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EFFECTS OF BLACK PEPPER (*PIPER NIGRUM*) AS FEED ADDITIVES ON GROWTH PERFORMANCE, CARCASS TRAITS, SOME BLOOD PARAMETERS AND GUT MORPHOLOGY IN BROILER CHICKENS

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ABSTRACT: Black pepper (*Piper nigrum*) is one of the most used spices. It is prized for having a unique, sharp flavor that is ascribed to alkaloid piperine. The current study aimed to determine how different dosages of black pepper powder (BPP) affected the immune system, gastrointestinal morphology, microbiological characteristics, growth performance, blood profiles, and antioxidant status in broiler chickens. Four experimental diets defined as (2.5, 5.0 and 7.5 g BPP /kg) were fed to 160 broiler chicks, randomly dispersed into 16 replicates, to have four replicates per treatment and 10 chicks per replicate. Measurements were made of growth performance, gut morphology, blood parameters, and slaughter tests. The results showed that dietary supplementation of different levels of BPP (2.5, 5.0 and 7.5 g/kg) led to a significant increase in body wight gain (BWG) of broiler chickens during the whole experimental period compared to the control group. While there were no significant effects on the feed intake of broiler chicks, the group fed 7.5g/kg BPP had the best feed conversion ratio (FCR) compared to the control group during the whole experimental period. On the other hand, significantly lower serum levels of cholesterol, low-density lipoprotein (LDL) and malondialdehyde (MDA) were recorded for broiler chickens supplemented with various levels of BPP compared with the control group. However, significantly highest serum levels of total protein and globulin were registered for bird supplementation with BPP at (5.0 and 7.5 g/kg) compared with the control group. The jejunum of birds fed BPP-enriched diets (2.5 and 5.0 g/kg) showed a significant increase in villus height compared with the control group. On the other hand, Feeding the BPP-containing diets resulted in a numerical increase in the total viable bacterial count compared with the control group. It is concluded that dietary supplements with BPP enhanced the performance and health status of broiler chickens.

Key Words: Chicken, Performance, Blood, gut microbiological, hematological, black pepper

INTRODUCTION

The growth performance of broiler chickens has been enhanced by the widespread use of herbs or phytogenic materials as feed additives. In addition to their crucial role in improving the flavor, scent, and colour of food for everyday human consumption, medicinal herbs, aromatic plants, and spices have also been effectively employed in animal nutrition to increase the health and well-being of animals. Alternative growth promoters must be discovered since the use of antibiotics in animal nutrition is prohibited due to the development of microbial resistance (Steiner, 2009). Black pepper (*Piper nigrum*) is one of the most used spices. It is prized for having a unique, sharp flavor that is ascribed to the alkaloid piperine. In addition to being utilized in human diets, black pepper has several other uses, including medicine, preservation, and fragrance. Numerous physiological benefits of black pepper, its extracts, or its main active ingredient, piperine, including improved pancreatic digestive enzyme stimulation, increased digestive capacity, and a markedly shorter gastrointestinal meal transit time Srinivasan (2007). The spicy flavor of black pepper has made it a popular spice. It was discovered that black pepper increased feed digestibility (Moorthy *et al.,* 2009). The flowering vine known as black pepper (*Piper nigrum*), which is a member of the genus Piper, family Piperaceae, and species Piper nigrum, is taken from the center of a pepper plant. Glutathione peroxidase and glucose-6-phosphate dehydrogenase are abundant in black pepper (Karthikeyan and Rani, 2003). Black pepper seeds have long been known to offer antioxidant and radical-scavenging qualities (Gülcin, 2005). In addition to other minerals, piperine can improve the absorption of beta-carotene, curcumin, vitamin B complex, and selenium (Khalaf *et al.,* 2008; Tazi *et al.,* 2014). According to Orav *et al.* (2004) black pepper is a spice that has been shown to have antibacterial and antioxidant qualities in addition to its capacity to increase the secretions of pancreatic and stomach enzymes, which improves digestibility and provides other health advantages. The study by Abou-Elkhair *et al.* (2014) demonstrated that adding black pepper to poultry diets improved health status by raising serum globulin content. The purpose of this study was to look at how black pepper affected the blood lipid profile and nutritional productivity of broiler chickens.

