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EFFECTS OF DIETARY SUPPLEMENTATION LEVELS OF TURMERIC POWDER(*CURCUMA LONGA*) ON PERFORMANCE, CARCASS CHARACTERISTICS AND GUT MICROFLORA IN BROILER CHICKENS

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ABSTRACT

The study was conducted to determine the effect of turmeric powder at different levels (0, 2, 4, 6, 8, 10 g/ kg), and a single dose of chlortetracycline (10 mg/kg) to broiler diets on performance, carcass yield and gut microflora. The results revealed that adding 10 g/kg turmeric powder to the ration significantly decreased feed intake (FI). Meanwhile, adding 2 g/kg turmeric powder improved feed conversion ratio (FCR). Neither carcass yield nor weights of heart and liver organs were significantly affected by dietary treatments. The colony forming unit of lactic acid bacteria was found to be higher in the group of birds fed on the diet supplemented with 2 g/kg turmeric powder than the other groups of birds. While the highest *E. coli* content was determined in the birds received control diet and those received the diet added with 10 mg/kg antibiotic, the lowest *E. coli* content was determined in the groups of birds fed with the diets added with 6, 8 and 10 g/kg turmeric powder.In conclusion, increasing dieatry supplementation levels of turmeric powder, except for the 10 g/kg level has positive effects on bird's performance and gutmicroflora. In particular, a level of 2 g/kg turmeric powder could be recommended as an alternative to feed antibiotics due to significantly improved FCR.

Key words: Broiler chickens, turmeric powder *(curcuma longa)*, performance, carcass yield, gut microflora.

INTRODUCTION

Recentlymany feed additives were investigated for alternatives to in-feed antibiotics. Therefore, some researchers have focused their studies on aromatic plants and spices.It is reported that aromatic plants may increase feed intake and may improve secretion of endogenous digestive enzymes (Craig, 1999; Jamroz *et al*., 2003).

Turmeric rhizome (*curcuma longa*), which is a tropical plant of the Zingiberaceae family, have been shown to influence growth performance in poultry. Curcumin is the most important active ingredient of curcuma longa, and has been widely used in Eastern societies (Gowda *et al*., 2009). Some studies have been demonstrated health effects of turmeric such as anti-inflamatuary (Holt, 2005) and antioxidant (Jayaprakasha *et al*., 2005; Karami *et al*., 2011).

Studies on broiler chickens showed increasedweight gain (Samarasinghe *et al*., 2003) and improved FCR (Samarasinghe *et al*., 2003; Wuthi-udomler *et al*., 2000)with dietary supplementation of turmeric. In contrary, Gowda *et al*. 2008; Kumari *et al*. 2007,Mehala and Moorthy, 2008foundno effect of turmeric on FCR.On the other hand, the use of turmeric in broiler diets has been successfully demonstrated with antimicrobial activity on *E.coli* and coliform bacteria (Samarasinghe *et al*., 2003).

Yet, the beneficial effects of turmeric powder in broiler diets need to be further imvestigated with a wide range of supplementation dosages. Therefore, the purpose of this study is to test the effects of turmeric powder added to broiler diet from 0 to 10 g/kg on body weight (BW), weight gain (WG), feed intake (FI), feed conversion ratio (FCR), carcass yield and intestinal microflora of broilers.

MATERIALS AND METHODS

Experimental design: Turmeric powder used in the study was obtained from a local retailerin Erzurum (Turkey). Turmeric powder has following composition, declared by the manufacturer: 70.79% Beta Tumerone, 9.65% Alpha-Tumerone, 2.06% Isocumene, 2.04% Beta-Sesquıphellandrene, 2% Zingiberene. The ingrediends used to produce the basal diet were obtained locally and the compositions of basel diets fed to broiler chickens in two different phases is given in Table 1.

A total of day-old 350 chicks (175 male and175 female) of Ross PM 308 commercial lines were was randomly distributed into 7 pens. The studywas conducted with 7 groups (1 control, and 6 treatment groups) each of which included 50 chicks. Each group consisted of 5 sub-groups and eachreplicatecontained 10 birds(5maleand5 female). The birds in control group was fed with basal feed, and the birds in treatment groups were fed with the basal diet containing

Table 1. The composition of the experimental diet (g/kg).

