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Antimicrobial Effect of Dietary Supplementation of Turmeric Powder in Intestine of Broilers

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A B S T R A C T

To study antimicrobial effects of supplementation of turmeric on intestine of broilers, three hundred, one day old commercial broiler chicks were taken for the experiment. The chicks were distributed randomly to six dietary treatments having five replicates each and ten birds per replicate. Maize-soybean meal based diet served as the basal diet. The basal diet without antibiotic was given to treatment T_1. Treatment group T_2 was offered basal diet with antibiotic. In treatment groups T_3, T_4, T_5 and T_6, basal diet was supplemented with turmeric @ 0.25, 0.50, 0.75 and 1.0%, respectively. Total *E. coli* count (log cfu/g) was recorded lowest in T_4 (4.55) as compared to control group T_1 (7.58). Other turmeric supplemented groups also showed significant reduction in the *Coliform* count as compared to control group. The total *Lactobacilli* count (log cfu/g) showed an increment among different turmeric powder supplemented treatments. *Lactobacill*i count was observed highest in turmeric supplemented group @ 0.75% (7.55) as compared to the control group (4.64). So from the above obtained results on intestinal bacteriology, it can be concluded that turmeric results in reduction of pathogenic bacteria and increment of beneficial bacteria.

Introduction

In the present era, broiler industry as a part of poultry industry has been developing at a satisfactory level. The main goal of broiler industry is to achieve optimum weight gain with efficient feed utilization keeping the survivability of the broilers as maximum as possible which could be achieved by use of specific feed additives. Feed additives increases feed conversion ratio, growth rate and survivability (Feltwell and Fox, 1979). Poultry are vulnerable to pathogenic microorganisms in the small intestine. This leads to depressed growth and increased incidences of diseases. Herbal products like turmeric control the pathogenic microorganism by creating favorable conditions in intestine. Herbs provide beneficial effect on health due to the antimicrobial activity (Lee *et al.*, 2004). Turmeric possess anti-inflammatory (Ammon *et al.*, 1993), antioxidative (Osawa *et al.*, 1995), anticoccidials (Allen and Fetterer,

2002; Abbas *et al.,* 2010) and immunomodulatory (Kumari *et al.,* 2007; Yarru *et al.,* 2009) properties.This study was planned to study the antimicrobial effects of turmeric powder in intestine of broilers.

Materials and Methods

Selection of chicks

Three hundred, one day old broiler chicks, were purchased from a local commercial hatchery. The chicks were individually weighed, wing banded and randomly distributed into 30 subgroups means six dietary treatments with five replicates per treatment and each replicate has ten birds. The first group was kept as a control (T_1) and given the basal diet without antibiotic while second (T_2) basal diet with antibiotic, third (T_3), fourth (T_4), fifth (T_5) and sixth (T_6) groups were supplemented with turmeric powder @ 0.25, 0.5, 0.75 and 1%, respectively in the diet. Birds were vaccinated against F1 strain of Ranikhet disease on 3rd day and IBD on 14th day.

Housing and brooding

The experimental chicks were reared under deep litter system. The floor of the pens was thoroughly cleaned, disinfected before scattering of the bedding material. Well chopped dry wheat straw was used as bedding material. The straw was evenly spread up to 5 cm thickness. The litter was regularly racked to avoid any lump formation. Wooden brooders fitted with bulb in the centre were used in each pen for brooding.

Feeding and watering

During the initial period of growth, extra care was taken to assure efficient feeding and watering of the chicks so that they could be well introduced and acclimatized. The feeding programme consisted of a starter diet until 28 days and a finisher diet from 28 to 42 days of age. Weighed amount of feed was offered on paper sheets for first 3 days and thereafter, in the automatic feeders up to 28 days of age. Afterwards, the feeds were offered through hanging feeders maintained at appropriate heights. The chicks were provided *ad libitum* clean drinking water through the plastic waterers during first two weeks of the experiment. Thereafter, bigger plastic waterers were used till the end of the experiment.

All feed ingredients, additives and supplements used in the experiment were procured in one lot before the start of the experiment. The ingredients, additives and supplements used in the diet formulations were maize, soybean meal, vegetable oil, fish meal, mineral mixture, vitamins, coccidiostat, lysine, DL- methionine and turmeric powder. The sources, composition and mixing rate of additives/supplements used in ration formulations are presented in Table 2.

