Journal of Animal and Poultry Production

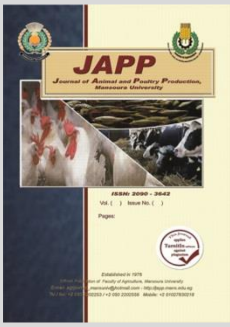
Journal homepage & Available online at: www.jappmu.journals.ekb.eg

Effect of Dietary Supplementation of Hot Red Pepper on Growth Performance, Carcass Characteristics, Blood Parameters, Microbiological Traits and Physiological Status of Broiler Chicks

Cross Mark

El-Gogary, M. R.* ; Tork M. Dorra and H. R. Khalil

Department of Poultry Production, Faculty of Agriculture, Mansoura University, 35516, Egypt



ABSTRACT

The present study aimed to determine the effects of inclusion different levels of hot red pepper (HRP) in broiler chickens diets on growth performance, physiological status, carcass traits and blood parameters of broiler chicks. One hundred and twenty-one-day-old Avian 48 broiler chicks were randomly split up into four treatment groups, with three replications in each group. Four HRP levels (0.0, 3.0, 5.0, and 7.0%) were included in both starter and grower diets and fed to the experimental groups of chicks from day-old to 42 days of age. There were no discernible variations in the production performance between the control group and the group fed the 3.0% HRP-supplemented diet during the whole experimental period. The results revealed no significant differences in most carcass traits among all experimental treatments. Compared to other treated groups, broilers fed 3.0 or 5.0 % RHP-supplemented diets led to significant reductions in serum levels of total antioxidant capacity, IgM and activity of ALT. Most hematological parameters of broilers, tested herin, were not affected by dietary supplementation with HRP. The dietary inclusion of 5.0% HRP in broiler diet resulted in a considerable drop in both the overall bacterial count and the count of coliform bacteria (Mackoncy and S.S.) compared to the other treated groups. When compared to the control group, the duodenum of birds fed HRP-enriched meals displayed slightly higher villus height during finisher phases. According to the current findings, broiler chicken productivity and gut histology responses are positively impacted by supplementing the diet with 3% HRP.

Keywords: Hot red pepper, broiler chickens, growth performance, carcass characteristics, blood parameters.

INTRODUCTION

For decades, the use of antibiotics in livestock farming has become a common practice to treat and enhance animal health and performance(Swelum *et al*., 2021).In 2006, the European Commission has banned the use of antibiotics as growth enhancers in animal feed due to the risk of the ongoing discovery of new antibiotic resistance mechanisms in various bacteria. Since spices are natural, non-toxic, residue-free, and easily accessible, they are highly accepted as natural feed additives.Hot red pepper (HRP), known also as chili pepper, is one of the most important spices (*Capsicum annuum* L.) in human nutrition(Singletary, 2011).In addition to its heat stress-lowering effects and enhancing feed digestibility, HRP can improve growth performance and carcass characteristics and can reduce the mortality in broiler chickens(Munglang and Vidyarthi,2019).They also stated that capsaicin is the main active substance responsible for the hot effects of various species of the hot red peppers.

Capsaicinhas several pharmacological and biochemical properties such as anti-inflammatory, anticarcinogenic, antioxidant, and anti-allergenic activities (Munglang and Vidyarthi, 2019).The HRP and other peppers have a significant amount of capsaicinwhich gives the pepper its relevantspicy taste(El-Tazi, 2014; Fattori *et al*., 2016; Abou-Elkhair *et al*., 2018). Furthermore, reports on the antioxidant and anti-stress properties of HRP have also been made(Puvača *et al.*, 2019; Batiha *et al.*, 2020). Additionally, capsaicin can protect the mucosal layer of the gastrointestinal tract from damage induced by irritants or medications(Al-Kassie *et al.*, 2012). Because they lack receptors specific to capsaicin binding, poultry is unable to detect the pungency of capsicum, which allows for high content of capsicum in broiler diets (Puvača *et al*., 2015a). Chili peppers are a great source of carotenoids(β-carotene], vitamin C, and vitamin E. These compounds are well-known for their antioxidant properties, which help prevent the damaging effects of free radicals, such as oxidative stress in broilers, which can cause cell damage(Tawfeek *et al*., 2014). According to the findings of Luqman and Razvi (2006), capsaicin can inhibit lipid peroxidation more effectively than vitamin E. They also demonstrated that pancreatic and intestinal enzyme activity can be enhanced by capsaicin.The goal of the current study was to assess how different levels of hot red pepper affect the growth performance, carcass yield, blood metabolites, immunity, microbiological traits, and histological characterizationof the duodeni in the broiler chickens.

MATERIALS AND METHODS

The Poultry Production Farm belonging to the Centre of Agricultural Research and Experiments, Faculty of Agriculture, Mansoura University, Egypt, served as the location of this study from September to October 2022.

The experimental design and management:

One hundred and twenty Avain-48 day-old broiler chicks were divided into four treatment groups, with four

*** Corresponding author.**
E-mail address: melgogary@mans.edu.eg
DOI: 10.21608/jappmu.2024.290237.1118

replicates (pens) in each group. A control group with no supplement (0.0%) and three groups with added dietary hot red pepper (HRP) at concentrations of 3.0%, 5.0%, and 7.0% were used. The trial lasted for 42 days, with 40 birds in each treatment group. The broilers were housed in battery cages with dimensions of 70 cm length, 60 cm width, and 40 cm height. All groups of chicks were fed their respective experimental diets until they reached 6 weeks of age. According to the determined nutrient analysis of HRP powder, it contains 91.50% dry matter (DM), 16.90% crude protein (CP), 9.00% ether extract (EE), 18.90% crude fiber (CF), 9.10% crude ash and 39.09% nitrogen-free extract (NFE).