MATERIALS AND METHODS

Between December 2023 and January 2024, the study was carried out at a private poultry farm in Egypt's Dakhaliah Governorate. The goal of the current study was to assess how black pepper powder affected the microbiological characteristics, intestinal morphology, production performance, carcass yield, and certain blood parameters of broiler chickens.

The experiment's administration and design:

Four treatment groups, each with four replicates (pens floor), were created from 160 one-day-old Ross 308 broiler chickens. A control group (0.0%) and groups receiving 2.5, 5.0, and 7.5 g/kg of black pepper powder were among the dietary treatments. The experiment lasted 42 days, with 40 birds in each treatment group. The broilers were housed on a 1.0 m^2 pen floor, measuring 100 cm in length and 100 cm in width. They were fed their experimental meals according to a dietary schedule until 42 days old. From day 1 to day 21, the chickens were fed a starter diet (3150 kcal of ME/kg of feed, 23% CP). From day 21 to day 42, they were fed a grower diet (3150 kcal of ME/kg of diet, 21% CP). The criteria of NRC (1994) for broiler chicken nutrition were followed in the formulation of experimental diets. Fresh water and feed (in the form of mash) were freely available to the bird. The composition of the experimental diets is shown in Table 1.

Performance of broiler chickens:
Throughout the trial, weekly measurements of live body weight (LBW), body weight growth (BWG), and feed intake (FI) were made based on a replication group. Consequently, a gramme feed: gramme gain ratio was used to compute the feed conversion ratio (FCR). At the start of the experiment and at weekly intervals until its conclusion, the chickens were weighed (in grammes) in the early morning before being given any feed or water. Additionally, weekly data on bird FI and BWG were computed on a replicate group basis.

Carcass traits:
Three birds per treatment were randomly selected for slaughter at the end of the trial (42 days of age) to collect their liver, gizzard, heart, and lymphoid organs (spleen, bursa of Fabricius, and thymus). Weighing these organs allowed us to calculate their percentage of the live body weight.

Biochemical analysis and blood collection: Blood samples were taken in tubes during slaughter and centrifuged for 15 minutes at 4000 rpm. Additionally, the obtained serum was kept at -20°C until it was analyses. 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 used to measure immunoglobulins IgG.

Intestinal morphometric measurement:
Morphometric measurements of the jejunum, including crypt width, villus width, and villus height, were measured (Langhout *et al.*, 1999). On day 42, three birds were decapitated and slaughtered from each treatment group. To measure the gut's morphology, 3 cm sections of the jejunum—more precisely, the middle of the pancreatic loop—were then 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 carried out using the methods described by Iji *et al*. (2001). Haematoxylin and eosin were used to stain the carefully prepared paraffin slices, which had a diameter of 6μm, from samples. These sections were examined under a light microscope to estimate the crypt width, villus height, and villus width. The length of the intestinal villi and the depth of the intestinal crypt were measured using a linear scaled graticule.

Cecal microflora concentration measurement:
The one-gram composite cecal sample from each pen was diluted with nine ml of a 0.9% saline solution and fully combined with a vortex. To ascertain the number of live bacteria present in the cecal samples, three distinct kinds of agar plates were plated with repeated 10-fold dilutions (in 1% peptone solution). 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). Difco Laboratories, Becton, Dickinson and Company, situated in Sparks, Maryland, is the text source cited above. Salmonella, Escherichia coli, and Lactobacillus were to be separated using these plates. Lactobacilli MRS agar plates were then incubated for 48 hours at 37 °C under anaerobic conditions. On the other hand, the Salmonella Shigella and Macconkey agar plates were incubated for 24 hours at the same temperature under aerobic circumstances. Following the incubation period, the Twin Room Incubator (DS-12B, Dasol Scientific Co. Ltd., Hwaseoung, South Korea) was quickly removed, and the Lactobacillus, E. Coli, and Salmonella colonies were enumerated. The color 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 used to perform statistical analysis on the collected data (SAS, 2006). The Tukey multiple-range test was used to find significant differences between means (Tukey, 1977).