Evaluation of feed ingredients

Feed ingredients used for ration formulations were evaluated for proximate nutrients (AOAC, 2013). The evaluated and measured values of feed ingredients used in preparing the experimental diets are presented Table 1.

Composition of diets

Basal ration was formulated as per BIS (2007) to fulfill the metabolizable energy (ME) and crude protein requirements of birds (Table 3). Level of crude protein in starter (0-4weeks) and finisher (4-6weeks) ration was 22 and 20 %, respectively. The respective ME content was 3000 and 3200 KCal/kg are presented in Table 1.

The experimental dietary treatments were as under:

T_1: Basal diet without antibiotic
T_2: Basal diet with antibiotic
T_3: Basal diet + 0.25 % turmeric powder
T_4: Basal diet + 0.50 % turmeric powder
T_5: Basal diet + 0.75 % turmeric powder
T_6: Basal diet + 1.00 % turmeric powder

Intestinal microbial count

For intestinal microbial count, the ileal contents were collected aseptically. Samples were weighed (1 g), transferred to sterile tubes and homogenized with sterile 0.9% normal saline solution (1:1). Then the solutions were mixed on vortex. Serial dilutions of samples were made up to six dilutions. 0.1 mL of each dilution was poured and spread uniformly on MacConkey lactose agar for *E. coli* and on nutrient agar for *lactobacilli*. Plates were incubated at 37^0C for 24 h. The average number of colonies was multiplied by reciprocal of the dilution factor and expressed as log cfu/g of contents.

Results and Discussion

Average feed intake did not differ significantly during the whole experimental period but it was numerically higher in treatment group T_2 (2115 g) as compared to control group and other turmeric supplemented groups as presented in Table 4. During the whole experimental period, the average body weight gain in treatment group T_4 (2239.7 g) was significantly higher as compared to control group (2001.2 g) and other dietary treatment groups (Table 4). Treatment group T_1 had the lowest body weight gain. Feed conversion ratio in groups with turmeric supplementation @ 0.5 % (1.77) was significantly better compared to the control group and non-significantly better than other treatments as depicted in Table 4.

Total *E. coli.* count (log cfu/g) ranged from 4.55 (T_4) to 7.58 (T_1) among different dietary treatments as presented in Table 5. The significant reduction in the *Coliform* count as shown in Figure 1 was observed in turmeric supplemented group @ 0.5% (4.55) in comparison to the control group (7.58). Other turmeric supplemented treatment groups also showed significant reduction in the *Coliform* count as compared to control group.

The total *Lactobacilli* count (log cfu/g) ranged from 4.64 (T_1) to 7.55 (T_5) among different dietary treatments as presented in Table 5. Significant increment in the *Lactobacilli* count as shown in Figure 2 was observed in turmeric supplemented group @ 0.75% (7.55) in comparison to the control group (4.64). Other turmeric supplemented treatment groups also showed significant increase in the *Lactobacilli* count as compared to control group.

There was no effect of turmeric supplementation on feed intake of broilers. The findings of present study are in accordance with findings of Akbarian *et al.*, (2012) who recorded that feed intake of broilers during different weeks were not influenced by turmeric powder supplementation. Consistent with results of present study, Rajput *et al.*, (2013) recorded that the feed intake of birds fed diet containing curcumin @ 100 mg/kg (4.38 kg), 150 mg/kg (4.45 kg) and 200 mg/kg (4.42 kg) did not differ significantly as compared to the control group (4.41 kg). In agreement with findings, Naderi *et al.*, (2014) also recorded no significant effect of turmeric supplementation on feed intake in broilers. Feed intake of birds fed diet containing turmeric @ 2.5 g/kg of feed (4242 g) and 7.5 g/kg of feed (4310 g) was at par as compared to the control group (4270 g).

With respect to the whole experimental period the average body weight gain in T_4 was significantly higher as compared to control and other groups.