Item	Starter diet (1-21 d)	Finisher diet (22-42 d)
Corn	562	556
Soybean Meal	189	120
Full-Fat Soybean	160.00	229.35
Animal by-products	69.00	69.00
Vegetable Oil	4.00	12.00
Salt and Soda	3.30	4.05
Lysine	3.00	2.10
Methionine	2.00	1.30
Limestone	2.00	2.20
Vitamin Mixture[1]	2.00	2.00
Mineral Mixture[2]	1.50	1.50
DCP (dicalcium phosphate)	2.20	0.50
Composition (%)		
Crude Protein (analysed)	22.70	20.99
Crude Fat (analysed)	8.13	10.15
Crude Fibre(analysed)	3.96	4.21
Crude Ash (analysed)	5.24	5.29
Dry Matter (analysed)	88.94	90.08
ME (kcal/kg)	3040	3240
Ca	1.05	0.99
P	0.56	0.53
Methionine	1.22	0.94
Lysine	1.50	1.25

[1:] Provided per kilogram of diet: 12 000 IU Vitamin A., 3 500 IU Vitamin D3, 100 g Vitamin E., 3 mg Vitamin K3, 2.5 mg. Vitamin B1, 6 mg Vitamin B2, 25 mg Niacin, 12 mg Ca-D-Pantothenate, 4 mg Vitamin B6., 0.015 mg Vitamin B12., 1.5 mg Folic Acid,150mg D-Biotin., 100 mg Vitamin C., 450 mg Colin chloride.

[2:] Provided per kilogram of diet: 100 mg Mangan., 25 mg Iron., 65 mg Zink., 15 mg Copper., 0.25 mg Cobalt., 1 mg Iodine., 0.2 mg Selenium.

turmeric powder at a rate of2, 4, 6, 8, 10 g/ kg, respectively, and the bird in positive control group was fed with the basal dietcontaining a single dose of 10 mg/kg antibioticfor 42 days. The feed and water were provided adlibitum. The research protocol was approved and applied in accordance with the Animal Ethics Committee Guidelines of Atatürk University (No: 2010/41). FI and BW were recorded by weighing the animals. FCR was measured with the obtained data.At the end of the study, five birds were randomly selected from each treatment group and were slaughtered (neck cutting). The carcasses were plucked and the heads, necks, shanks as well as the feet were removed. The liver and heart were dissected from the viscera. The carcass yield was calculated. The carcasses of the birds were opened, and 2 g of intestinal contents from jejunum was transferred to sterile plastic tubes. All samples were processed within the same day for enumeration of microbial populations. A total of 35 samples from the all groups were also taken. Total aerobic mesophilic bacteria counts and lactic acid bacteriacounts by using the methods reported by Baumgart *et al*., (1993) and *E. coli*counts by using the methods reported by Halkman *et al*.,(1994).

Data analyses: Analysis of variance was applied to the data using statistical package programme of SPSS for Windows (SPSS 1999) version 10.0. Significantly differed means were seperated by a Duncan's multiple comparison test at $\alpha = 0.01$ and 0.05 levels, respectively.

RESULTS

When Table 2 is examined it is observed that there are no significant differences between the groups in terms of BW at 0-d and at 42 d, with a exception of a numerically low BW of the birds fed with the diet containing 10 g/kg turmeric.

Dietary suplementation turmeric significantly ($P<0.05$) changed WG). It was observed that the lowest WG value occurred in the group that included 10 g/kg turmeric powder with 2276.10 g; and the highest WG value occurred in the control group, the group which received 2,6 g/kg turmeric powder, and in the antibiotic group.

FI values were significantly influenced by dietary turmeric ($P<0.01$). It was observed that the lowest FI occurred in the group which included 10 g/kg turmeric powder and the highest FI occurred in the antibiotic group. At the end of the study, the difference between the groups in terms of FCR was found to be important ($P<0.05$). The best FCR was observed in the group which received 2 g/kg turmeric powder with 1.53.

When Table 3 is examined it is found that the difference between the groups in terms of slaughtering weight, hot carcass weight and cold carcass weight was found to be very important ($P<0.01$). It was observed that adding turmeric powder to the ration increased the carcass weight. It was determined that there were not significant differences between the groups in terms of carcass yield results and the weight of the heart and the liver.

