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Effect of dietary supplementation of turmeric (*Curcuma longa*) powder on the carcass quality of commercial broiler chicken

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Abstract
A six weeks period trial was carried out to study the effect on carcass quality and organoleptic evaluation of commercial broiler chicken due to turmeric powder supplementation as feed additive. A number of 144 day-old commercial broiler chicks (Cobb 400) from a single hatch randomly divided into four groups *viz.* T_0, T_1, T_2 and T_3 supplemented with turmeric powder at the rate of 0.00, 0.25, 0.50 and 0.75%, respectively which consist of 36 birds per group, further sub divided into 3 replicates with 12 birds per sub group. The mean body weight per broiler significantly increased ($P<0.01$) in turmeric supplemented group compared to control while carcass traits like dressed weight, dressing percentage, per cent relative organ weights, except liver and giblet yield showed non-significant ($P>0.05$). Mean scores for organoleptic evaluation of meat under different treatment groups did not differ significantly. Thus the present study suggests that the turmeric powder can be safely used as a natural feed additive in broiler chicken diet.

Keywords: turmeric powder, performance, carcass traits, dressing yield and broiler

1. Introduction
The use of antibiotic as growth promoters in poultry has been banned due to concern about their residues in tissue and induction of bacterial resistance. Due to these concerns, recently many feed additives were investigated for alternatives to in-feed antibiotics. It is reported that aromatic plants may increase feed intake and may improve secretion of endogenous digestive enzymes. It has been shown that the dietary incorporation of herbs may provide beneficial effect on poultry performance and health due to the antimicrobial activity of their phytochemical components Turmeric (*Curcuma longa*) is one of such perennial herbs which contained an active component named curcumin (Wuthi-Udomler *et al*., 2000 and Mashhadani, 2015) [36, 21] and it range from 2 to 5% of the turmeric (Bagchi, A. (2012) [7]. The curcumin content of local variety of turmeric of Assam was estimated and it was found to contain 3.00% on dry weight basis.

Turmeric were found to have anti-oxidative value Osawa *et al*.,1995; Iqbal *et al*., 2003 [25, 18] and certain beneficial pharmacological activities like hypolipidaemic (Ramirez-Tortosa *et al*., 1999 [29], anti-inflammatory (Ammon *et al*., 1993; Holt *et al*., 2005) [4, 16]. Turmeric also has beneficial effects on human health (Nishiyama *et al* 2005) [40]. Curcumin, demethoxycurcumin and bis-demethoxycurcumin are yellowish curcuminoids which are the main antioxidant compounds of turmeric (Cousins *et al* 2007) [39] which has the ability to inhibit the lipid peroxidation and can scavenge the harmful free radicals.

The activity profile and safety of the major lipophilic molecules in turmeric supports its plausible phytobiotic potential (Johannah *et al*, 2018) [18]. The present study is based on the hypothesis that the dietary addition of curcumin can act as a natural antibiotic in poultry feed and may help growth promotion and carcass traits of meat. Thus, we investigated the growth promoting and carcass quality enhancing potential of a standardized formulation of broiler ration containing turmeric powder as a cost-effective natural antibiotic feed additive for chicken.

2. Materials and Methods
The trial was conducted done in the Instructional Poultry farm, College of Veterinary Science, Assam Agricultural University, Khanapara, Assam for a period of six weeks from the month of August to October, 2016. A batch of 144 number of day-old commercial broiler chicks (Cobb-400) having similar body weight from a single hatch and were randomly divided into four treatment groups each comprising 36 number of birds which was further subdivided into 3 replicates of 12 chicks. The chicks were maintained following standard feeding and uniform managemental practices under deep litter system of rearing. The diet was formulated according to BIS (2007). Local variety of raw turmeric rhizomes were procured from local market of Guwahati city. The turmeric rhizomes were first washed thoroughly, sliced and then boiled. After boiling the turmeric rhizomes were allowed to sun dried and finally pulverized into powder form. The curcumin content was estimated

following a standard procedure and added in the dietary treatment groups as T_0 (only basal diet as control), T_1 (basal diet+0.25% turmeric powder), T_2 (basal diet+0.50% turmeric powder) and T_3 (basal diet+0.75% turmeric powder). The following carcass quality traits such as pre-slaughter body weight, dressing yield giblet weight, relative organ weights on dressed weight basis, yield of cut-up parts such as neck, wings, back, breast, thighs and drumsticks, abdominal fat and lymphoid organs like spleen, thymus and Bursa of Fabricius. Organoleptic evaluation of meat was carried out for which breast meat cubes were taken, pressure cooked at 15 lb pressure for 5 minutes and then subjected to taste panel evaluation. Codified samples were served immediately to a 20 member semi-trained panelist provided with a 7 point hedonic score card (Table 01) to assess the colour, flavor, tenderness, juiciness and overall acceptability of the meat samples as described by Bratzler (1971) [8].