From day 1 to day 21, the chicks were fed a starter diet (about 3050 kcal of ME/kg of feed, 22.9% CP). From 3 to 6 weeks of age, the birds were fed a grower diet (around 3050 kcal of ME/kg of diet, 21% CP). According to the National Research Council (NRC,1994) guidelines, the experimental diets were designed to provide broiler chickens with the necessary amounts of nutrients. The chicks had unrestricted access to fresh water and feed (in the form of mash). The ingedient composition and calculated analysis of the experimental diets are shown in Tables 1.

Performance of Broiler Chickens:

For the duration of the study, weekly measurements of live body weight (LBW), feed intake (FI), and body weight gain (BWG) of broiler chickens were recorded, on a repllicate group basis. The ratio of feed to gain, expressed in grams was then computed to get the feed conversion ratio (FCR). At the beginning of the trial, birds in each replication were weighed in the early morning before receiving any feed or water, and then at weekly intervals therafter. The health status of birds and deaths were mononitored daily throughout the course of this study.

Carcass Traits of Broiler Chickens:

At 42 days of age, four birds from each treatment group were randomly chosen for slaughtering. After complete bleeding and feather plucking, their carcasses were eviscerated and the inedible organs were removed. Then theirindividual eviscerated carcasses (carcass yield) and edible organs (hearts, gizzards, livers), and lymphoid organs (bursa of Fabricius and spleen) were collected and weighed separately. Next, the relative weights of these organs (% of their LBW before slaughtering) were calculated.

Table 1. Ingredient composition and calculated analysis of the experimental diets fed to broiler chickens from one to 42 days of age.

Ingredients (%)	HRP Levels in starter diets				HRP Levels in grower diets			
	0.0	3.0	5.0	7.0	0.0	3.0	5.0	7.0
Yellow corn	60.00	60.04	60.10	59.91	65.20	65.07	65.10	65.17
SBM 44% CP	23.00	15.48	10.20	5.70	21.30	14.12	9.03	3.80
CGM 60% CP	11.85	16.13	19.15	21.8	9.50	13.60	16.50	19.5
DCP	1.78	1.82	1.87	1.91	1.25	1.31	1.35	1.40
Limestone	1.43	1.45	1.48	1.48	1.45	1.48	1.50	1.50
DL-Methionine	0.09	0.07	0.06	0.04	0.00	0.00	0.00	0.00
L-Lysine	0.25	0.41	0.54	0.56	0.20	0.32	0.42	0.53
NaCl	0.30	0.3	0.30	0.30	0.30	0.30	0.30	0.30
Premix**	0.30	0.3	0.30	0.30	0.30	0.30	0.30	0.30
Soybean oil	1.00	1.00	1.00	1.00	0.50	0.50	0.50	0.50
Nutrients:	Calculated Analysis (As fed basis: NRC, 1994)							
ME, kcal/kg	3051	3050	3050	3045	3056	3050	3049	3049
CP, %	22.9	22.9	22.9	22.9	21.0	21.0	21.0	21.0
Ca, %	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90
Av. P, %	0.45	0.45	0.45	0.45	0.35	0.35	0.35	0.35
Methionine %	0.51	0.51	0.51	0.50	0.39	0.40	0.42	0.43
Meth.+Cys., %	0.90	0.90	0.9	0.89	0.75	0.77	0.78	0.78
Lysine, %	1.14	1.14	1.16	1.10	1.04	1.00	1.00	1.00

****: 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.SBM= Soybean meal, CGM= Corn gluten meal, DCP= Dicalcium phosphate, CP= Crude protein and ME= Metabolizable energy.**

Blood Biochemical and Haematological Parameters:

Following the slaughter of three birds from each treatment, blood samples were taken and placed in two test tubes (one heparinized and another non-heparinized). First samples were centrifuged for 15 minutes at 4000 rpm to separate the plasma and sera. Plasma and serum samples were subsequently kept at -20°Cuntil analysis. Commercial kits were utilized to analyze blood serum biochemical parameters calorimetrically, following the manufacturer's recommendations. Blood serum concentrations of total protein (TP), albumin (Alb), glucose (Glu), triglyceride (Tri), cholesterol (Cho), high-density lipoprotein-cholesterol (HDL-C), uric acid(UA), total antioxidant capacity (TAC), immunoglobulins (IgG, IgA and IgM), malondialdehyde (MDA)and serum activity of alanine aminotransferase (ALT)and aspartate aminotransferase (AST) were determined. Haematological parameters, including the concentration of blood haemoglobin (Hb), red blood cells (RBCs), white blood cells (WBCs), packed cell value (PCV), mean corpuscular value (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelets, heterophils, lymphocytes, monocytes, and eosinophils were also measured in another set of blood samples that were collected in heparinized test tubes.

Intestinal Morphometric Measurements:

Morphometric variables including villus width andheight, and crypt width were measured in the duodenum as describede by Langhout et al. (1999). Three birds from each treatment group were slaughtered at 42days of age. Then, 3cm sections of the duodenum were taken for gut morphological measurements, precisely at the middle of the pancreatic loop. The intestinal samples that were extracted from each segment were preserved right away in formaldehyde and then placed in paraffin and Bouin's solution to be embedded. Following that, histological examinations were carried out using the protocol described by Iji et al. (2001). Hematoxylin and eosin were used to carefully produce paraffin slices, measuring 6 µm in thickness, from each sample. These sections were examined under a light microscope to estimate the villus height and width, and crypt width. The length of the intestinal villi and the depth of the intestinal crypt were measured using a linear scaled graticule.

Measurement of Cecal Microflora:

The one-gram composite cecal sample from each pen was combined well with a vortex after being diluted with nine millilitres of a 0.9% saline solution. Three distinct kinds of agar plates were plated with serial 10-fold dilutions (in 1% peptone solution) to ascertain the viable bacterial counts in the cecal samples. These comprised Salmonella and Shigella (S.S) agar plates, McConkey agar plates Anderson and Cindy (2013), and Plate count agar (PCA) Aryal and Sagar (2021). Atlas and Snyder (2006) The text source referenced above is Difco Laboratories, a Sparks, Maryland-based branch of Becton, Dickinson and Company. These plates were being used with the intention of separating *Salmonella*, *Escherichia coli*, and *Lactobacillus*. After that, the *Lactobacilli* MRS agar plates were incubated for 48 hours at 37°C under anaerobic conditions. On the other hand, for a duration of 24 hours, both the Macconkey and Salmonella Shigella agar plates were incubated under aerobic conditions at the same temperature. 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 swiftly counted. The colour appearances of the various bacterial colonies were used to identify them: *Salmonella Shigella* colonies seemed colourless, *E. Coli* colonies had a reddish-pink color, and *Lactobacillus* colonies showed a yellowish hue.

