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Impact of dietary supplementation levels of turmeric powder (*curcuma longa*) on performance, carcass characteristics, blood biochemical, jejunum histological and gut microflora in broiler chickens

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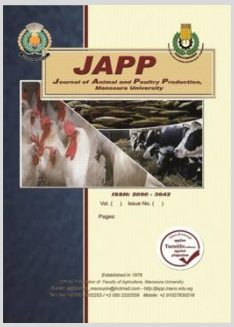

ABSTRACT

The present study investigated the dietary effect of different turmeric powder (TUR) levels on growth performance, blood parameters, immune response, antioxidant status, gut morphology, and microbiological traits in broiler chickens during winter (December 2023 to January 2024). 160 broiler chicks, divided into 16 duplicates at random, were fed four experimental meals (0.0, 2, 4, and 6 g/kg) of turmeric powder, with 10 chicks per replicate and 4 replicates per treatment. Growth performance, slaughter test, and blood parameters were measured. The results showed that LBW and TBWG of 6-week-old chicks fed diets containing higher levels of turmeric powder (4.0 or 6.0 g/kg) increased significantly compared with the control group. At the same time, there were no significant effects on the FI or FCR of broiler chicks during the whole experimental period. On the other hand, significantly lower serum levels of LDL and MDA were recorded for broiler chickens supplemented with different levels of TUR compared with the control group. However, significantly the highest serum levels of TP and HDL were registered for birds supplemented with TUR at 6 g/kg compared with the control group. The jejunum of birds fed TUR-enriched diets (4.0 and 6.0 g/kg) showed a significant increase in villus height compared with the other groups. In contrast to the control group, there was a numerical rise in the total number of live bacteria. The performance and overall health of broiler chickens were found to be improved by TUR-containing dietary additives.

keywords: Chicken, Carcass, Performance, Blood parameters, microbiological, hematological, turmeric

INTRODUCTION

The rhizome and roots of turmeric (*Curcuma longa*), a tropical herb belonging to the *Zingiberaceae* family, are necessary for making curry powder, especially in South and Southeast Asia. Additionally, it is frequently utilized as an antibiotic, endogenous stimulant, anti-flatulent, and anti-inflammatory medication in Asian traditional medicine Dang *et al*., 2000. Curcumin (diferuloylmethane), the main bioactive ingredient of turmeric, has been shown to have a variety of biological effects. These include antioxidant, antidiabetic, anticoagulant, anti-inflammatory, anti-mutagen, and anti-carcinogenic properties Verma *et al.* (2018). The reports that are currently available indicate that in addition to its strong antioxidant properties, turmeric may also be a real source of proteins and carbohydrates. Additionally, the positive effects of turmeric on birds' growth and productivity make it a viable feed additive (Hafez *et al.*, 2022). Furthermore, it was demonstrated that supplementing broiler chickens with turmeric, a natural plant, improves their performance Al-Sultan and Gameel (2004). Additionally, turmeric curcumin can strengthen the immune system and act as an antioxidant Gandhi *et al.* (2011). Furthermore, Durrani *et al.* (2006) claimed that giving broiler chickens supplements of turmeric increased their BWG and FCR. Curcumin has anti-inflammatory, antibacterial, and antioxidant properties Chattopadhyay *et al.* (2004). Chemicals and biologicals known as growth promoters are added to livestock feed to help chickens grow faster during fattening, increase feed utilization, and improve production and financial outcomes. They work in different ways. Better appetite, enhanced feed conversion, immune system stimulation greater vitality, gut microbiota modulation, etc. are examples of positive impacts. Poultry diets contain a variety of feed additives to maximize the growth of the chickens. In addition to raising production costs, the use of hormones and antibiotics in feed causes residues in meat and bacteria that become resistant to antibiotics (Al-Jaleel, 2012). The current study's goal was to assess how additional TUR affected the broiler chickens' gut morphology, microbial characteristics, production performance, carcass yield, and certain blood parameters.

MATERIALS AND METHODS

From December 2023 to January 2024, the current study was carried out at a private chicken farm in the Dakhaliah Governorate, Egypt. The current study set out to assess how turmeric powder affected the microbiological characteristics, intestinal morphology, production performance, carcass yield, and some blood parameters of broiler chickens.