Table 1: Score card under hedonic scale for evaluation of broiler meat

Score under hedonic scale	
Excellent	7
Very good	6
Good	5
Fair	4
Poor	3
Very poor	2
Extremely poor	1

3. Results & Discussion

All carcass quality traits (live weight, dressed weight, dressing percentage and giblet weight) except giblet yield recorded in the present study did not differ significantly ($P \leq 0.05$) among the different treatment groups (Table 02). These findings were in agreement with the reports of Nouzarian *et al.* (2011) [24], Noori *et al*. (2011) [23], Al-Jaleel (2012) [2], Mashhadani (2015) [21], Wang *et al*. (2016) [34], Hidayat *et al.* (2017) [14] who reported that supplementation of turmeric powder had no significant effect on carcass quality traits including dressed weight and dressing percentage. However, few researchers (Durrani *et al*., 2006; Hussein, 2013; Mondal *et al.,* 2015 and Ukoha and Ununkwo, 2016) [9, 16, 22, 32]. found that there were significant differences ($P \leq 0.05$) in the carcass traits including dressing percentage in broiler chicken due to inclusion of turmeric powder in the diet. The giblet yield of the control group (T_0) in the present study was significantly ($P \leq 0.05$) higher as compared to treatment groups T_2 and T_3. The differences in the giblet yield might be due to the higher weight of liver in control group (T_0).

The per cent yields of cut-up parts like neck, wings, back, breast, thighs and drumsticks did not differ significantly ($P > 0.05$) among the different treatment groups (Table 03). Similar observations were reported in broiler chicken fed with turmeric powder by Durrani *et al.* (2006) [9] and Mashhadani (2015) [21] who found non-significant differences in the per cent yields of breast, thighs, back, drumsticks, neck and wings among the control and turmeric powder fed groups. Contrary to the present findings, Hussein (2013) [16] and Ukoha and Ununkwo (2016) [32] found significant ($P \leq 0.05$) differences in per cent yields of thigh, back, drumstick, neck and wings between the control and turmeric supplemented groups. Significant differences ($P \leq 0.05$) in per cent yield of breast were reported by Wang *et al*. (2016) [34] in broiler chicken due to supplementation of turmeric powder in the basal diet.

The mean (±SE) per cent weights of relative organs of broiler chicken on dressed weight basis did not differ significantly ($P \leq 0.05$) among different treatment groups except the per cent weights of liver (Table 04). The per cent weight of liver of T_0 group (2.46) was found to be significantly ($P \leq 0.05$) higher than the turmeric supplemented groups. The significantly lower weights of liver in turmeric treated groups might be due to the fact that turmeric contained an important bioactive substance called curcumin which has been shown to have anti-inflammatory and anti-microbial activities (Holt *et al*. 2005) [15]. Besides, turmeric also acted as hepatoprotective (Prasad and Aggarwal, 2011) [27] and hypolipidemic substance (Ramirez-Tortosa *et al*., 1999) [29]. Emadi and Kermanshahi (2007) [12] in their study showed increase in activity of lactate dehydrogenase (LDH) and decrease in serum alkaline phosphatase (ALP) of the chickens due to addition of turmeric powder in the basal diet implying that turmeric might have some positive effects on liver enzymes that directly or indirectly reflect a healthier liver status in broiler chickens. Similar to the present findings on liver yield, Nouzarian *et al*. (2011) [24] and Al-Jaleel (2012) [2] in their study on the effect of turmeric powder on performance and internal organ yield of the broiler chicken found that there was significant ($P \leq 0.05$) decrease in liver weight in broilers fed with turmeric supplemented diets. Contrary to the present findings, Al-Sultan (2003) [3], Noori *et al*. (2011) [23], Vashan *et al*. (2012) [33], Mashhadani (2015) [21], Hady *et al.* (2016) [13], Ukoha and Ununkwo (2016) [32] and Yesuf *et al.* (2017) [37] found non-significant differences in per cent yields of liver among the different treatment groups. However, Abou-Elkhair *et al*. (2014) [1] and Maaty *et al.* (2014) [20] found significant ($P \leq 0.05$) increase in the mean weights of liver due to feeding of turmeric powder in the basal diet of broiler chickens compared to the untreated group.