Statistical Analysis:

One-way analysis of variance was used to statistically analyze the collected data (SAS, 2006). The Tukey multiple range test was used to see whether there were any significant differences between the means(Tukey, 1977).

RESULTS AND DISCUSSION

Effect of Hot Red Pepper powder on Growth performance of broiler chicks:-

The effects of feeding diets enriched with HRP 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 HRP (0.0, 3.0, 5.0 and 7.0%) had significant effects on the LBW of broiler chickens at 7,14,21,28,35and 42 days of age (Table 2). The final LBW of 6-wk-od chicks fed diets containing 3.0% HRP was comparable to that of the control birds (Table 3). Broilers fed the higher levels of HRP (5.0 or 7.0%) exhibited significantly lower (P≤0.01) means of LBW during the first, second, third, fourth, fifth, and sixth weeks of age than those of the control group.

As shown in Table 2, it was observed that dietary supplementation of HRP at levels of 5.0 and 7.0% led to a significant reduction (P≤ 0.01) in BWG of broiler chickens in the succeeive weeks of growing period and during the whole experimental period compared to other groups (control group and 3.0% HRP-supplemented group). Feeding the diets supplemented with different levels of HRP had a significant effect(P≤0.01) on FI of broiler chicks in most weeks of study and during the whole experimental period (Table 2).

Table 2. Growth performance of broiler chickens fed HRP-supplemented diets from day-old to 6 weeks of age

Performance	Dietary levels of RHP (%)				Pooled	P
Criteria	0.0	3.0	5.0	7.0	SEM	Value
LBW (g):						
LBW: 1-d	45.83	45.96	46.00	46.00	0.273	0.9667
LBW: 7-d	151.16^{a}	156.00^{a}	130.16^{b}	117.50^{b}	4.199	0.0006
LBW: 14-d	423.16^{a}	415.16^{a}	319.66^{b}	258.66^{c}	10.542	0.0001
LBW: 21-d	811.66^{a}	720.00^{a}	556.30^{b}	486.66^{b}	20.501	0.0001
LBW: 28-d	1390.0^{a}	1288.7^{a}	1026.5^{b}	837.0^{c}	27.040	0.0001
LBW: 35-d	1963.3^{a}	1976.9^{a}	1796.3^{b}	1338.0^{c}	29.674	0.0001
LBW: 42-d	2615.0^{a}	2551.3^{a}	2218.5^{b}	1917.4^{c}	38.452	0.0001
BWG (g):						
BWG: 1stwk	105.33^{a}	110.03^{a}	84.16^{b}	71.50^{b}	4.239	0.0006
BWG:2nd wk	272.00^{a}	259.16^{a}	189.50^{b}	141.16^{c}	9.279	0.0001
BWG:3rdwk	388.50^{a}	304.83^{b}	236.63^{bc}	288.00^{c}	16.557	0.0004
BWG:4thwk	578.33^{a}	568.70^{a}	470.20^{b}	350.36^{c}	11.771	0.0001
BWG:5thwk	573.33^{b}	688.16^{a}	769.80^{a}	500.93^{b}	18.956	0.0001
BWG:6thwk	651.66^{a}	574.43^{a}	422.20^{b}	579.43^{a}	32.927	0.0070
TBWG: 0-6 wk	2569.2^{a}	2505.3^{a}	2172.5^{b}	1871.4^{c}	38.498	0.0001
FI (g):						
FI: 1stwk	156.5^{a}	163.2^{a}	127.2^{b}	127.3^{b}	6.063	0.0047
FI: 2nd wk	422.2^{ab}	442.7^{a}	396.0^{bc}	375.0^{c}	9.415	0.0046
FI: 3rdwk	636.0^{a}	618.0^{ab}	527.4^{bc}	523.0^{c}	20.308	0.0072
FI: 4thwk	907.0^{a}	921.0^{a}	793.2^{ab}	717.5^{b}	34.677	0.0093
FI: 5thwk	1102.2^{a}	1111.3^{a}	932.4^{b}	929.8^{b}	37.211	0.0106
FI: 6thwk	1322.7	1154.4	1160.2	1175.3	44.607	0.0821
TFI: 0-6 wk	4546.5^{a}	4410.6^{a}	3936.4^{b}	3848.0^{b}	98.264	0.0023
FCR (g:g):						
FCR: 1stwk	1.497	1.483	1.513	1.779	0.072	0.0588
FCR: 2nd wk	1.55^{c}	1.70^{bc}	2.10^{b}	2.68^{a}	0.110	0.0004
FCR: 3rdwk	1.63	2.04	2.26	2.29	0.146	0.0443
FCR: 4thwk	1.56^{b}	1.61^{b}	1.68^{b}	2.04^{a}	0.0585	0.0016
FCR: 5thwk	1.92^{a}	1.62^{a}	1.21^{b}	1.85^{a}	0.072	0.0005
FCR: 6thwk	2.03	2.04	2.08	2.02	0.202	0.0624
TFCR: 0-6 wk	1.77^{b}	1.76^{b}	1.81^{ab}	2.05^{a}	0.056	0.0192

$^{a-c}$: 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.