Designing and experimenting:

Four treatment groups, each with four-floor replicas, were created from 160 one-day-old Ross 308 broiler chickens. A control group (0.0%) and groups receiving TUR at doses of 2, 4, and 6 g/kg were among the dietary treatments. The experiment lasted 42 days, with 40 birds in each treatment group. The broilers of replicate were housed on a 1.0 m^2 pen floor, which measured 100 cm in length and 100 cm in width. Until they were 42 days old, they were fed their assigned experimental diets according to a dietary program.

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From day 1 to day 21, the chickens were fed a starter diet (3150 kcal ME/kg diet, 23%CP). From day 21 to day 42, they were fed a grower-finisher diet (3150 kcal of ME/kg of diet, 21% CP). The NRC (1994) criteria for broiler chicken nutrition were followed in the formulation of the experimental diets. Fresh water and feed (in the form of mash) were freely available to the chicken. The composition of turmeric powder is given in Table 1 (Chattopadhyay *et al.,* 2004), and the experimental diet details are shown in Table 2.

Table 1. The determined nutrient composition of turmeric powder.

Chemical Component	Dry matter	Crude protein	Carbohydrates	Fats	Minerals
Amount (% dry matter basis)	86.9	6.3	69.4	5.1	3.5

Table 2. Composition of calculated analysis for starter and growing period ratio.

Ingredients (%)	Starter	Grower-finisher
Yellow corn	61	65
Soybean meal 44	17.7	18.17
Corn Gluten Meal 60.2	15.6	11.7
Dicalcium Phosphate	1.78	1.35
Limestone	1.45	1.45
DL-methionine	0.06	0.0
L-Lysine	0.31	0.23
Sodium chloride	0.3	0.3
Vit+Min Premix[1]	0.3	0.3
Soybean oil	1.5	1.5
Total	100	100
Calculated Analysis		
ME, kcal/Kg	3150.5	3150
CP,%	23.015	21.003
Crude Fiber,%	2.78	2.85
Ether extract%	2.84	2.9
Calcium%	1.006	0.913
Av-Phosphorus, %	0.451	0.369
Lysine, %	1.105	1.008
Methionine, %	0.511	0.4039
Meth. +Cys. (TSAA, %)	0.910	0.769

****Premix provided the following per kilogram of diet: VA (retinyl acetate), 2654 µg; VD3 (cholecalciferol), 125 µg; VE (dl-α-tocopheryl acetate), 9.9 mg; VK3 (menadionedimethylpyrimidinol), 1.7 mg; VB1 (thiamin mononitrate), 1.6 mg; VB12 (cyanocobalamin), 16.7 µg; riboflavin, 5.3 mg; niacin (niacinamide), 36 mg; calcium pantothenate, 13 mg; folic acid, 0.8 mg; d-biotin, 0.1 mg; choline chloride, 270; BHT, 5.8; Fe (iron sulphate monohydrate), 50 mg; Cu (copper sulphatepentahydrate), 12 mg; I (calcium iodate), 0.9 mg; Zn (zinc oxide), 50 mg; Mn (manganous oxide), 60 mg; Se (sodium selenite), 0.2 mg; Co (cobalt sulphate), 0.2 mg.*coriander seed powder was included in these starter and grower diets at the expense of the total diet.**

Performance of broiler chickens:

The investigation was conducted using weekly measurements of body weight gain (BWG), live body weight (LBW) and feed intake (FI) based on a replication group. Consequently, a gram feed: gram gain ratio was used to compute the feed conversion ratio (FCR). At the start of the experiment and every week until its conclusion, the chickens were weighed (in grams) in the early morning before being given any feed or water. Additionally, weekly broiler chicken FI and BWG records were computed on a replicate group basis.

characteristics of a carcass:

At the study's end (42 days of age), three birds per treatment were selected birds weighed around two kilograms to be killed to remove their heart, liver, gizzard, and lymphoid organs (spleen, bursa of Fabricius, and thymus). Weighing these organs allowed us to calculate their fraction of live body weight.

Blood collection and biochemical evaluation:

Blood samples from the slaughter were taken in tubes and centrifuged for 15 minutes at 4000 rpm. Moreover, until analysis, the obtained serum was kept at -20°C. Aspartate aminotransferase (AST), alanine aminotransferase (ALT), triglycerides (Trig), total protein (TP), albumin (ALB), total cholesterol (Chol), high-density lipoprotein (HDL), low-density lipoprotein (LDL), total antioxidant capacity (TAC), and malondialdehyde (MDA) were among the serum biochemical components and metabolites that were measured using commercial kits. ELISA was employed to measure immunoglobulins IgG.