Total aerobe mesophilic bacteria and lactic acid bacteria count were significantly ($P<0.01$) affected by supplementation turmeric powder. When Table 4 is examined it is found that the highest aerobe mesophilic bacteria count were observed in the group which received 10 mg/kg antibiotics and 2 g/kg turmeric powder (8.49 vs 8.48 cfu/g, respectively), while the lowest value of 7.64 cfu/gwas observed in the group which received 4 g/kg turmeric powder.

Table 2. The effect of adding turmeric powder on performance values in broilers.

Groups	BW at 0 d (g/bird)	BWat 42 d (g/bird)	WG at42 d (g/bird)	FI at 42 d	FCR
Control	43.10	2499.09	2455.98^{a}	3971.78^{ab}	1.62^{abc}
2 g/kg	42.30	2537.37	2495.15^{a}	3825.45^{bc}	1.53^{c}
4 g/kg	42.60	2433.86	2391.25^{ab}	4030.88^{ab}	1.69^{ab}
6 g/kg	43.10	2489.77	2463.23^{a}	3955.55^{ab}	1.61^{abc}
8 g/kg	42.10	2418.97	2376.85^{ab}	3893.48^{b}	1.64^{abc}
10 g/kg	41.70	2317.82	2276.10^{b}	3595.18^{c}	1.58^{bc}
Antibiotic 10 mg/kg	43.90	2492.65	2448.73^{a}	4172.43^{a}	1.71^{a}
SEM	0.33	19.88	18.988	41.447	0.015
P	NS	NS	0.020*	0.002**	0.024*

$^{a, b, c, d}$: Column means with no common superscript differ significantly
SEM: standard error of means**: p<0.01 NS: Not significant

Table 3. The effect of turmeric powder on some slaughtering properties of broiler chicken.

Groups	Parameters						
	Slaughtering weight (g)	Hot Carcass Weight (g)	Cold Carcass Weight (g)	Hot Yield (%)	Cold Yield (%)	Liver Weight (g)	Heart Weight (g)
Control	2392.25^{d}	1813.33^{c}	1773.33^{c}	75.80	74.13	41.77	10.90
2 g/kg	2663.96^{b}	1970.00^{ab}	1921.67^{abc}	73.95	72.14	42.43	11.73
4 g/kg	2660.67^{b}	1981.67^{ab}	1940.00^{ab}	74.48	72.91	42.18	11.61
6 g/kg	2540.30^{c}	1901.67^{bc}	1860.00^{bc}	74.86	73.22	41.57	11.86
8 g/kg	2723.11^{ab}	2048.33^{ab}	2010.00^{ab}	75.22	73.81	47.37	13.90
10 g/kg	2401.28^{d}	1800.00^{c}	1760.00^{c}	74.96	73.29	45.00	12.83
Antibiotic 10 mg/kg	2782.21^{a}	2091.67^{a}	2050.00^{a}	75.18	73.68	46.23	12.50
SEM	32.69	27.60	27.87	0.002	0.003	1.044	0.362
P	0.01**	0.005**	0.007**	NS	NS	NS	NS

a, b, c, d: Column means with no common superscript differ significantly
SEM: standard error of means**: p<0.01 NS: Not significant

When we examined Table 4 in the number of lactic acid bacteria, it was found that the highest value was observed in the group which received 2 g/kg turmeric powder with value of 8.58 cfu/g; this group was followed by the group that received antibiotic. The lowest lactic acid bacteria count was determined in the groups which received 4 and 8 g/kg turmeric powder with the values of 7.10 and 7.18 cfu/g, respectively.

Broiler fed the diet with turmeric powder had significantly (P<0.01) reduced *E. coli* in the jejunum. The highest *E. coli* content was observed in the control group and the groups that received 10 mg/g antibiotic to the ration; and these groups were followed by the groups that received 2 and 4 g/kg turmeric powder. The lowest *E. coli* content was determined in the groups that received 6, 8 and 10 g/kg turmeric powder to the ration.

Table 4. The effect of turmeric powder on jejunum microflora in broilers.

