable age). The broiler chicks of all seven groups were kept under uniform housing management and standard hygienic conditions throughout the experiment. All the replicate groups of chicks were offered with respective experimental diets and clean and fresh drinking water were provided *ad libitum* daily throughout the experimental period. Birds were immunized for Marek's disease at hatchery and Newcastle disease (ND) with Lasota vaccine on 7th and 28th day of age and Infectious Bursal Disease of Georgia strain vaccine on 14th day of age through ocular route.

Experimental Diets

A standard corn soya basal control diet was prepared as control feed for pre starter, starter and finisher phases [5]. Six turmeric oil extracted concentrate (TOC) supplemented diets viz., 0.25% TOC, 0.50% TOC, 0.75% TOC, 1.00% TOC, 1.25% TOC and 1.50% TOC were prepared by mixing the TOC at graded concentrations (250, 500, 750, 1000, 1250 and 1500g TOC/100 kg diet, respectively) to the control diet. TOC is procured from the Arjuna Natural Pvt Ltd, India and it is standardized to contain curcuminoids 12% and calcium 8%. During experiment, the temperature humidity index (THI) was recorded one fixed time daily. As indicated in the experimental design, the dosage regimen of the TOC supplements was strictly followed for each treatment group.

Growth performance

The live body weights (g) of all birds were recorded on the electronic weighing machine at weekly interval in morning hours before feeding. The average weekly body weight per bird was calculated for each treatment group. Similarly, the average weekly feed intake (g) was calculated by recording the amount of feed consumed by each group in a day. The weekly cumulative feed conversion ratio was calculated by dividing total amount of feed consumed up to that particular week by the body weight gain record up to that week.

Humoral Immune response to Newcastle Disease Virus (NDV)

Blood samples were collected from six birds individually from each dietary group at 42nd day of age and serum was collected aseptically. Antibodies specific for NDV were detected in sera of chicks by hemagglutination inhibition (HI) test and were expressed as log₂ titers [6].

Evaluation of Cell mediated Immune response

Cell mediated immune (CMI) response was evaluated by cutaneous basophil hypersensitivity (CBH) test by injecting 100 µg phytohaemagglutinin -P (PHA-P) in 0.1ml of NSS into toe web of six birds from each dietary group. Thickness of toe web was measured before and at 24 hours after injection of PHA-P. The CBH was calculated using the standard formula [7].

Antioxidant enzymes activity

The antioxidant enzymes in serum such as glutathione peroxidase (GPx) [8], glutathione reductase (Grx) [9], super oxide dismutase (SOD) [10], and lipid peroxidation (LPx) [11] were estimated by following proven methods.

Statistical Analysis

The data were analysed using general model procedure of Statistical Package for Social Sciences (SPSS) 15th version and comparison of means was done using Duncan's multiple range test [12] and significance was considered at $P < 0.05$. Data were subjected to statistical analysis under completely randomized design employing one-way analysis of variance [13].

Results and Discussion

Performance Parameters

Experimental diets significantly affected body weights, feed consumption, and feed conversion ratio ($P < 0.001$) (Table 1). Compared to birds on a basal diet, those receiving diets supplemented with TOC exhibited a considerably greater increase in body weight due to higher feed consumption ($P < 0.01$). The highest feed intake was recorded in 1.5% TOC supplemented group. The lowest ($P < 0.05$) feed conversion ratio (FCR) was noted in the groups supplemented with 0.25% and 0.5% TOC, however it was intermediate in the groups supplemented with 1% and 1.25% TOC. Consistent with the present study, significant improvement in body weight gains and the rise in total feed consumption was observed in broilers with the addition of TP (0.75%) [14]. Similar to the current investigation, TP supplementation at rates of 0.5, 1, and 1.5% increased the FCR; however, 1.5% supplementation showed to be the most effective [1].

Immune response

Dietary interventions had a significant ($P < 0.01$) impact on humoral and cell-mediated immune responses (Table 2). Regardless of the levels, a greater ($P < 0.01$) CMI response was seen with TOC supplementation. At the 1.00% and 1.25% levels, TOC supplementation was associated with increased ($P < 0.01$) humoral immunity. While at 0.25%, 0.50%, 1.75% and 1.50% levels, TOC supplementation did not improved the humoral response and it was comparable to control group.

The current investigation's immune response results coincide with previous investigation, which demonstrated that TP supplementation at 1.0-2.0% greatly enhanced antibody titer against ND [15]. In comparison to controls, the hens given diets enriched with turmeric exhibited improved cellular and systemic humoral immune responses [16]. The enhanced immune response is attributed to influence of curcumin in maximizing the production of immunoglobulins M and G [17] and their by increased antibody titers against ND and infectious bursal disease [2, 18].