Table.1 Chemical composition of feed ingredients used in ration formulation

Ingredient	CP (%)	CF (%)	EE (%)	TA (%)	Lysine* (%)	Methionine* (%)	ME* (kcal/kg)
Maize	9.11	2.44	3.44	2.25	0.18	0.15	3300
Soybean meal	45.15	3.93	3.16	8.47	2.57	0.76	2230
Fish meal	47.40	1.79	5.16	26.62	1.42	1.42	2210

*Calculated values (Singh and Panda, 1992)

Table.2 Ingredient composition of experimental diets during different phases of growth

Ingredient (kg /100 of feed)	0-4 wk	4-6 wk
Maize	58	60
Soybean meal	30	25
Fish meal	7	7
Vegetable oil	3	6
Mineral mixture	2	2
Feed additives (g/100 kg feed)		
Spectromix*	10	10
Spectromix BE*	20	20
Veldot*	50	50
Choline chloride*	50	50
Lysine*	50	50
DL-methionine*	150	150

*Composition, sources and rate of mixing of feed additives/supplements

1. Spectromix: Powder (Ranbaxy Animal Health, New Delhi). Each g. contained VitaminA-82,500 IU, Vit D3-12000 IU, Vit B2-50 mg and Vit.K-10 mg. Mixing rate: 10 g/100 kg of feed.
2. Spectromix BE: Powder (Ranbaxy Animal Health, New Delhi). Each g contained Vit.B1- 8 mg, Vit.B6- 16 mg, Vit.B12- 80 mg, niacin-120mg, calcium pentothenate-80 mg, Vit. E-160 mg, Lysine hydrochloride-10 mg, DL-methionine-10 mg and calcium 260 mg. Mixing rate: 20g/100 kg of feed.
3. Veldot: Venkeys- Dinitro-O-Toluamide (Coccidiostat). Mixing rate: 50 g/100 kg of feed.
4. Choline chloride: Contain 60 percent choline. Mixing rate: 50 g/100 kg of feed.
5. Lysine: Contained 98% lysine. Mixing rate: 50 g/100 kg of feed.
6. DL-methionine: Contained 98% methionine. Mixing rate: 150 g/100 kg of feed.

Table.3 Chemical composition (% DM basis) of experimental diets in different growth phases of broiler chicks

Attribute	0-28 d	29-42 d
DM	88.79	88.59
CP	22.92	20.32
EE	3.32	3.62
CF	5.12	5.19
ASH	9.15	9.25
NFE	59.49	61.62

Table.4 Average feed intake, body weight gain and feed conversion ratio of broilers under different dietary treatments

Treatment	Average feed intake	Average body weight gain	Feed conversion ratio
T_1	3891.0 ± 67.9	2001.2 ^{a} ± 12.8	1.94 ^{c} ± 0.04
T_2	3966.1 ± 26.7	2103.2 ^{bc} ± 35.3	1.88^{bc} ± 0.04
T_3	3916.3 ± 30.2	2067.7 ^{b} ± 20.5	1.89^{bc} ± 0.02
T_4	3972.9 ± 64.5	2239.7 ^{e} ± 12.6	1.77 ^{a} ± 0.04
T_5	3991.3 ± 27.7	2171.6 ^{d} ± 17.9	1.83^{abc} ± 0.02
T_6	3886.1 ± 38.0	2138.1 ^{cd} ± 13.0	1.81^{ab} ± 0.01

*Values bearing different superscripts in a column differ significantly (P<0.05)

Table.5 Total *Coliform* (log cfu/g) and total *Lactobacilli* (log cfu/g) count of the ileal content of the experimental birds under different dietary treatments

Treatment	*Coliform* (log cfu/g)	*Lactobacilli* (log cfu/g)
T_1	7.58 ^{e} ± 0.02	4.64 ^{a} ± 0.02
T_2	5.57 ^{c} ± 0.03	5.55 ^{b} ± 0.03
T_3	6.45 ^{d} ± 0.04	5.63 ^{b} ± 0.03
T_4	4.55 ^{a} ± 0.02	6.63 ^{d} ± 0.03
T_5	5.42 ^{b} ± 0.04	7.55 ^{e} ± 0.05
T_6	5.54 ^{c} ± 0.01	6.47 ^{c} ± 0.05