RESULTS AND DISCUSSION

Effect of black pepper on the Growth performance of broiler chicks: -

The effects of feeding diets supplementation with BPP on the growth performance of broiler chickens from one to 42 days of age are given in Table 2. In the present study, dietary supplementation of different levels of BPP (0.0, 2.5, 5.0 and 7.5 g/kg) had no significant effects on the LBW of broiler chickens during the whole experiment period between all groups except LBW at 21 days of age the control group was highest weight compared with group supplementation with higher level of BPP 7.5 g/kg (Table 3). As shown in Table 2, it was observed that dietary supplementation of different levels of BPP (2.5, 5.0 and 7.5 g/kg) led to a significant increase ($P\leq 0.01$) in TBWG of broiler chickens during the whole experimental period compared to the control group. Significant differences were likely between the birds fed the diet fortified 7.5 g/kg BPP on BWG 3rd and BWG 4th compared with the control group. Feeding the diets supplemented with different levels of BPP had no significant effects on the FI of broiler chicks in all weeks of the study and during the whole experimental period except the feed intake in the 4th wk was found the lowest consumption in the control group compared with the other groups (Table 2). The effect of different levels of BPP had significant effects ($P\leq 0.05$) on the FCR of chicks during the 3rd, 6th and TFCR 0-6wk of age between all groups (Table 2). On the other hand, the group fed 5g/kg BPP had the best FCR compared to the control group during the whole experimental period. Black pepper powder had a substantial impact on body weight, which was consistent with other investigations that found supplementing broiler chickens with black pepper powder improved their body weight gain (Ghazalah *et al.,* 2007). According to Abaza *et al.* (2008), broiler chickens fed 0.1% black pepper oil at 4 weeks of age showed improvements in live weight and weight gain, demonstrating the value of black pepper as a growth-promoting ingredient. According to Abou-Elkhair *et al.* (2014) broiler chickens that were fed a meal containing black pepper and the combination of black pepper and turmeric powder had greater ultimate body weights after 35 days of fattening. According to Ndelekwute *et al.* (2016) broiler chicken diets supplemented with 0.75 and 1% black pepper had lower final body weights and higher FCR values than those supplemented with 0, 0.25, and 0.5%. According to Ndelekwute *et al.* (2015), there was an important relationship between feed consumption and final live weight, compared to the control group, BPP at 0.25 and 0.50% resulted in higher body weight. Live weight significantly decreased at 1.00%, and feed intake was adversely influenced by 1.0% BPP; nevertheless, the feed:gain ratio did not alter significantly ($P>0.05$). The results of BPP supplementation on broiler BW improvement were comparable to those of Ghazalah *et al.* (2007), Tollba *et al.* (2007), and Mansoub (2011). Additionally, Akbarian *et al.* (2012) found that BPP did not affect the BWG of male broilers throughout several weeks.

Effect of Black pepper powder on carcass characteristics and lymphoid organs weights of broiler chickens: -

Table 3 demonstrates the results of adding various levels of BPP to the diet of broiler chickens on their relative weights of carcass characteristics and lymphoid organs (spleen and bursa of Fabricius). It revealed no significant differences (P>0.05) among means of carcass yield %, heart %, liver %, gizzard%, and bursa of Fabricius % in all experimental treatments. These findings concurred with Abou-Elkhair *et al*. (2014) that reported the relative weight (% BW) of the gizzard, heart, spleen, thymus gland, and bursa of Fabricius did not significantly differ across the groups, indicating that the addition of BP to the diet did not influence these carcass characteristics. Al-Kassie and Witwit (2010) and Al-Kassie *et al*. (2012) found no difference in dressing %, gizzard, or heart when using herbal plants, which is consistent with our findings. Furthermore, Mansoub (2011) found that broilers fed a diet enriched with 1% BPP had a higher proportion of liver weight. According to Hernandez *et al*. (2004) adding aromatic herbs to chicken has stimulatory effects on the digestive system by stimulating the generation of digestive enzymes and enhancing liver function, which improves the utilization of digestive products. According to Singh *et al*. (2018) black pepper powder did not affect the carcass features or the amount of fat in the abdomen of broiler chickens.