Measurement of intestinal morphometry:

Morphometric factors such as crypt width, villus width, and villus height were measured in the jejunum (Langhout *et al.,* 1999). Three birds from each treatment group were decapitated and slaughtered on day 42. To measure the gut's morphology, 3 cm sections of the jejunum—more precisely, the middle of the pancreatic loop—were gathered. Each section's intestinal samples were promptly preserved in formaldehyde before being submerged in paraffin and Bouin's solution for embedding. Histological analyses were then conducted using the methods described by Iji *et al.* (2001). Haematoxylin and eosin were used to stain the carefully prepared paraffin slices, which had a thickness of 6µm, from each sample. Using a light microscope, these sections were examined to estimate the crypt width, villus height, and villus width. A linear-sized graticule was used to measure the depth of the intestinal crypt and the length of the intestinal villi.

Quantification of the concentration of cecal microbiota:

Nine milliliters of a 0.9% saline solution were used to dilute one gramme of the composite cecal sample from each pen, which was then forcefully mixed using a vortex. Three distinct types of agar plates were plated with serial 10-fold dilutions (in 1% peptone solution) to determine the viable bacterial counts in the cecal samples. These included Salmonella shigella (S.S.) agar plates Atlas and Snyder (2006), Macconkey agar plates Anderson and Cindy (2013), and Plate count agar (PCA) Aryal and Sagar (2021). The text source is Difco Laboratories, Becton, Dickinson and Company, in Sparks, Maryland. Salmonella, Escherichia coli, and Lactobacillus were to be separated using these plates. The Lactobacilli MRS agar plates were then incubated at 37°C under anaerobic conditions for 48 hours. On the other hand, the Salmonella Shigella and Macconkey agar plates were incubated for 24 hours at the same temperature under aerobic circumstances. The colonies of Lactobacillus, E. Coli, and Salmonella were immediately identified after the incubation period when they were removed from the Twin Room Incubator (DS-12B, Dasol Scientific Co.Ltd., Hwaseoung, South Korea). The colour appearances of the bacterial colonies were used to identify them: Salmonella Shigella colonies seemed colorless, E. Coli colonies were reddish-pink, and Lactobacillus colonies were yellowish.

Statistical analysis:

One-way analysis of variance was employed to perform statistical analysis on the collected data (SAS, 2006). The Tukey multiple range test was utilized to find significant differences between means (Tukey, 1977).

RESULTS AND DISCUSSION

Effect of turmeric powder on the Growth performance of broiler chicks: -

Table 3 shows the effects of feeding broiler chickens diets enhanced with turmeric powder on their growth performance from one to forty-two days of age. The LBW of broiler chickens at 28 and 42 days of age was significantly impacted by the nutritional supplementation of varying amounts of turmeric powder (0.0, 2.0, 4.0, and 6.0 g/kg) in that study. The final LBW of 6-week-old chicks fed diets containing higher levels of turmeric powder 4.0 or 6.0 g/kg increased significantly compared with the control group. Nevertheless, there were no significant differences between the low level of turmeric powder 2.0 g/kg on the LBW throughout the experiment, compared to the control group (0.0). Turmeric powder supplementation at 4.0 and 6.0 g/kg resulted in a substantial ($P \leq 0.01$) rise in broiler chickens' TBWG during the trial compared to the control group, as indicated in Table 3. On TBWG, there were no appreciable variations between the control group and the birds fed the diet supplemented with 2.0 g/kg of turmeric powder. Except for the fourth week, when it was discovered that the control group consumed more feed than the other groups, feeding the broiler chicks diets supplemented with varying amounts of turmeric powder had no discernible effects on their FI or FCR throughout the entire experimental period (Table 3).

Table 3. Effect of turmeric powder supplementation on production performance of broiler chickens at different ages.