^{abc} Means bearing different superscripts in a column differ significantly (P<0.05)

Fig.1 *E. coli* count (log cfu/g) of ileal content under different dietary treatments

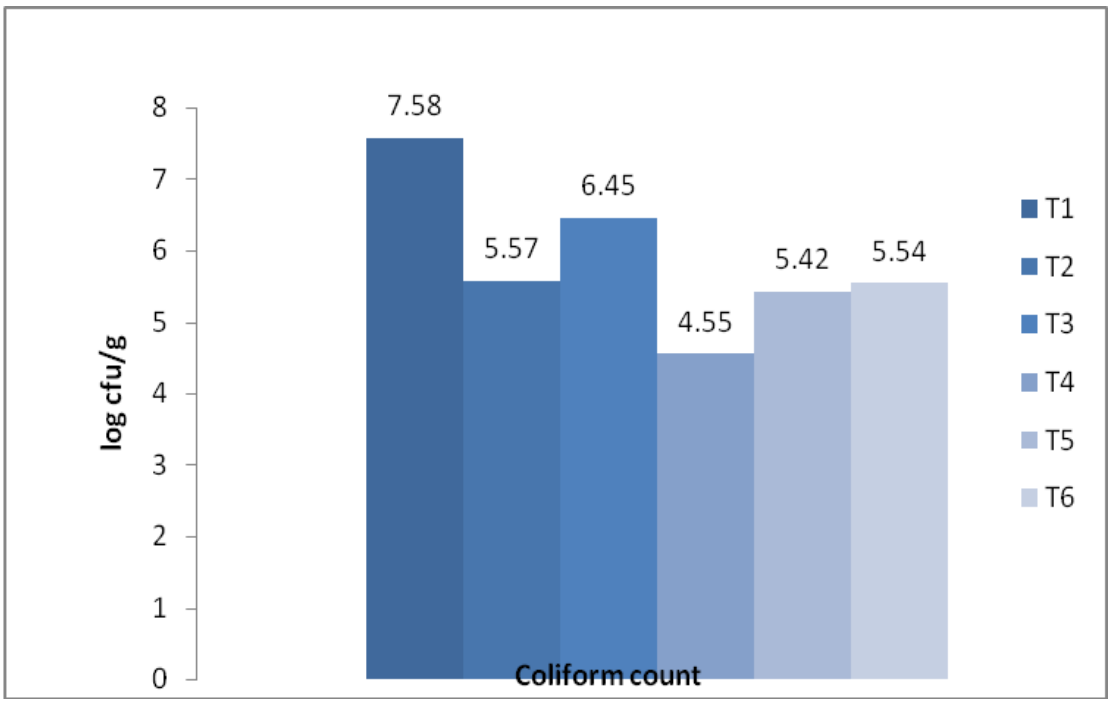
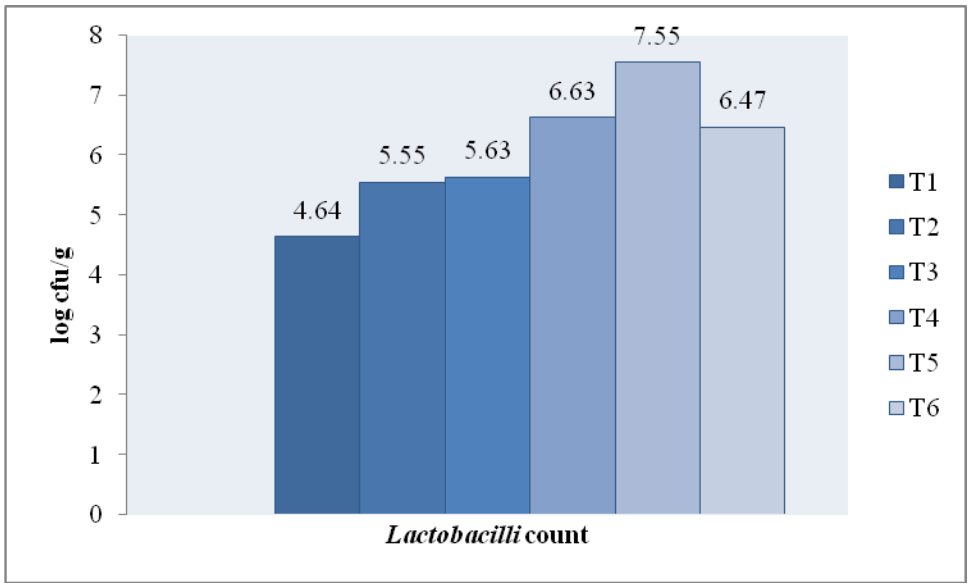