Effect of black pepper powder on blood serum biochemical parameters: -

Results on blood serum biochemical parameters of broiler chickens fed diets supplemented with different levels of BPP are illustrated in Table 4. Feeding diets supplemented with diverse levels of BPP had no significant effect (P>0.05) on serum concentrations of Alb, Trig, HDL, ALT, AST and immunoglobins IgG among the experimental groups. However, significantly lower serum levels of cholesterol, LDL and MDA were recorded for broiler chickens supplemented with various levels of BPP (2.5, 5.0 and 7.5 g/kg) compared with the control group. On the other hand, significantly highest serum levels of total protein and globulin were registered for bird supplementation with BPP at (5.0 and 7.5 g/kg) compared with the control group. Our results contrast with those of the study by Abou-Elkhair *et al.* (2014) which found that adding black pepper to broiler diets improved health status by raising serum globulin concentration. According to Ghaedi *et al.* (2014) adding black pepper to broiler chickens raised their HDL concentration while lowering their triglycerides and total cholesterol. Additionally, adding varying doses of black pepper (ranging from 0.25 to 1%) to the broiler diet resulted in lower blood cholesterol and other blood biochemical markers (AL-Kassie *et al*., 2012). According to Puvača *et al*. (2015) the control group's chicken blood had the highest levels of triglycerides, total cholesterol, LDL, and non-high-density lipoprotein, with significant ($p < 0.05$) differences from the treatments that included black pepper powder. The control group had the notably lowest level of high-density lipoproteins (HDL). In vitro tests have shown that piperine prevents oxidative damage by preventing lipid peroxidation, squelching reactive oxygen species, and preventing free radicals (Mittal and Gupta, 2000). As demonstrated by copper ion-induced lipid peroxidation of human LDL, which measures the formation of thiobarbituric acid reactive substance and the relative electrophoretic mobility of LDL on agarose gel, piperine is an effective antioxidant that protects against the oxidation of human low-density lipoprotein (Naidu and Thippeswamy, 2002).

Effect of black pepper powder on histological aspects of jejunum: -

The gut morphology characteristics of broiler chicken-fed diets_ enriched with different levels of BPP are shown in Table 5 and Fig.1. The jejunum of birds fed BPP-enriched diets (2.5 and 5.0 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 BPP-fortified diets at level 2.5 g/kg found a significantly increased villus width compared to the other groups. Still, there was no significant difference between groups (2.5, 5.0 and 7.5 g/kg BPP). On the other hand, significantly the deepest crypt registered for bird supplementation with BPP at 7.5 g/kg compared with other groups. This study's findings are consistent with those of Hosseini (2011) who demonstrated that black pepper improves digestion by stimulating stomach contents and eliminating harmful microorganisms. Black pepper improves digestive enzymes, reduces material transit velocity, and influences absorption power. Piperine, the most potent ingredient in black pepper, supports pancreatic digestive enzymes that are crucial to digestion, including lipase, amylase, and proteases (Platel and Srinivasan, 2000). Additionally, Platel and Srinivasan (2001) found that supplementing with piperine improved digestion and decreased the amount of time feed passed through the digestive tract. Thus, the mechanisms may be responsible for the enhancement of broiler performance with dietary supplementation of BPP. The structure and integrity of the intestinal epithelium are crucial for the digestion, absorption, and general health of the gut (Soumeh et al., 2019). Since intestinal villi serve as the primary site for nutrient absorption, longer villi may indicate a greater surface area, which can improve the capacity to absorb nutrients, while deeper crypts may indicate rapid cellular turnover and tissue regeneration processes because of pathogen-induced tissue damage (Jazi et al., 2018).