Performance	Dietary Levels of Turmeric(g/kg)				Pooled	P
Criteria	0.0	2.0	4.0	6.0	SEM	Value
LBW(g):						
LBW:1-D	42.77	42.90	42.80	42.82	0.155	0.9458
LBW:7-D	123.1	120.3	116.6	124.3	3.213	0.3738
LBW:14-D	344.7	337.7	316.7	332.5	13.29	0.5170
LBW:21-D	695.6	669.3	616.8	654.3	25.59	0.2300
LBW:28-D	1017^{b}	1020^{b}	1012^{b}	1057^{a}	6.923	0.0022
LBW:35-D	1691	1721	1724	1785	32.63	0.2773
LBW:42-D	2275^{b}	2360^{ab}	2420^{a}	2467^{a}	30.87	0.0051
BWG(g):						
BWG1StWK	80.62	77.18	73.24	81.52	3.188	0.2920
BWG2ndWK	221.6	217.3	200.1	208.1	11.98	0.6016
BWG3rdWK	350.8	331.6	300.1	321.8	14.49	0.1509
BWG4thWK	321.3	351.1	395.6	403.1	28.10	0.1867
BWG5thWK	674.2	700.5	712.2	727.5	32.63	0.1736
BWG6thWK	584.2	639.6	696.0	682.0	35.65	0.1696
TBWG:0-6WK	2232^{b}	2317^{ab}	2377^{a}	2424^{a}	30.7	0.0051
FI(g):						
FI:1StWK	153.2	157.5	141.7	143.7	4.480	0.0825
FI:2ndWK	338.2	325.4	336.0	350.8	9.242	0.3298
FI:3rdWK	540.1	526.8	534.6	521.6	13.20	0.7649
FI:4thWK	605.4^{a}	675.1^{b}	716.1^{b}	697.6^{b}	14.62	0.0009
FI:5thWK	1136	1150	1096	1113	34.16	0.6925
FI:6thWK	1095	1088	1126	1120	24.22	0.6205
TFI:0-6WK	3868	3923	3951	3948	54.43	0.0178
FCR(g:g):						
FCR1StWK	1.907	2.047	1.957	1.770	0.094	0.2615
FCR2ndWK	1.530	1.512	1.695	1.717	0.105	0.4101
FCR3rdWK	1.540	1.590	1.800	1.632	0.073	0.1224
FCR4thWK	1.890	1.930	1.837	1.785	0.112	0.8130
FCR5thWK	1.695	1.650	1.542	1.537	0.055	0.1706
FCR6thWK	1.877	1.707	1.645	1.655	0.079	0.1958
TFCR0-6WK	1.735	1.692	1.660	1.630	0.027	0.0957

a-b: Means in the same row carrying different superscripts differ significantly at P ≤0.05, Live body weight (LBW), Body weight gain (BWG), Total body weight gain (TBWG), feed intake (FI), Total feed intake (TFI), feed conversion ratio (FCR), Total feed conversion ratio (TFCR), SEM = Standard error of the means.

The significant effect of turmeric powder on body weight was in line with several previous research findings (Al-Jaleel, 2012; Mondal *et al.,* 2015), which discovered that adding TUR at a rate of 5g/kg considerably raised the body weight of broiler chickens. These results, however, directly counter to Namagirilakshmi (2005) discovery that broilers given turmeric at levels of 0.25, 0.50, 0.75, or 1% did not exhibit a significant change in body weight gain. Additionally, the final body weight of chickens fed a diet additive with TUR was statistically larger than that of the control group, according to Nouzarian *et al.* (2011). However, the detected differences fell short of statistical significance. Compared to a control group, feed efficiency was enhanced over the 21–42- and 1–42-day periods by supplementing with 3.3, 6.6, and 10 g/kg of TUR. The body weight results are consistent with those of Emadi and Kermanshashi (2006) They discovered that at inclusion rates of 2.5, 5, and 7.5 g/kg of food, turmeric did not affect the weight gain of broiler chickens. These results were consistent with those of previous studies by Hussein (2013), Arslan *et al*. (2017) and Ahlawat *et al.* (2018), who also documented the beneficial benefits of supplementing with turmeric powder on the increase of body weight in broiler chickens. These findings concurred with those of Durrani *et al*. (2006) who discovered that broilers given 0.5% turmeric showed noticeably better weight increase. Similar findings were also achieved by Sethy *et al*. (2016) They discovered that adding Curcuma longa powder at 0.5% and 1% significantly increased body weight gain. The addition of 0.5 or 1% turmeric powder significantly boosted weight gain and FCR when compared to the control group ($P < 0.05$) Kumari *et al*., 2007 & Al-Sultan and Gameel, 2004). The findings are consistent with those of Kumar *et al*. (2005) who found that broiler-fed turmeric (1%) increased weight gain significantly ($P<0.05$) compared to the control