Also, it was observed that the experimental groups fed the higher levels of HRP (5.0 and 7.0%) displayed a significant reduction (P≤0.01)in FI of chicks compared to other groups (0.0 and 3.0 % HRP). On the other hand, the dietary supplementation of 3.0 % HRP did not significantly affect (P>0.05) FI of chicks throughout the course of this study. Table 2 illustrates the results of FCR of broiler chickens in response to feeding diets supplemented with various amounts of HRP from day-old to 42 days of age. The effect of different levels of HRP had significant effects (P≤0.01) on the FCR of chicks during the second, fourth, fifth weeks of age and the entire experimental period. For the whole period of study, the best mean of FCR was achieved by the experimental group fed the diet-supplemented with 3.0% HRP but was in significantly different from those fed the control diet or the diet enriched with 5.% HRP. The lack of positive effect of HRP, particularly with the high levels (5.0 and 7.0%), on LBW, BWG and FCR might be attributed to a depression in appetite of birds and/or a decrease in feed digestibility.

The beneficial effect of HRP as growth promoter was documented by El-Deek *et al.* (2012), Wadasen (2012), Al-Kassie *et al.* (2011), Al-Kassie *et al.* (2012), Thiamhirunsopit *et al.* (2014), Puvaca (2018) and Islam *et al.*(2018).

In this respect, El-Deek *et al.* (2012) demonstrated that feeding diets fortified with HRP (1.5 or 3.0 g/kg) led to significant improvements in BWG of broiler chickens as compared to the control birds. Wadasen (2012) indicated that total BWG of broiler chickens fed HRP-supplemented diets (0.5, 1.0 or 1.5%) was significantly better than that of the control group. Similarly, Al-Kassie *et al.* (2011)found that broilers fed HRP-enriched diets (0.25, 0.50, 0.75 or 1.0%) from one to 42 days of age exhibited significant improvements in BWG and FCR compared with the control group. Additionally, Al-Kassie *et al.* (2012)reported that broiler chickens fed diets containing 0.75 or 1.0% of HRP and black pepper displayed significantly better means of BWG and FCR than did other experimental groups. Investigation by Thiamhirunsopit *et al.* (2014) has revealed that dietary supplementation with HRP resulted in better growth performance of chickens in comparison to control treatment.

Other reports have revealed that dietary inclusion of chili pepper at different levels (0.5%, 0.75% and 1%) for broiler chicken diets improved BWG and FCR compared with the control group (Puvaca, 2018 and Islam *et al.*, 2018).In this direction, it has been reported that HRP can boost pancreatic and intestinal enzyme activity, enhance bile acid secretion, and improve LBW, FCR and feed digestibility in broiler chickens (Munglang and Vidyarthi, 2019). Capsaicin can also potentiate the activities of pancreatic and intestinal enzymes(Platel and Srinivasan, 2004)and increase bile acid secretion and BWG in broiler chickens(Puvaca *et al*., 2014). On the other hand, some researchers (Wadasen, 2012; Dougnon *et al*., 2014 and El-Amin *et al.* (2015) observed no significant differences in the FI of broiler chickens fed diets supplemented with HRP at levels of 0.0, 0.5, 1.0and 1.5% of the feed.

Effect Hot Red pepper powder on Carcass Characteristics of Broiler Chickens:-

Table 3 demonstrates the results of adding various levels of HRP to the diet of broiler chickens on the relative weights of carcass characteristics and lymphoid organs (spleen and bursa of Fabricius).

Table 3. Carcass characteristics of 6-wk-old broiler chickens fed HRP-supplemented diets

Criteria:	Dietary levels of RHP (%)				Pooled	P
	0.0	3.0	5.0	7.0	SEM	Value
LBW (g)	2548^{ab}	3106^{a}	2501^{b}	2508^{b}	129.6	0.0284
Carcass yield (%)	76.06^{a}	71.46^{ab}	70.01^{b}	72.31^{ab}	1.034	0.0173
Heart (%)	0.53	0.58	0.63	0.69	0.046	0.1640
Liver (%)	2.23	2.31	2.35	2.26	0.180	0.9704
Gizzard (%)	1.63	1.20	1.39	1.44	0.118	0.1677
Spleen	0.11	0.13	0.10	0.10	0.0195	0.6841
Bursa of Fabricius (%)	0.17	0.14	0.20	0.19	0.033	0.6225

$^{a-b}$: Means in the same row carrying different superscripts differ significantly at P ≤0.05, SEM= Standard error of the means.

The current results revealed no significant differences in most carcass traits among all experimental treatments. Many studies recorded no significant differences in carcass traits of broiler chickens between HRP-treated birds and controls(Afolabi *et al*., 2017; Islam *et al.,* 2018; Soliman and Al-Afifi, 2020). Afolabi *et al.* (2017) observed that the dietary supplementation of HRP at the concentrations of 0.1, 0.2, and 0.3% of feed did not affect the weights of the carcass, liver, heart, gizzard, and abdominal fat, but the kidney weight significantly decreased in the 0.3% group compared with the 0.1%, 0.2%, and control groups.

Effect Hot Red pepper powder on Blood Serum Biochemical Parameters:-

Results on blood serum biochemical parameters and hematological parameters of broiler chickens fed diets supplemented with different levels of HRP are illustrated in Table 4. Feeding diets supplemented with different levels of HRP had no significant effect (P>0.05) on serum concentrations of TP, Alb, Glu, UA, Tri, Cho, and immunoglobin G (IgG, IgA), MDA, or activity of AST among the experimental groups. However, significantly lower means of serum activity of ALT were recorded for broilers supplemented with different levels of HRP compared with thea control group. On the other hand, significantly higher serum levels of HDL-C, TAC and IgM were recorded for broilers supplemented with control compared with different levels of HRP.