Effect of black pepper powder on microbiological traits: -

Cecal microflora counts of broiler chickens fed BPP-supplemented diets are presented in Table 6. The cecal contents of broiler chickens were enhanced due to feeding the diets containing BPP, specifically affecting the populations of a total bacterial count, a total coliform account (*E. coli*) and Salmonella (Table 6). These findings indicated that the inclusion of BPP 2.5 g/kg led to a numerical decrease in the count of coliform bacteria compared to other groups. While the cecal contents of broiler chickens fed supplementation BPP was free of salmonella bacteria compared to the control group which contained salmonella bacteria. However, feeding the BPP-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 Chowdhury *et al*. (2018) many phytogenic feed additives have antibacterial action against intestinal pathogens like E. coli and coliform in vivo. Furthermore, several in vivo investigations have shown that black pepper essential oil has strong antibacterial properties against harmful *Staphylococcus* and *Escherichia coli* (Abdallah and Abdolla, 2018; Zhang *et al.,* 2017).

CONCLUSIONS

Adding black pepper to broiler chicken nutrition benefits production performance, according to the results collected. In comparison to a control group, the addition of 2.5 to 7.5 g/kg g of black pepper has resulted in the greatest final body weights, the lowest feed conversion ratio, and the highest feed utilization. Additionally, the fact that this spice herb supplementation significantly reduced LDL and plasma cholesterol in a broiler diet suggests that black pepper was successful in controlling lipid metabolism. Thus, the overall conclusion would be that the addition of black pepper improved the microbiological characteristics, intestinal morphology, blood lipid profile, and chicken output of broiler chickens.

Table (1): Composition and Calculated Analysis of the Basal Diets

Ingredients (%)	Starter	Grower
Yellow corn	61	65
Soybean meal 44	17.7	18.17
Corn Gluten Meal 60.2	15.6	11.7
Di calcium 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	21.0038
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.

Table (2): Effect of black pepper powder supplementation on performance of broiler chickens at different ages.

Performance Criteria	**Dietary Levels of Black Pepper (g/kg)**				**Pooled SEM**	**P Value**
	0.0	**2.5**	**5.0**	**7.5**		
LBW(g):						
LBW:1-D	42.7	42.9	43.0	42.5	0.214	0.4376
LBW:7-D	123.1	127.2	126.2	124.0	2.753	0.7112
LBW:14-D	344.7	346.5	362.2	336.0	8.951	0.2670
LBW:21-D	695.6^{a}	695.6^{a}	699.3^{a}	620.6^{b}	14.96	0.0073
LBW:28-D	1017	1082	1090	1042	18.89	0.0573
LBW:35-D	1691	1792	1799	1809	28.97	0.0557
LBW:42-D	2275	2433	2478	2472	34.18	0.0539
BWG(g):						
BWG1StWK	80.62	83.97	83.13	81.67	2.706	0.8215
BWG2ndWK	221.6	219.3	236.0	211.9	8.578	0.2961
BWG3rdWK	350.8^{a}	349.1^{a}	337.1^{a}	284.6^{b}	10.66	0.0026
BWG4thWK	321.3^{b}	386.8^{ab}	390.6^{ab}	421.8^{a}	19.97	0.0251
BWG5thWK	674.2	710.0	709.5	767.0	24.48	0.1132
BWG6thWK	584.2	641.0	679.0	662.8	30.02	0.1834
TBWG:0-6WK	2232^{b}	2390^{a}	2435^{a}	2429^{a}	34.13	0.0039
FI(g):						
FI:1StWK	153.2	139.4	140.9	146.7	4.901	0.2325
FI:2ndWK	338.2	363.9	364.5	376.8	13.53	0.2806
FI:3rdWK	540.1	520.0	529.7	528.1	16.05	0.8486
FI:4thWK	605.4^{b}	701.8^{a}	710.3^{a}	723.8^{a}	5.505	0.0001
FI:5thWK	1136	1152	1089	1156	31.26	0.4354
FI:6thWK	1095	1095	1109	1051	24.86	0.4227
TFI:0-6WK	3868	3972	3943	3983	57.83	0.5146
FCR(g:g):						
FCR1StWK	1.907	1.662	1.697	1.800	0.074	0.1413
FCR2ndWK	1.530	1.677	1.547	1.790	0.098	0.2598
FCR3rdWK	1.540^{b}	1.492^{b}	1.577^{b}	1.857^{a}	0.044	0.0003
FCR4thWK	1.890	1.820	1.880	1.717	0.118	0.7235
FCR5thWK	1.695	1.620	1.535	1.510	0.045	0.0529
FCR6thWK	1.877^{a}	1.710^{ab}	1.652^{ab}	1.587^{b}	0.059	0.0266
FCR0-6WK	1.735^{a}	1.662^{ab}	1.620^{b}	1.640^{ab}	0.026	0.0476

a-b Means in the same row with different superscripts differ significantly ($P \leq 0.05$)