Antioxidant enzymes activity: The activities of antioxidant

enzymes such as GPx, GRx and SOD were significantly improved ($P<0.05$) with all the studied levels of TOC supplementation (Table 3). The activity of SOD was increased ($P<0.05$) linearly with increased dietary TOC concentration and highest ($P<0.05$) activity was recorded at 1.5% TOC supplementation. Similarly, the highest ($P<0.05$) activity of GPx was recorded at 1.5% TOC supplementation, while, the higher ($P<0.05$) activity of GRx was observed with 0.75% and 1% TOC supplementation. Lipid peroxidation in the blood expressed as TBARS and it was significantly reduced ($P<0.001$) in 0.75%, 1.0%, 1.25, 1.5 and 1.75% TOC supplemented groups. The TBARS concentration in 0.25 and 0.5% TOC supplemented groups reduced numerically but their levels were comparable with the control group. Thus, it was revealed that increased activity of antioxidant enzymes such as GPx, GRx and SOD in birds fed TOC as

compared to the control, while levels of TBARS were reduced with TOC supplementation. In agreement with present findings, previous studies on broilers fed turmeric powder revealed increased GPx, GRx and SOD activities and alleviated the increased levels of malondialdehyde (MDA) and TBARS [19, 20, 21, 22]. Similarly Addition of curcumin to the diets of poultry lowered the duodenal lipid peroxidation and enhanced mitochondrial SOD in stressed birds [2, 23, 24]. Thus results of previous and present studies clearly showed that likewise in dietary TP supplementation in broilers beneficial effects on performance, immunity and anti oxidant enzymes activity were observed with TOC supplementation. Beneficial effects in present study could be due to presence of phytochemical compounds (Curcuminoids) in TOC even after extraction of oil from the turmeric. Thus it can be used safely up to 1.25% in the diets of commercial broilers.

Table 1: Effect of dietary supplementation of TOC on performance in commercial broiler chicken

Diets	Body weight (gm)	Feed Intake (gm)	Feed Conversion Ratio
Control feed	2367 ^a	3965 ^a	1.678 ^a
0.25% TOC	2668 ^b	4194 ^b	1.573 ^c
0.50% TOC	2636 ^b	4167 ^b	1.584 ^c
0.75% TOC	2545 ^b	4184 ^b	1.647 ^a
1.00% TOC	2621 ^b	4221 ^b	1.613 ^b
1.25% TOC	2598 ^b	4192 ^b	1.620 ^b
1.50% TOC	2615 ^b	4289 ^c	1.644 ^a
P-value	0.005	0.001	0.035
SEM	23.22	16.41	0.013

Means bearing at least one common superscripts in a column do not differ significantly ($P<0.05$)

Table 2: Effect of dietary supplementation of TOC on Immunity response in commercial broiler chicken at 42days of age

Diets	CMI Response to PHA-P	HI titers (log2)
Control feed	110.4 ^b	91.50 ^c
0.25% TOC	127.0 ^a	96.00 ^{bc}
0.50% TOC	121.6 ^a	98.00 ^{bc}
0.75% TOC	123.1 ^a	96.50 ^{bc}
1.00% TOC	121.9 ^a	106.17 ^a
1.25% TOC	121.3 ^a	102.17 ^a
1.50% TOC	125.7 ^a	95.67 ^{bc}
P-value	0.001	0.01
SEM	1.132	1.097

Means bearing at least one common superscripts in a column do not differ significantly ($P<0.01$)

Table 3: Effect of dietary supplementation of TOC on antioxidant enzymes in commercial broiler chicken at 42days of age

Diets	Glutathione peroxidase (units/ml)	Glutathione reductase (units/ml)	Super oxide dismutase (units/ml)	TBARS (units/ml)
Control feed	180.3 ^e	192.7 ^c	6.228 ^c	2.842 ^a
0.25% TOC	210.2 ^{cd}	230.3 ^{ab}	6.740 ^b	2.497 ^{ab}
0.50% TOC	197.7 ^d	228.0 ^{ab}	6.910 ^{ab}	2.552 ^{ab}
0.75% TOC	203.3 ^d	247.0 ^a	6.958 ^{ab}	2.072 ^c
1.00% TOC	217.7 ^c	244.7 ^a	7.023 ^{ab}	2.038 ^c
1.25% TOC	235.0 ^b	214.5 ^b	7.232 ^a	2.122 ^c
1.50% TOC	256.7 ^a	217.2 ^b	7.273 ^a	2.277 ^{bc}
P-value	0.001	0.001	0.001	0.001
SEM	3.960	3.672	0.065	0.061

Means bearing at least one common superscripts in a column do not differ significantly ($P<0.001$)

Conclusion

Based on findings of the present study, it was concluded that dietary supplementation of TOC up to 1.25% improved the body weights, immunity and antioxidants activity without

affecting feed efficiency in commercial broilers.

Conflict of Interest

Not available.

Financial Support

Not available.

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