group. Yaghobfar *et al*. (2011) stated that feeding turmeric powder had no significant effect on FCR at the levels of 0.4 and 0.8%. On the contrary, Yesuf *et al*. (2017) reported that turmeric supplementation at 1 g/kg feed significantly improved feed conversion ratio (FCR) compared to control groups. According to Arslan *et al.* (2017) feed conversion efficiency was enhanced by supplementing with turmeric at rates of 0, 0.5, 1.0, and 1.5 percent; however, when compared to the control group, supplementation at the rate of 1.5 percent produced the best results. The impact of adding turmeric rhizome powder (TRP) on broiler chickens' FCR was assessed by Akbarian *et al*. (2012). Using two TRP doses (0.0 and 0.50 g/kg), the results showed that TRP supplementation in the diet had no discernible effect on FCR (1.45 vs. control, 1.38). Additionally, Al-Jaleel (2012) discovered that, in comparison to the control, adding 0.5 percent turmeric powder improved feed conversion efficiency. Hussein (2013) found that supplementing with 7 g/kg of diet TUR greatly increased the feed conversion ratio. According to Rajput *et al.* (2013), feed conversion efficiency at the marketing age was considerably increased by dietary supplementation of 200 mg/kg of curcumin.

Effect turmeric powder (TUR) on carcass characteristics and lymphoid organs weights of broiler chickens: -

The effects of varying TUR levels on the relative weights of the broiler chickens' lymphoid organs (spleen and bursa of Fabricius) and carcass characteristics are shown in Table 4. The means of carcass yield percentage, heart percentage, liver percentage, gizzard percentage, spleen percentage, and bursa of Fabricius percentage for each experimental treatment showed no significant changes (P>0.05).

Table 4. Effect of dietary supplementation of Turmeric on **carcass yield, edible organs and lymphoid organ weights of 42-day-old broiler chicks**

Treatments	Levels of Turmeric(g/kg)				Pooled	p-
	0.0	2.0	4.0	6.0	SEM	value
LBW (g)	1983	1966	2000	2033	47.87	0.7881
Carcass yield (%)	70.6	70.4	70.9	71.7	1.650	0.9501
Carcass (%)	65.3	65.1	66.0	66.5	1.40	0.8847
Heart (%)	0.67	0.57	0.56	0.61	0.045	0.3930
Liver (%)	2.70	2.64	2.37	2.75	0.246	0.7148
Gizzard (%)	1.92	2.05	1.94	1.77	0.177	0.7378
Giblets (%)	5.29	5.28	4.88	5.13	0.396	0.8699
Spleen (%)	0.22	0.17	0.16	0.20	0.019	0.2338
Bursa (%)	0.04	0.05	0.05	0.03	0.004	0.2265
Thymus (%)	0.35	0.39	0.36	0.31	0.033	0.4472

LBW= live body weight, SEM= Standard error of the means

These findings concurred with those of Mondal *et al.* (2015), who found that the weight of the internal organs (heart, liver, and gizzard) of broilers fed turmeric powder at non-significant levels (0%, 0.5%, 1.0%, and 1.5%). Mehala and Moorthy (2008) found no discernible effect of TUR (up to 10 g/kg of feed) on the carcass % of broiler chickens raised to six weeks of age, which is consistent with our findings regarding carcass yield. Al-Noori *et al.* (2011) found that TUR had an impact on the carcass characteristics of broiler chickens. For six weeks, 0.0, 0.5, and 1.0 percent of the base diet was supplemented with curcuma longa powder. The findings showed no discernible change in the percentage of dressings or the weight of the liver, spleen, heart, or gizzard. According to Nouzarian *et al.* (2011), the carcass yield was unaffected by the use of turmeric. There were no variations in the heart's weight. The weight of the giblet, chopped-up sections, and dressing % did not significantly differ between the groups, according to Khwairakpam *et al.* (2016) and Durran *et al.* (2006). However, the turmeric powder significantly reduced the amount of fat in the broiler chicks' abdomens. Conversely, broilers fed a diet containing 5 g/kg of turmeric powder showed increased dressing percentage, breast, thigh, and giblet weight (Durrani *et al.*, 2006). The findings of Al-Sultan (2003) suggest that broiler feed of TUR did not affect the proportion of liver, gizzard and heart characteristics.

Effect turmeric powder on blood serum biochemical parameters: -

Table 5 shows the blood serum biochemical parameter results for broiler chicks fed diets supplemented with varying amounts of TUR.