Table 4. Blood serum biochemical and haematological parameters of 6-wk-old broiler chickens fed HRP-supplemented diets

Measurements	Dietary levels of RHP (%)				Pooled	P
	0.0	3.0	5.0	7.0	SEM	Value
Serum Parameters:						
TP, g/dL	3.06^{b}	3.23^{ab}	3.40^{a}	3.03^{b}	0.057	0.0071
Alb, g/dL	1.73	1.73	1.76	1.63	0.060	0.4725
Glu, g/dL	167.00	182.66	179.00	131.33	14.022	0.1094
Tri, mg/dL	89.66	155.66	145.66	125.33	18.581	0.1372
Cho, mg/dL	124.0	167.6	166.6	166.3	11.09	0.0603
HDL-C, mg/dL	62.33^{a}	42.66^{b}	50.33^{ab}	44.00^{ab}	4.330	0.0440
UA, mg/dL	7.30	7.10	7.33	7.70	0.568	0.8978
TAC, mM/L	0.60^{a}	0.20^{b}	0.30^{b}	0.40^{ab}	0.057	0.0066
MDA, U/mL	40.00	60.00	50.00	55.00	7.308	0.3212
IgA, mg/dL	22.00	35.00	33.00	27.00	4.453	0.2322
IgM, mg/dL	55.00^{a}	27.00^{b}	30.00^{b}	43.00^{ab}	4.898	0.0131
IgG, mg/dL	400.00	235.00	273.00	341.00	57.22	0.2575
ALT, U/L	17.00^{a}	10.33^{b}	8.33^{b}	7.66^{b}	0.957	0.0005
AST, U/L	178.33	216.66	209.33	246.00	26.305	0.3981
Hematological Parameters:						
Hb, g/dL	17.00	13.73	14.26	13.40	1.088	0.1576
PCV, %	50.66	41.86	41.46	38.20	3.571	0.1618
MCV, fl	90.50	87.40	85.80	82.76	1.941	0.1117
MCH, pg	30.36	29.10	29.46	28.96	0.763	0.5868
MCHC, %	33.56	32.93	34.36	35.00	0.465	0.0589
RBCs (×106/µL)	5.60	4.73	4.83	4.63	0.425	0.4127
WBCs (×103/µL)	14.30^{b}	21.76^{a}	19.80^{ab}	14.73^{b}	1.248	0.0064
Platelets (×103/µL)	358.0	387.6	423.3	382.3	28.05	0.4722
Heterophils (×103/µL)	19.90	26.36	22.30	22.03	2.447	0.3644
Lymphocytes (×103/µL)	69.53	62.90	70.10	71.46	2.286	0.1091
Eosinophils (×103/µL)	1.33	1.16	0.00	1.50	0.472	0.1819
Monocytes (×103/µL)	9.23^{a}	9.56^{a}	7.60^{ab}	5.00^{b}	0.854	0.0195

$^{a-b}$: Means in the same row carrying different superscripts differ significantly at P ≤0.05, total protein (TP), Albumin (ALb), Glucose (Glu),Triglyceride (TG), Cholesterol (Cho), High density lipoprotein (HDL-c), uric acid (UA), total anti-oxidant capacity (TAC), malondialdehyde (MDA), immunoglobulins (IgA, IgM and IgG), alanine amino transferase (ALT), aspartate amino transferase (AST), Hemoglobin (Hb), packed cell value (PCV), mean corpuscular value (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red blood cells (RBCS), white blood cells (WBC), SEM= Standard error of the means.

The findings of the present study concur with those of Traesel *et al.* (2011) and Corduk *et al.* (2013), who did not observe any significant effects on the serum levels of total protein, albumin, and globulins following the addition of HRP in broiler diets. On the other hand, Abdul Aziz (2010) reported an improvement in serum TP concentration with dietary HRP supplementation at 1% and 2% compared with the control diet. Goncalves *et al.* (2012) observed an increase in serum level of

AST and a decrease in level of ALT in broiler birds fed a diet supplemented with HRP as compared with those of the control group. Puvaca *et al.* (2015b) reported that triglycerides, total cholesterol, LDL, and HDL concentrations showed significant (P < 0.05) differences in broiler chickens fed diets supplemented with HRP at levels of 0.5 and 1.0% and a mixture of garlic, black pepper and HRP (1:1:1) at 0.5% when compared with those fed the control diet. This could be attributed to the inhibitory effects of the bioactive components of HRP on the activity of hepatic 3-hydroxy-3-methylglutaryl coenzyme A reductase (a critical enzyme in cholesterol biosynthesis), thereby reducing cholesterol synthesis (Crowell, 1999).

Effect Hot Red pepper powder on Haematological Parameters:-

Table 4 shows the effects of feeding diets supplemented with different levels of HRP on haematological parameters of broiler chickens. Feeding diets enriched with different levels of HRP had no significant effect on concentrations of Hb, RBCs, WBCs, PCV, MCV, MCH, MCHC, platelets, heterophils(H), lymphocytes (L) and eosinophils of broiler chickens.

However, a significantly lower level of blood monocytes was recorded for broilers supplemented with 7.0% of HRP compared with other groups. Al-Kassie *et al.* (2012) observed that the levels of cholesterol, WBCs, RBCs, Hb, and H/L ratios (indicating a good indicator on the immune system) were significantly lower in broilers fed diets supplemented with a mixture of black pepper and 0.50, 0.75, and 1.0 % HRP in comparison with those fed the same diet enriched with 0.0 or 0.25% HRP.

Effect Hot Red pepper powder on Microbiological Traits:-

Caecal microflora counts of broiler chickens fed HRP-supplemented diets are presented in Table 5.

Table 5. Caecal microflora counts of 6-wk-old broiler chickens fed HRP-supplemented diets

Bacterial counts (CFU):	Dietary levels of RHP (%) 0.0	3.0	5.0	7.0	Pooled SEM	P Value
Total bacteria	7.47a	7.13ab	6.48c	6.82bc	0.076	0.0001
Mackoncy	5.98a	6.12a	4.94b	6.14a	0.124	0.0004
Salmonella and Shigella	3.874a	2.991a	0.00b	1.699ab	0.495	0.0028

a-c: Means in the same row carrying different superscripts differ significantly at P ≤0.05 , SEM= Standard error of the means.

The cecal contents of broiler chickens were enhanced due to feeding the diets containing HRP, specifically affecting the populations of total bacterial count, Mackoncy, and Salmonella and Shigella (S.S.) (*Salmonella typhimurium*, *Staphylococcus aureus*) (Table 5).