Groups	Total aerobe mesophilic bacteria (cfu/g)	Lactic acid bacteria (cfu/g)	*E.coli* (MPN/g)
Control	7.92^{c}	7.28^{cd}	1100^{a}
2 g/kg	8.48^{a}	8.58^{a}	886^{a}
4 g/kg	7.64^{d}	7.10^{d}	886^{a}
6 g/kg	8.03^{bc}	7.50^{bc}	460^{b}
8 g/kg	8.27^{ab}	7.18^{d}	460^{b}
10 g/kg	8.18^{bc}	7.55^{bc}	460^{b}
Antibiotic 10 mg/kg	8.49^{a}	7.74^{b}	1100^{a}
SEM	0.0622	0.0946	71.473
P	0.0001**	0.0001**	0.002**

$^{a, b, c, d}$: Column means with no common superscript differ significantly.
SEM: standard error of means **: p<0.01

DISCUSSION

The present results indicated that turmeric powder has no effects on final BW of broiler chicken.Similar results were previously reported byHernandez *et al*. (2004) and Lee *et al*. (2004) with plant extracts. Turmeric powder, except 10 g/kg level, did not significantly affected final WG. The values of WG of broilers fed various levels of dietary turmeric powder were found to be similar to the values reported by Kumari *et al*. (2007).In contrary, there were some other studies reporting improvements in WG; Arkan *et al*., (2012) reported that WG in broiler chicken increased significantly by 0.1% and 0.2% dietary turmeric supplementations. Yarru *et al*., (2009) reported supplementation of 0.5% turmeric powder decreased WG of broilers. Differences in WG reported in the lietarture due to various dietary levels of turmeric powder appeared to be due to appetizereffectsof plant extractsincreasing gastric digestion liquor(Lee, 2002; William and Losa 2001) and forming more balanced intestine flora due to their antimicrobial effects (Erhan *et al*.,2012). However, it is evidently clear that the high level ofturmeric powder such as 10 g/kg is not suitable, in broiler nutrition, because of decreased BW and WG as a result of limited intake of feed (see FI figures in Table 2).

According to the data of the study, the turmeric powder added to the ration decreased FIsignificantly at the end of the study; FI and WG being lower in the group which received 10 g/kg turmeric powder. These results were found to be similar with the results reported by Gowda *et al*., (2008) and Wuthi-udomler *et al*., (2000). Low FI may be due to the fact that the powder might have spoilt the taste and smell of the feed. Except with the highest dosage (10 g/kg), both final WG and FIwere better in the groups which received 2 g/kg turmeric powder than the control group and antibiotic group. These results may indicate some beneficial effects of the feed additive in gastro-intestinal tract.

Supplementation of 10 g/kg turmeric powder to diet significantly improved FCR. This results was mainly due to decreased amount of feed intake. In the literature there were sporadic results of FCR under the influence of turmeric powder: FCR improvements were found to be important in some studies (Arkan *et al*.,2012; Nouzarian *et al*., 2011), while not important in some other studies(Gowda*et al*., 2008; Kumari *et al*. 2007; Mehala and Moorthy, 2008). It is considered that turmeric powder *(curcuma longa)* has important effects on increasing the activity of digestion enzymes and decreasing the intestine viscosity in increasing the beneficial effects of the feed.

Turmeric powder did not affect weights of heart liver, but it increased the weight of carcass weight in this study.Similarly some researchersMehala and Moorthy (2008); Nouzarian *et al*. (2011) reported that adding turmericdid not affect thecarcass yield.There were no differences in the weight of the heart.Yarru *et al*., (2009)conducted a study and examined the effects of adding 0.5 % turmeric powder diets of broiler chicken. According to the results of this study it was reported that turmeric powder did not have an influence on the weights of the liver. These results also support the findings of our study.

The level of 2 g/kg turmeric powder increased total aerobe mesophilic bacteria and the lactic acid bacteria count. It was observed that the decrease in the *E.coli* amount was more in the groups where the turmeric powder increased in the ration. Samarasinghe *et al*., (2003) reported that dietary turmeric powder reduced coliform bacteria in duedenom of the broilers.Also, there are many studies conducted that adding essential fat to the feed of the broiler chickens decreased the amount of *E. coli* in the intestine (Bölükbaşi *et al*., 2007; Dalkiliç, 2007; Güler *et al*., 2005; Jamroz and Kamel 2002; Suk, 2003). The findings of these authors are in agreement with the findings of our study.

Having considered overall results the turmeric powder may regulategut microflora by decreasing the activities of some pathogenic bacteriafor a better absorption of nutrients. In particular, the level of 2 g/kg turmeric powder was found to be beneficial to broiler chickens since the birds gained more wieght and improved FCR due to positivelly affected gut microflora. Therefore, we could recommend the supplementation of diets with 2 g/kg turmeric powder for commercial production of broiler chickens.

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