Table (3): Impact of black pepper powder supplementation on carcass traits lymphoid organs of broiler chickens at marketing age.

Treatments	Levels of Black Pepper (g/kg)				Pooled SEM	p-value
	0.0	2.5	5.0	7.5		
LBW (g)	1983	1983	1966	2000	38.18	0.941
Carcass yield (%)	70.6	71.6	70.4	71.8	1.789	0.9303
Carcass (%)	65.3	66.9	65.8	66.9	1.756	0.886
Heart (%)	0.67	0.63	0.57	0.55	0.034	0.121
Liver (%)	2.70	2.52	2.46	2.57	0.258	0.922
Gizzard (%)	1.92	1.51	1.61	1.76	0.118	0.161
Giblets (%)	5.29	4.67	4.65	4.88	0.319	0.4971
Spleen (%)	0.22^{a}	0.15^{b}	0.12^{b}	0.15^{b}	0.010	0.001
Bursa (%)	0.04	0.05	0.04	0.04	0.002	0.801
Thymus (%)	0.35	0.30	0.39	0.31	0.066	0.8071

a-bMeans in the same row with different superscripts differ significantly ($P\leq 0.05$)

Table (4): Effect of black pepper powder supplemented diet on some blood parameters of 42-day-old broiler chicks

Main effects	Control	BPP (2.5g/kg)	BPP (5.0 g/kg)	BPP (7.5g/kg)	Pooled SEM	P value
Tp (g/dl)	3.683^{b}	5.090^{ab}	5.196^{ab}	5.296^{a}	0.339	0.030
Alb (g/dl)	2.166	2.873	2.873	2.833	0.189	0.075
globulin (mg/dl)	1.516^{b}	2.216^{ab}	2.323^{a}	2.463^{a}	0.156	0.011
Trig (mg/dl)	72.67	100.6	83.33	101.6	9.337	0.157
Chol (mg/dl)	134.3^{a}	109.0^{b}	98.33^{b}	106.6^{b}	5.123	0.005
HDL (mg/dl)	38.33	47.33	41.00	44.33	2.291	0.099
LDL (mg/dl)	81.46^{a}	41.53^{b}	40.66^{b}	42.00^{b}	3.043	0.0001
ALT (U/L)	18.14	9.847	12.21	15.07	2.251	0.129
AST (U/L)	227.4	155.5	203.5	187.4	33.47	0.522
TAC (mM/l)	0.563^{b}	0.766^{a}	0.756^{a}	0.800^{a}	0.041	0.014
MDA (nmol/ml)	42.33^{a}	35.03^{ab}	32.10^{b}	28.66^{b}	1.763	0.003
IgG (mg/dl)	79.96	101.5	87.26	92.70	6.000	0.153

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

Table (5): Effect of dietary supplementation of black pepper on villus height, villus width and crypt width in the duodenum of broiler chickens at 42 days age.