The other relative organs like heart, gizzard, head, shank, intestine, kidneys and pancreas showed non-significant ($P > 0.05$) difference in per cent weights between the different experimental groups (Table 04). The present findings were in agreement with the observations of Noori *et al*. (2011) [23], Al-Jaleel (2012) [2], Maaty *et al*. (2014) [20], Mashhadani (2015) [21], Hady *et al.* (2016) [13] and Yesuf *et al.* (2017) [37] who found that relative organ weights of chicken were not significantly affected ($P > 0.05$) by dietary supplementation of turmeric powder.

In the present findings, it was observed that supplementation of turmeric powder in the basal diet of broiler chicken did not show any significant ($P > 0.05$) difference in the abdominal fat content of the different experimental groups of birds. The present findings corroborated well with the reports of earlier workers (Mashhadani, 2015 and Hady *et al.,* 2016) [21, 13] who also found non-significant ($P > 0.05$) reduction in abdominal fat per cent in carcasses of broiler chicken supplemented with turmeric powder in the diets. Nevertheless, the present results numerically suggested that the abdominal fat percentage was lowered with increasing the doses of turmeric powder administered in the diet. The positive effect of turmeric in abdominal fat could be attributed to its negative influence on liver fatty acid synthesis (Asai and Miyazawa, 2001) [6]. The liver triacylglycerol and plasma triacylglycerol in the VLDL fraction and liver cholesterol significantly decreased but the activity of hepatic acyl-CoA oxidase increased (Asai and

Miyazawa, 2001) [6]. Concomitant to the present results, Vashan *et al.* (2012) [33] and Rajput *et al*. (2013) [28] reported that turmeric powder supplementation in the broiler diet could reduce abdominal fat content of broilers by regulating the enzyme activity related to fat metabolism and by adjusting blood lipid metabolism (Zhong-ze *et al*., 2007) [38]. Among the lymphoid organs, the spleen, bursa of Fabricius and thymus showed non-significant (P>0.05) differences in per cent weights among the different experimental groups. Similar findings were also observed by Vashan *et al.* (2012) [33] and Mashhadani, (2015) [21] who reported no significant (P>0.05) differences in weights of lymphoid organs due to supplementation of turmeric powder in feed.

The mean (±SE) scores for organoleptic evaluation of meat of broiler chicken under different treatment groups did not differ significantly (P>0.05). Thus the various organoleptic parameters of broiler meat like colour, flavor, texture, juiciness and overall acceptability were not affected due to supplementation of turmeric powder in feed (Table 05). The mean overall acceptance of various groups of meat ranged from 5.55 to 6.05 and hence according to the hedonic scale, the meat can be said as of good to very good quality Similar findings were also observed by Al-Sultan (2003)[3] and Wattanachant *et al.* (2004)[35] who showed non-significant differences in colour, flavor and overall acceptance of broiler chicken meat among control and turmeric treated groups.

Table 2: Mean (± SE) Carcass quality traits of broilers under different treatment groups

Parameters \ Group	T_0 (Control)	T_1 (TP- 0.25%)	T_2 (TP- 0.50%)	T_3 (TP- 0.75%)
Live weight (g)	1884.00^a ± 67.12	1840.60^a ± 117.76	1855.40^a ± 75.90	1874.20^a ± 97.07
Dressed weight (g)	1304.20^a ± 51.20	1262.20^a ± 62.68	1294.60^a ± 69.80	1309.40^a ± 73.18
Dressing percentage (%)	69.19^a ± 0.46	68.83^a ± 1.41	69.65^a ± 1.27	69.82^a ± 0.89
Giblet weight (g)	88.80^a ± 2.74	78.40^a ± 5.39	80.80^a ± 6.01	83.60^a ±7.65
Giblet yield (%)	4.71^a ±0.19	4.27^{ab} ± 0.07	4.34^b ± 0.21	4.46^b ± 0.08