These findings indicated that the dietary inclusion of HRP at a level of 50 g/kg led to a significant decrease in total bacteria count and the count of coliform bacteria (Mackoncy and S.S.) compared to other groups.

The findings of the present study concur with the conclusion of other researchers that the inclusion of HRP into the broiler diet reduced the growth of the gram-negative pathogenic bacteria (*E. coli* and other members of the family Enterobacteriaceae). The reduction was significant for *E. coli*. Furthermore, HRP supplementation significantly inhibited the growth of gram-positive lactobacilli. It has been reported that HRP has broad-spectrum bactericidal activity against gram-positive and gram-negative pathogenic and nonpathogenic bacteria (Soliman and Al-Afifi, 2020). This finding agrees with the results of Corduk *et al.* (2013), who stated that capsaicinoids of HRP possess anti-microbial activities against pathogenic *E. coli* and other genera of the family Enterobacteriaceae. Abdul Aziz (2010) suggested that the capsicum pepper has a broad-spectrum effect on isolated bacterial strains due to the bacteriostatic and bactericidal activities of the capsaicin derivatives t-cinnamic and caffeic acids, respectively.

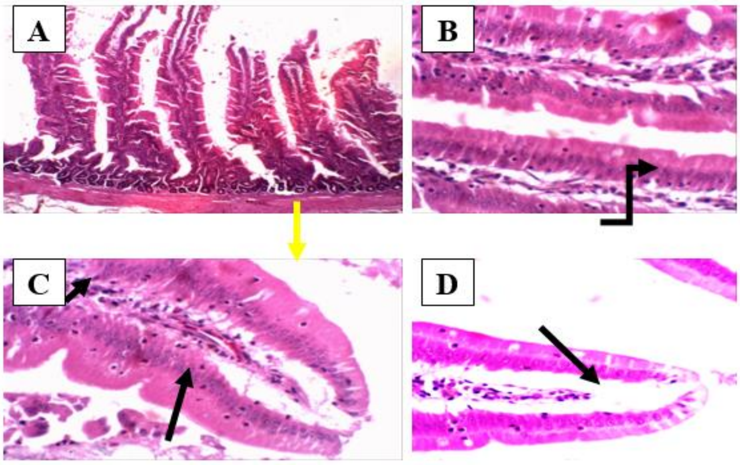
Effect Hot Red pepper powder on Histological Aspects of Duodenum:-

The gut morphology characteristics of broiler chicken fed enriched with different levels of HRP are shown in Table 6 and Fig.1.

Table 6. Duodenal dimensions of villi and crypts of 6-wk-old broiler chickens fed HRP-supplemented diets

Measurements:	Dietary levels of RHP (%) 0.0	3.0	5.0	7.0	Pooled SEM	P Value
Villus height, µm	439.71	680.21	537.34	469.94	72.592	0.1310
Villus width, µm	276.77^{a}	114.81^{b}	199.41^{ab}	236.25^{a}	24.850	0.0021
Crypt width, µm	48.12^{b}	81.44^{a}	64.84^{ab}	50.78^{b}	4.972	0.0008

a-b: Means in the same row carrying different superscripts differ significantly at P ≤0.05 , SEM= Standard error of the means.



A) normally arranged intestinal villi with few edema separated mucosal layers from submucosa and muscularis layers (black arrow) with few aggregations of inflammatory cells in between the crypt(yellow arrow), H&E, 100X.B) High intestine normally arranged intestinal villi with normal goblet cell (black arrow) H&E, 400X.C and D) showing mild inflammatory with few expansion of intestinal mucosa with som inflammatory cells(black arrow) around individual enterocyte necrosis with normal goblet cell, H&E, 400X

Fig. 1. Representative photomicrograph of intestine from different treatment groups.

The duodenum of birds fed HRP-enriched diets showed a slight increase in villus height compared with the control group in finisher phases. However, the duodenal villus width was significantly greater in birds fed the control diet or the diet containing the highest level of HRP (7.0 %) than in the group fed the diet containing 3.0 % HRP but was comparable to those fed the diet enriched with 5.0% HRP in the finisher phases. On the other hand, the crypt width in the duodenum of broiler chickens fed the diet having 3.0% HRP was greater than other treatments in phase finisher but was not significantly different from that of chicks fed the diet containing 5.0% HRP.

The study conducted by Soliman and Al-Afifi (2020) showed that villi length significantly improved due to the addition of HRP at levels of 0.5 and 1% in the diets of broiler chickens. The increase in villi length was associated with a significant reduction in crypt depth.

It is generally believed that red pepper is used to increase the bioavailability of corn gluten meal by two pathways: a) modification of the morphology of the small intestine by reducing the growth of pathogenic intestinal bacteria (Shahverdi *et al*., 2013); b) these reductions in pathogenic bacteria reduce the inflammatory reactions in the intestinal mucosa, thereby leading to a significant increase in villus area and improvement in the functions of secretion, digestion, and nutrient absorption (Cardoso *et al.*, 2012; Shahverdi *et al.*, 2013).

CONCLUSION

The results of this study show that the inclusion of hot red pepper (RHP) at 3 and 5% in broiler diets had no negative impact on growth performance, carcass characteristicsor hematological parameters. Furthermore, the most favorable microbiological traits were achieved when RHP was added at levels of 3, 5 and 7%;leading to effectively reducing the population of ilealharmful bacteria.

REFERENCES

Abdul Aziz, A. (2010).The effect of the *Capsicum annuum* in the diet of broilers on the isolation and shedding rate of Salmonella paratyphoid. Kufa J. Vet. Med.Sci., 1(1): 28–38.Doi: 10.36326 /kjvs/ 2010/ v1i14235

Abou-Elkhair,R.; S. Selim and E. Hussein (2018). Effect of supplementing layer hen diet with phytogenic feed additives on laying performance, egg quality, egg lipid peroxidation and blood biochemical constituents. Anim. Nutr., 4(4): 394-400.