Table 5.Effect of turmeric powder supplemented diet on some blood serum parameters of 42-day-old broiler chicks

Main effects	Control	TUR(2g/kg)	TUR (4g/kg)	TUR (6g/kg)	Pooled SEM	P value
Tp (g/dl)	3.683^{b}	5.113^{ab}	5.190^{ab}	5.373^{a}	0.337	0.026
Alb (g/dl)	2.166	2.796	2.826	2.920	0.185	0.071
Globulin (mg/dl)	1.516^{b}	2.316^{a}	2.363^{a}	2.453^{a}	0.152	0.008
Trig (mg/dl)	72.67	110.6	93.67	93.67	11.23	0.205
Chol (mg/dl)	134.3	111.3	107.3	106.3	8.838	0.162
HDL (mg/dl)	38.33^{b}	43.00^{b}	47.00^{b}	68.00^{a}	2.990	0.0005
LDL (mg/dl)	81.46^{a}	46.20^{b}	41.60^{b}	19.60^{b}	6.859	0.001
ALT (U/L)	18.14	13.55	12.08	14.01	2.926	0.533
AST (U/L)	227.4	215.9	185.7	210.2	27.25	0.745
TAC (mM/l)	0.563	0.670	0.703	0.823	0.062	0.098
MDA (nmol/ml)	42.33a	33.93^{b}	33.33^{b}	27.13^{b}	1.711	0.001
IgG (mg/dl)	79.96	87.40	90.66	91.46	3.127	0.107

"a-b Means in the same row with different superscripts differ significantly (P≤ 0.05)" total protein(TP), Albumin (ALB) , cholesterol (Chol) , high-density lipoprotein (HDL), low-density lipoprotein (LDL), Triglyceride (TG), total antioxidant capacity (TAC), malondialdehyde (MDA), immunoglobulins (IgG), SEM= Standard error of the means.

The experimental groups' serum concentrations of Alb, Trig, Chol, ALT, AST, TAC, and immunoglobin IgG were not significantly affected (P>0.05) by feeding diets supplemented with different amounts of TUR. However, significantly lower serum levels of LDL and MDA were recorded for broiler chickens supplemented with different

levels of TUR (2.0, 4.0 and 6.0 g/kg) compared with the control group. On the other hand, significantly highest serum levels of TP and HDL were registered for birds' supplemented with TUR at 6 g/kg compared with the control group. Our results operate counter to those of Emadi *et al.* (2007), who found that adding turmeric to broiler chickens' base diets significantly raised total cholesterol and HDL cholesterol while lowering LDL cholesterol. However, they did not affect total triglycerides or total protein at 42 days of age. Additionally, Shawky *et al.* (2022) found that adding TUR to the broiler diet did not affect plasma TP and plasma Alb, alpha 2 globulins, the A/G ratio, or beta globulin when compared to the control group. According to Qasem *et al.* (2015) the chickens treated with TUR had considerably higher serum globulin levels than the control group.

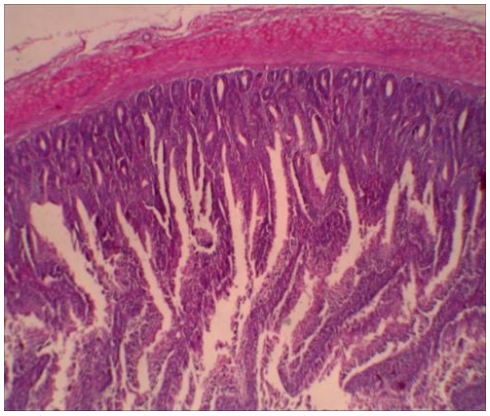
Effect of turmeric powder on histological aspects of jejunum: -

The gut morphology characteristics of broiler chicken-fed diets_ enriched with different levels of TUR are shown in Table 6 and Fig.1. The jejunum of birds fed TUR-enriched diets (4.0 and 6.0 g/kg) showed a significant increase in villus height compared with the other groups at 6 weeks of age. Likely, the jejunum of birds fed TUR-fortified diets at a level of 6.0 g/kg was found to have a significantly increased villus width compared to the other groups.

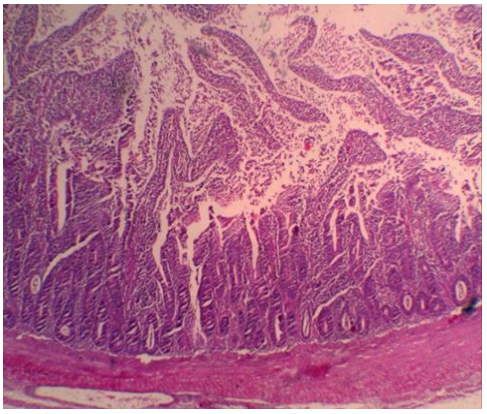
Table 6. Effect of dietary supplementation of turmeric powder on villus height, villus width and crypt width in the jejunum of broiler chickens at 42 days age.