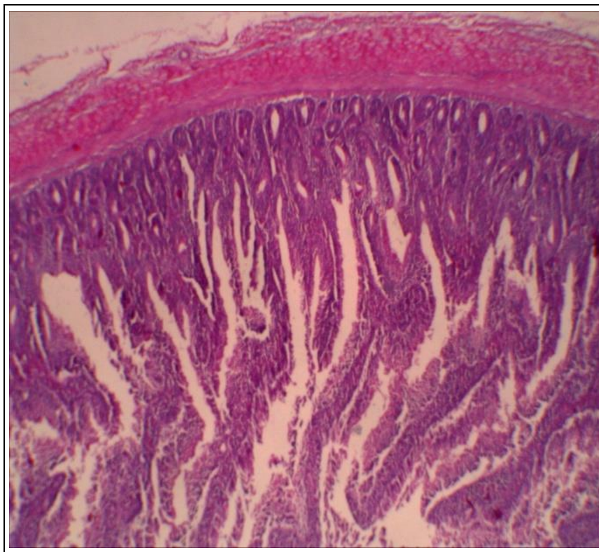
Treatments	Control (0.0 g/kg)	BPP (2.5g/kg)	BPP (5.0 g/kg)	BPP (7.5 g/kg)	Pooled SEM	p-value
villus height µm	649.6^{b}	1218^{a}	1253^{a}	741.9^{b}	93.73	0.0003
villus width µm	101.4^{b}	174.1^{a}	133.5^{ab}	143.7^{ab}	16.00	0.0398
crypt width µm	91.94^{ab}	79.25^{b}	86.87^{b}	126.0^{a}	8.926	0.0095

a-b means in the same row bearing different superscripts differ significantly ($p \leq 0.05$), SEM= Standard error of the means

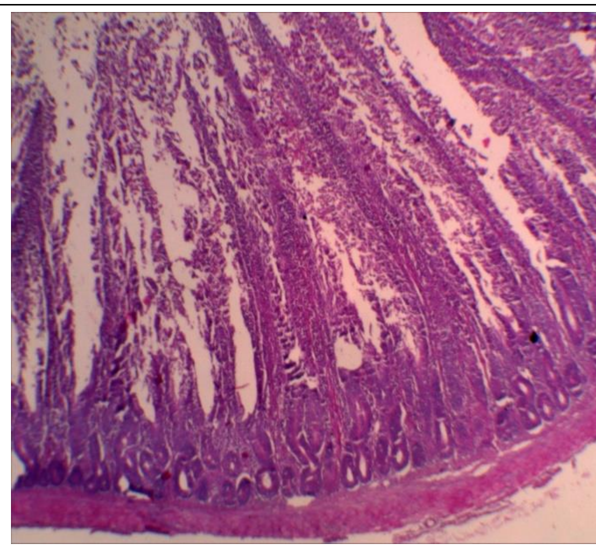
Table (6): Effect of dietary supplementation of black pepper powder on microbial characteristics of broiler chickens at 42days of age.

Treatments	Control	Black Pepper 0.25 %	Black Pepper 0.50%	Black Pepper 0.75%
Total bacterial countLog (CFU/g)	8.59	9.57	9.23	8.76
Total coliform countLog (CFU/g)	7.91	7.67	8.01	8.09
Total coliform count (%)	92.11	80.13	86.77	92.39
Salmonella sp. Log (CFU/g)	3.48	Free/g	Free/g	Free/g

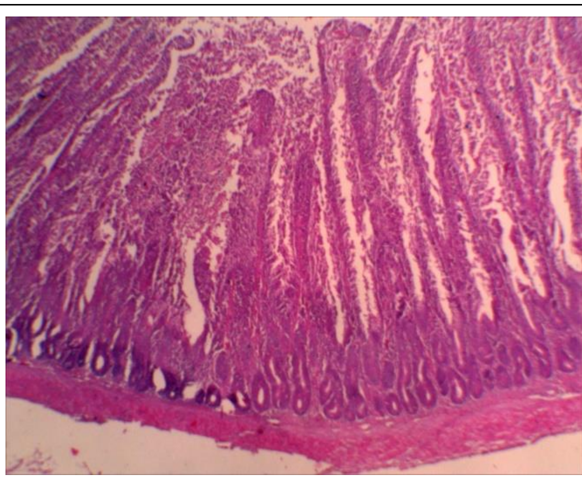
Fig. (1): showed that T. S. of jejunum for different levels supplementation of black pepper powder for broiler chickens