Means bearing same superscripts in a row did not differ significantly

Table 3: Mean (± SE) Per cent yield cut-up parts of broilers (on DWB) under different treatment groups

Parameters \ Group	T_0 (Control)	T_1 (TP-0.25%)	T_2 (TP-0.50%)	T_3 (TP-0.75%)
Neck	3.14^a ± 0.22	2.86^a ± 0.19	3.39^a ± 0.35	3.42^a ± 0.45
Wings	7.01^a ± 0.29	6.93^a ± 0.53	7.58^a ± 0.33	8.12^a ± 0.78
Back	12.66^a ± 0.48	14.52^a ± 1.47	14.66^a ± 1.36	14.51^a ± 0.27
Breast	23.38^a ± 0.64	24.17^a ± 1.19	24.01^a ± 1.11	23.85^a ± 1.08
Thighs	10.53^a ± 0.94	11.41^a ± 0.58	10.96^a ± 0.40	11.50^a ± 0.73
Drumsticks	9.18^a ± 0.67	10.19^a ± 0.46	9.87^a ± 0.60	10.43^a ± 0.63

Means bearing same superscripts in a row did not differ significantly

Table 4: Mean (± SE) Per cent weights of relative organs (on DsWB) under different treatment groups

Parameters \ Group	T_0 (Control)	T_1 (TP-0.25%)	T_2 (TP-0.50%)	T_3 (TP-0.75%)
Liver	2.46^a ± 0.09	2.21^b ± 0.04	2.03^b ± 0.08	1.98^b ± 0.08
Heart	0.448^a ± 0.02	0.44^a± 0.03	0.48^a ± 0.02	0.48^a ± 0.02
Gizzard	1.75^a ± 0.11	1.59^a ± 0.07	1.83^a ± 0.14	1.92^a ± 0.09
Head	2.34^a ± 0.03	2.31^a ± 0.04	2.50^a ± 0.14	2.60^a ± 0.08
Shank	3.88^a± 0.09	3.78^a ± 0.15	3.81^a ± 0.20	3.97^a ± 0.17
Intestine	4.82^a ± 0.31	4.54^a ±0.10	4.71^a ± 0.40	4.17^a ± 0.14
Kidneys	0.52^a ± 0.39	0.47^a ± 0.18	0.51^a ±0.46	0.62^a ± 0.57
Pancreas	0.19^a ± 0.02	0.25^a ± 0.02	0.19^a ± 0.01	0.23^a ± 0.02
Abdominal fat	1.63^a ± 0.21	1.37^a ± 0.13	1.32^a ± 0.10	1.32^a ± 0.10
Lymphoid organs				
Spleen	0.14^a ± 0.08	0.12^a ± 0.19	0.11^a ± 0.11	0.10^a ± 0.05
Thymus	0.22^a ± 0.03	0.21^a ± 0.03	0.23^a ± 0.03	0.20^a ± 0.02
Bursa of Fabricius	0.058^a ± 009	0.056^a ± 0.011	0.052^a ± 0.006	0.050^a ± 0.004

Means bearing same superscripts in a row did not differ significantly**.**

Table 5: Mean (± SE) scores for organoleptic evaluation of broilers under different treatment groups

Parameters \ Group	T_0 (Control)	T_1 (TP-0.25%)	T_2 (TP-0.50%)	T_3 (TP-0.75%)
Colour	5.15^a ± 0.19	5.25^a ± 0.17	5.50^a ± 0.18	5.80^a ± 0.15
Flavour	5.40^a ± 0.27	5.15^a ± 0.22	5.25^a ± 0.11	5.75^a ± 0.20
Texture	5.20^a ± 0.19	5.30 ± 0.25	5.10^a ± 0.16	5.75^a ± 0.16
Juiciness	5.25^a ± 0.16	5.45 ± 0.17	5.50^a ± 0.25	5.45^a ± 0.17
Overall acceptance	5.55^a ± 0.13	5.60^a ± 0.11	6.05^a ± 0.08	5.70^a ± 0.20

Means bearing same superscripts in a row did not differ significantly.

4. Conclusions

Thus, from this study, it can be recommended that turmeric powder can be used safely and economically as a natural feed additive in broiler chicken diet due to presence of bioactive principle responsible for the health beneficial effects on commercial broiler chicken meat. Further in depth studies may be required using different levels of turmeric powder as feed additive in broiler chicken to validate the present results.

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