Treatments	Control (0.0 g/kg)	TUR (2g/kg)	TUR(4 g/kg)	TUR(6 g/kg)	Pooled SEM	p-value
villus height µm	649.6^{b}	633.7^{b}	1414^{a}	1562^{a}	71.52	0.0001
villus width µm	101.4^{b}	120.2^{ab}	135.8^{ab}	172.7^{a}	15.41	0.0298
crypt width µm	91.94	82.30	110.7	111.9	13.72	0.3698

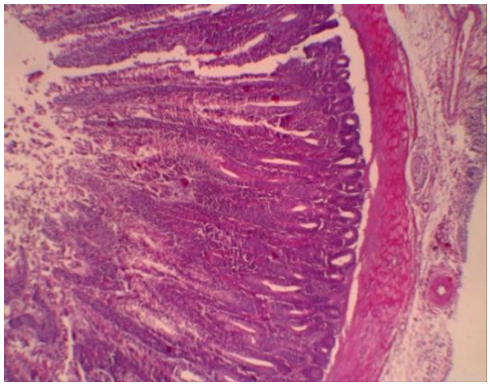
"**a-b means in the same column bearing different superscripts differ significantly (p ≤ 0.05), SEM= Standard error of the means.**



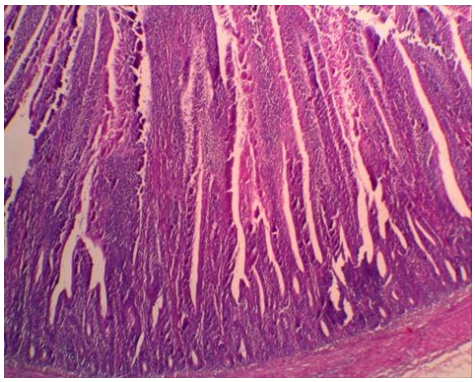
T. S. of jejunum TUR 0.0g/kg group of broilers (H & Ex 100)



T. S. of jejunum TUR 2 g/kg group of broilers (H & Ex 100)



T. S. of jejunum TUR 4 g/kg group of broilers (H & Ex 100)



T. S. of jejunum TUR 6 g/kg group of broilers (H & Ex 100)

Fig.1. showed that T. S. of jejunum for different levels supplementation of turmeric powder for broiler chickens

On the other hand, it revealed no significant differences (P>0.05) among means of crypt width in all experimental treatments. The findings of this study are consistent with those of Bondar *et al.* (2023) who discovered that the villi grew by 23.24% in comparison to the control group when 0.5% TUR was added to the feed. The mean height of the villi in the group that received 1% turmeric powder was 35.17% higher than that of the control group and 9.67% higher than that of the group that received 0.5% turmeric. The treatment group fed the highest dose of turmeric powder (1.0%) saw a considerable increase in villi length mean values, going from 947.94 micrometers in the control group to 1145.77 micrometers in the treatment group Kosti *et al.* (2018). Birds fed 200 mg/kg of turmeric at 21 days had a considerably bigger diameter of the duodenal villi, but the control group and the group that also received 100 mg/kg of turmeric at 42 days had wider duodenal villi (Durrani *et al.*, 2006). Broiler chicks supplemented with TUR had longer villi and lower intestinal pH (Sieo *et al.*, 2005).

Effect of turmeric powder on microbiological traits: -

Cecal microflora counts of broiler chickens fed TUR-supplemented diets are presented in Table 7. The cecal contents of broiler chickens were enhanced due to feeding the diets containing TUR, specifically affecting the populations of a total bacterial count, a total coliform account (*E.coli*) and Salmonella (Table 7). These findings indicated that the inclusion of TUR led to a numerical decrease in the count of coliform bacteria compared to the control group. While the cecal contents of broiler chickens fed supplemented TUR was

free of salmonella bacteria compared to the control group which contained salmonella bacteria. However, feeding the TUR-containing diets resulted in a numerical increase in the total viable bacterial count compared with the control group. These findings agreed with the earlier findings of Ürüşan and Bölükbaşı (2017) when compared to the other groups of birds, the group fed the feed supplemented with 2 g/kg turmeric powder had a greater colony-forming unit of lactic acid bacteria. The groups of birds fed diets supplemented with 6, 8, and 10 g/kg of turmeric powder had the lowest *E. coli* concentration, However, the highest levels of E. coli were seen in the birds that were fed the control diet and the diet enhanced with 10 mg/kg of antibiotic. According to Samarasinghe *et al.* (2003), broiler duodenal coliform bacteria were decreased by dietary turmeric powder. Considering the overall findings, turmeric powder may control gut microbiota by reducing the activity of some harmful bacteria to improve nutrient absorption.