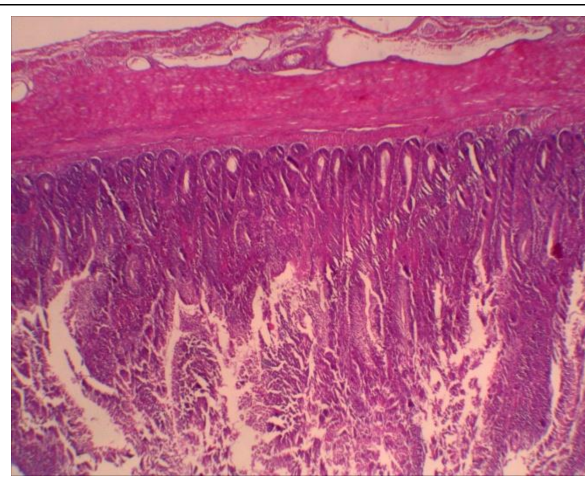
T. S. of jejunum BPP 0.0g/kg group of broilers (H & Ex 100)



T. S. of jejunum BPP 2.5 g/kg group of broilers (H & Ex 100)



T. S. of jejunum BPP 5.0 g/kg group of broilers (H & Ex 100)



T. S. of jejunum BPP 7.5 g/kg group of broilers (H & Ex 100)

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الملخص العربى

تأثير الفلفل الأسود كإضافة غذائية على الأداء الإنتاجي ومقاييس الذبيحة وبعض مقاييس الدم ومورفولوجيا الأمعاء في كتاكيت التسمين.

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يعد الفلفل الأسود أحد التوابل الأكثر استخدامًا ويتميز بطعمه اللاذع الذي يعزى إلى مادة البيبيرين القلوية. تهدف هذه الدراسة إلى دراسة تأثير مستويات مختلفة من الفلفل الأسود على أداء النمو، والخصائص الدموية، والاستجابة المناعية، ومضادات الأكسدة ومورفولوجيا الأمعاء، والخصائص الميكروبية في دجاج التسمين. تم تقسيم 160 كتكوت تسمين عشوائيًا إلى 16 مكرره، بواقع أربع مكررات لكل معاملة وبحيث تحتوي على 10 كتاكيت تسمين لكل مكرره. تم تغذية كل مجموعة على علف يحتوي على مستويات مختلفة من مسحوق الفلفل الأسود (2.5، 5.0، 7.5 جم/كجم). تم قياس أداء النمو، ونتائج الذبح، والخصائص الدموية، ومورفولوجيا الأمعاء. أظهرت النتائج أن إضافة الفلفل الأسود بمستويات مختلفة (2.5، 5.0، 7.5 جم/كجم) إلى العلف أدت إلى زيادة في الوزن النهائي للجسم خلال فترة التجربة الكلية مقارنة بالكنترول. بينما لا يوجد تأثير معنوي على استهلاك العلف لكتاكيت التسمين ووجد أن المجموعة الغذائية التي تحتوي على 7.5 جم /كجم من مسحوق الفلفل الأسود كانت أفضل في معدل التحويل الغذائي مقارنة بالمجموعة الكنترول خلال فترة التجربة الكلية. من ناحية أخرى، لوحظ انخفاض كبير في مستويات الكوليسترول والكوليسترول منخفضة الكثافة و (MDA) الذي تم تغذيته على علف يحتوي على مستويات مختلفة من الفلفل الأسود مقارنة بالمجموعة الكنترول. من ناحية أخري، لوحظ ارتفاع كبير في مستويات البروتين الكلي والجلوبولين في الدم للكتاكيت التي تم تغذيته على علف يحتوي على جرعات 5.0 و7.5 جم/كجم من الفلفل الأسود مقارنة بالمجموعة الكنترول. كما أظهرت العلائق الغنية بمسحوق الفلفل الأسود بمستويات 2.5 و5.0 جم/كجم زيادة معنوية في طول الخملات مقارنة بمجموعة الكنترول في منطقة الصائم بالأمعاء. كما أدت إضافة الفلفل الأسود إلى زيادة عدد البكتيريا الحية الكلية مقارنة بالمجموعة الكنترول. لخصت الدراسة إلى أن إضافة الفلفل الأسود إلى علف كتاكيت التسمين حسّنت من الأداء الإنتاجي وحالتها الصحية