Afolabi, K.D.; E.K. Ndelekwute; O.M. Alabi and R. Olajide (2017).Hot red pepper (*Capsicum annum* L.) meal enhanced the immunity, performance and economy of broilers fed in phases. J. Biol. Agric. Healthc., 7(8): 1-7.

Al-Kassie, G.A.M.; G.Y. Butris, and S.J. Ajeena (2012).The potency of feed supplemented mixture of hot red pepper and black pepper on the performance and some hematological blood traits in broiler diet. Int. J. Adv. Biol. Res., 2(1): 53–57.

Al-Kassie, G.A. M.: M. A. M. Al-Nasrawi; S. J. Ajeena (2011).The effects of using hot red pepper as a diet supplement on some performance traits in broiler. Pakistan Journal of Nutrition 10(9): 842-845.Doi: 10.3923/pjn.2011.842.845

Anderson and Cindy (2013). Great Adventures in the Microbiology Laboratory (7th ed.). Pearson. pp. 175–176.

Aryal and Sagar (2021). "Streak Plate Method- Principle, Methods, Significance, Limitations". Microbe Notes. Retrieved 12-10.

Atlas, R.M. and J.W. Snyder (2006). Handbook of Media for Clinical Microbiology (2ed.). Taylor and Francis Group. p. 173.

Batiha, G. E. ; A. Alqahtani; O.A. Ojo; H. M. Shaheen; L. Wasef; M. Elzeiny; M. Ismail; M. Shalaby; T. Murata; A. Zaragoza-Bastida; N. Rivero-Perez; A. M. Beshbishy ; K.I. Kasozi; P. Jeandetand H.F. Hetta (2020). Biological properties, bioactive constituents, and pharmacokinetics of some Capsicum spp. and capsaicinoids. Int. J. Mol. Sci., 21(15): 5179. Doi: 10.3390/ijms21155179.

Cardoso, V.S.; C.A.R. de Lima; M.E.F. de Lima; L.E.G. Dorneles and M.G.M. Danelli (2012).Piperine as a phytogenic additive in broiler diets. Pesq. Agropec. Bras. Brasília. 47(4): 489–496.

Corduk, M.; S. Sarica and G.F. Yarim (2013).Effects of oregano or red pepper essential oil supplementation to diets for broiler chicks with delayed feeding after hatching. 1. Performance and microbial population. J. Appl. Poult. Res., 22(4): 738–749.Doi: 10.33 82/ja pr.2012-00672

Crowell, P.L. (1999).Prevention and therapy of cancer by dietary monoterpenes. J. Nutr., 129(3): 775S-778S.Doi: 10.1093/jn/129.3.775S

Dougnon, T.J.; P. Kiki; T.V. Dougnon and I. Youssao(2014). Evaluation of Capsicum frutescens powder effects on the growth performances, biochemical and hematological parameters in Hubbard broiler. J. App. Pharm. Sci., 4(10): 38-43.Doi: 10.7324 /JAPS. 2014.401007

El-Amin, H.M.S.; K.A. Mohamed and M.A. Mukhtar (2015).Effect of hot red pepper (*Capsicum frutescens*) on performance, abdominal fat and blood serum parameters of broiler. J. Glob. Biosci., 4(5): 2251-2257.

El-Deek, A.A.; M.A. Al-Harthi; M. Osman; F. Al-Jassas and R. Nassar (2012). Hot pepper (*Capsicum annum*) as an alternative to oxytetracycline in broiler diets and effects on productive traits, meat quality, immunological responses and plasma lipids.European Poult. Sci., 76(2): 73–80.

El-Tazi, S.M.A. (2014). Response of broiler chicken to diets containing different mixture powder levels of red pepper and black pepper as natural feed additive. Anim. Vet. Sci., 2(3): 81-86.Doi: 10.11 648 /j.av s.20140203.15

Fattori, V.; M.S.N. Hohmann; A.C. Rossaneis; F.A. Pinho-Ribeiro and W.A. Verri (2016). Capsaicin: current understanding of its mechanisms and therapy of pain and other pre-clinical and clinical uses. Molecules, 21(7): 844. Doi: 10.3390/molecules21070844.

Goncalves, F.G.; S.F. Zanini; M.L. Feitosa; E.P.M. Goncalves and G.L. Colnago (2012). Effect of Brazilian red pepper meal associated with different levels of antibiotics on broilers chickens. Ciencia Rural, Santa Maria, 42(8): 1503–1509.Doi:10.1590/S0103-8478 2012005000055

Iji, P.A.; A.A. Saki and D.R. Tivey (2001).Intestinal development and body growth of broiler chicks on diets supplemented with non-starch polysaccharides. Anim. Feed Sci. Technol., 89(3-4): 175-188.Doi: 10.1016/S0377-8401 (00) 0022 3-6

Islam, M.; M. Haque; A.Shikhauu; J. Uddin; M.N.Uddin and M. Islam (2018).Effect of red chili and garlic nutrition as feed additives on growth performance of broiler chicken. Int. J. Nat. Soc. Sci., 5(3): 16–24.

Langhout, D.J.; J.B. Schutte; L.V. Leeuwen; J. Wiebenga and S. Tamminga(1999). Effect of dietary high and low methylated citruspectin on the activity of the ileal microflora and morphology of the small intestinal wall of broiler chickens. Br. Poult. Sci., 40(3): 340-347.Doi: 10.1080/00071669987421

Luqman, S. and S.I. Razvi(2006).Protection of lipid peroxidation and carbonyl formation in proteins by capsaicin in human erythrocytes subjected to oxidative stress. Phytother. Res., 20(4): 303-306. Doi: 10.1002/ptr.1861

Munglang, N.N. and V.K. Vidyarthi(2019).Hot red pepper powder supplementation diet of broiler chicken- A review.Livestock Res. Int., 7(3): :159–167.

NRC; National Research Council (1994).Nutrient Requirements of Poultry, 9th revised edition, National Academy Press, Washington, DC, USA.

Platel, K. and K. Srinivasan (2004). Digestive stimulant action of spices: a myth or reality? Indian J. Med. Res. 119(5):167–179.