Table 7. Effect of dietary supplementation of turmeric powder on cecal microbial characteristics of broiler chickens at 42days of age

Treatments	Control (0.0 g/kg)	TUR (2g/kg)	TUR(4 g/kg)	TUR(6 g/kg)
Total bacterial countLog (CFU/g)	8.59	8.69	9.42	9.00
Total coliform countLog (CFU/g)	7.91	5.76	6.37	6.02
Total coliform count (%)	92.11	66.32	67.66	66.87
Salmonella sp.Log (CFU/g)	3.48	Free/g	Free/g	Free/g

Used method: Plate count method Media used: Nutrient agar was used for total bacterial count. MacConkey agar was used for total coliform. SS agar was used for *Salmonella* count.

CONCLUSION

It was determined that adding TUR to the diet improved the performance of broiler chickens in terms of production, total protein, high-density lipoprotein (HDL), low-density lipoprotein (LDL), malondialdehyde, gut morphology, and microbiological traits when compared to the birds that did not receive the supplement.

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تأثير التغذية على مستويات من مسحوق الكركم على الأداء الإنتاجي وخصائص الذبيحة ومقاييس الدم وهستولوجيا الصائم والميكرو فلورا المعوية لدجاج التسمين

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الملخص

تهدف هذه الدراسة إلى تقييم التأثير الغذائي لمستويات مختلفة من مسحوق الكركم على أداء النمو، والأداء الإنتاجي ومقاييس الدم والاستجابة المناعية، ومضادات الأكسدة، ومورفولوجيا الأمعاء في كتاكيت التسمين خلال فصل الشتاء من (ديسمبر2023 الي يناير 2024). تم توزيع 160 كتكوت عشوائياً إلى أربع مجموعات، بحيث كل مجموعة تحتوي على 4 مكررات وكل مكرره تحتوي على 10كتاكيت تسمين حيث تم تغذية كل مجموعة على نظاماً غذائياً يحتوي على مستويات مختلفة من مسحوق الكركم (0، 2، 4، 6 جرام/كيلوجرام عليقة). أظهرت النتائج أن إضافة مسحوق الكركم أدت إلى زيادة وزن الجسم الكلي وزيادة في معدل الوزن الكلي في كتاكيت التسمين خلال فترة التجربة والذي تم تغذيته على (4 و6 جرام/كيلوجرام) من مسحوق الكركم مقارنة بالمجموعة الكنترول. ومع ذلك، لم يكن هناك تأثير معنوى على معدل استهلاك العلف أو كفاءة التحويل الغذائي خلال فترة التجربة بأكملها. من ناحية أخرى، لوحظ انخفاض كبير في مستويات الكوليسترول منخفض الكثافة LDL وMDA في سيرم الدم لكتاكيت التسمين التي غذيت بمستويات مختلفة من الكركم مقارنة بالمجموعة الكنترول. ومع ذلك فان كتاكيت التسمين التي غذيت على مسحوق الكركم بمستوى 6 جرام/كيلوجرام سجلت أعلى مستويات من البروتين الكلي والكوليسترول عالي الكثافة HDL في الدم مقارنة بمجموعة الكنترول. أظهرت الأمعاء الدقيقة بمنطقة الصائم لكتاكيت التسمين التي تم تغذيتها بمسحوق الكركم بمستوي (4 و6 جرام/كيلوجرام) زيادة كبيرة في طول الزغبات مقارنة بالمجموعات الأخرى. في حين لوحظت زيادة عددية في العدد الإجمالي للبكتيريا الحية النافعة بمنطقة الأعور مقارنة بالمجموعة الكنترول. خلصت الدراسة إلى أن الإضافات الغذائية التي تحتوي على الكركم حسنت الأداء والإنتاجية والحالة الصحية لدجاج اللحم.