Fig.2 Total *lactobacilli* count (log cfu/g) of ileal content under different dietary treatments



These findings concur with the results of Al-Sultan (2003) who investigated the effect of *Curcuma longa* (turmeric) feed additive on overall performance of broiler chickens. The effect of different dietary levels of turmeric inclusion (0.25, 0.5 and 1.0%) on body weight gain was recorded as compared to the control group. The higher body weight gain (1344.5 g) was observed in birds fed diet contained turmeric at level of 0.5% followed by birds which received 0.25% (1329.8 g), 1% (1306 g) and control (1268.2 g). Durrani *et al.*, (2006) revealed that highest average body weight gain (734 g) was recorded in birds fed diet containing turmeric at the level of 5 g/kg of feed but it was not significantly different as compared to the control group (646 g).

At 42 days of age, FCR of the treatment group with turmeric supplementation @ 0.5 % (1.77) was significantly better as compared to the control group (1.94). These results are in accordance with Al-Sultan (2003) who observed that the feed conversion ratio of birds receiving turmeric @ 0.5% in their diets was the best (2.08) as compared to controls (2.47) and other treated groups (2.27 and 2.31). The results concur with the findings of Naderi *et al.*, (2014) who recorded significantly better feed conversion ratio in birds fed diet containing turmeric @ 2.5 g/kg (1.85) as compared to the control group (1.93). However, feed conversion ratio of birds receiving turmeric supplementation @ 7.5 g/kg of feed (1.96) was at par as compared to the control group (1.93).

The coliform count of the birds receiving diet supplemented with turmeric powder at the level of 0.5% was significantly lower as compared with the control and other turmeric powder supplemented groups. The control group receiving basal diet showed significantly higher coliform count in comparison to all other groups. Also, the coliform count of birds receiving turmeric at the rate of 1% in their diet did not differ significantly in comparison to birds receiving diet containing antibiotic. Consistent with our results Samarasinghe *et al.*, (2003) revealed that colony forming units (cfu) of coliform bacteria, yeast and mould significantly reduced ($P>0.05$) when the diet was supplemented with turmeric,

mannonoligosaccharide or virginiamycin. However, in contrast to our results Hanan E. Al-Mashhadani (2015) recorded that dietary supplementation of turmeric powder did not have significant (P>0.05) effect on *E. coli* count. However, *E. coli* count was numerically lower in all supplemented groups as compared to the control group.

The results of the present study revealed that the total *Lactobacilli* count of the birds receiving diet containing turmeric powder @ 0.75% was significantly higher as compared to control and other turmeric supplemented groups. The control group receiving basal diet showed significantly lower *Lactobacilli* count in comparison to all other groups. Consistent with results of present study, Hanan E. Al-Mashhadani (2015) recorded that dietary supplementation of turmeric powder caused a significant (P<0.05) increase in Lactobacillus count compared with the control group. So from the results obtained from the experiment it was depicted that dietary supplementation of turmeric powder decreases the pathogenic bacterial count like *E. coli* simultaneously increasing beneficial bacteria like *Lactobacillus* by creating a favorable intestinal environment for their growth.

Supplementation of turmeric powder in the diet of broilers resulted in increased average body weight gain and better feed conversion ratio. Dietary supplementation of turmeric powder in broilers resulted in balanced intestinal microbial environment due to decreased colonization of *E. coli* and increased *lactobacilli* count Thus, there was efficient utilization of feed which resulted in enhanced survivability the broilers.

Considering the results obtained in the present experiment, It could be concluded that supplementation of turmeric @0.5% has the potential to improve intestinal microbial ecosystems by increasing lactobacillus count. So, turmeric could be used as an alternative to antibiotics as a growth promoter.

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