Puvaca, N. (2018). Bioactive compounds in selected hot spices and medicinal plants. J. Agron. Technol. Eng. Manag, 1(1): 8–17.

Puvaca, N.M., D. Ljubojevic, D. Lukac, L.J. Kostadinovic, V. Stanacev, S. Popovic, M.Zivkov Balos, and N. Nikolova (2014).Digestibility of fat in broiler chickens influenced by dietary addition of spice herbs. Maced. J. Anim. Sci., 4(2): :61–67.

Puvaca, N.M. ; Ljubojevic; L.J. Kostadinovic; L. Levic; N. Nikolova; B. Miscevic; T. Konyves; D. Lukac and S. Popovic(2015a).Species and herbs in broiler nutrition: Hot red pepper (Capsicum annuum L.) and its mode of action.Worlds Poult. Sci. J., 71(): 683-688.

Puvaca, N.;L.J.Kostadinović;D. Ljubojević; D. Lukač; J.Lević; S. Popović;N. Novakov;B. Vidović and O.Đuragić(2015b). Effect of garlic, black pepper and hot red pepper on productive performances and blood lipid profile of broiler chickens. European Poultry Science 79: 1-13. Doi: 10.1399/eps.2015.73

Puvaca, N.M.; D.L. Pelić; S. Popović; P. Ikonić; O. Đuragić, T. Peulićand J. Lević(2019). Evaluation of broiler chickens lipid profile influenced by dietary chili pepper addition.J. Agron. Technol. Eng. Manag., 2(5): 318-324.

SAS (2006).Statistical Analysis System, SAS User's Guide. Statistics SAS institute Inc., Cary, NC, USA.

Shahverdi, A.; F. Kheiri; M. Faghani; Y. Rahimian and A. Rafiee(2013).The effect of use red pepper (*Capsicum annum* L.) and black pepper (*Piper nigrum* L.) on performance and hematological parameters of broiler chicks. Eur. J.Zool. Res., 2(6): 44–48.

Singletary, K. (2011). Red pepper: overview of potential health benefits. Nutr. Today, 46(1):33–47.

Soliman, N.K. and Sh.F. Al-Afifi (2020).The productive performance, intestinal bacteria and histomorphology of broiler chicks fed diets containing hot red pepper. Egypt. Poult. Sci., 40(I): 345-357.

Swelum, A.A.; A.R. Elbestawy; M.T. El-Saadony; E.O.S. Hussein; R. Alhotan; G.M. Suliman; A.E. Taha; H. Ba-Awadh; K.A. El-Tarabily, and M.E. Abd El-Hack (2021).Ways to minimize bacterial infections, with special reference to *Escherichia coli*, to cope with the first-week mortality in chicks: an updated overview. Poult. Sci., 100(1) :1010 39 .Doi: 10 .1016/ j.psj .2021.101039

Tawfeek, S.S.; K.M.A. Hassanin and I.M.I. Youssef(2014). The effect of dietary supplementation of some antioxidants on performance, oxidative stress, and blood parameters in broilers under natural summer conditions.J. World's Poult. Res., 4(1): 10-19.

Thiamhirunsopit, K.; C. Phisalaphong; S. Boonkird and S. Kijparkorn (2014).Effect of chili meal (*Capsicum frutescens* LINN.) on growth performance, stress index, lipid peroxidation and ileal nutrient digestibility in broilers reared under high stocking density condition. Anim. Feed Sci.Technol., 192(3): 90-100. Doi: 10. 101 6/j.anifeedsci.2014.03.009

Traesel, C.K.; P. Wolkmer; C. Schmidt; C.B. Silva; F.C. Paim; A.P.Rosa; S.H.Alves; J.M. Santurio and S.T.A. Lopes (2011).Serum biochemical profile and performance of broiler chickens fed diets containing essential oils and pepper.Comp.Clin.Pathol., 20(5): 453–460.Doi: 10.1007/s00580-010-1018-1

Tukey, J.W. (1977).Exploratory Data Analysis.Addison-Wesley Publishing Company Reading, Mass. Menlo Park, Cal., London, Amsterdam, Don Mills, Ontario, Sydney 1977, XVI, 688 S.

Wadasen, M.L.P. (2012).Study on the effect of hot red pepper (*Capsicum annuum*) supplementation on the growth performance of broilers. MSc. Thesis. Benguet State University, Philippines.

تأثير المكملات الغذائية للفلفل الأحمر الحار على الأداء الإنتاجى وخصائص الذبيحة وقياسات الدم والصفات الميكروبيولوجية والحالة الفسيولوجية لبداري التسمين

محمد رأفت الجوجرى ، ترك محمد درة و حسام رضا محرم على خليل

قسم إنتاج الدواجن، كلية الزراعة، جامعة المنصورة، ٣٥٥١٦، مصر

الملخص

كان الغرض من هذه الدراسة هو تحديد كيفية تأثير إضافة الفلفل الأحمر الحار (HRP) على الحالة الفسيولوجية لدجاج التسمين، ومؤشرات الدم، والخصائص الميكروبيولوجية، والأداء الانتاجي بالإضافة إلى خصائص الذبيحة لدجاج التسمين. تم تقسيم ١٢٠ كتكوت تسمين بعمر يوم واحد من نوع أيفين ٤٨ إلى أربع مجموعات تجريبية، كل منها ضمت ثلاث مكررات. احتوت المعاملات الغذائي على أربعة مستويات من HRP (٠,٠، ٣,٠، ٥,٠ و ٧,٠٪) واستمرت لمدة ٤٢ يومًا. لم تكن هناك فروق معنوية بين مستويات ٣,٠٪ HRP و مجموعة الكنترول على الأداء الإنتاجي طوال مدة التجربة. ومع ذلك، لم تظهر المعاملات التي تحتوي على مستويات مختلفة من HRP أي تأثير معنوي على البروتين الكلي، الألبيومين، الجلوكوز، حمض اليوريك، AST، الكولسترول، الدهون الثلاثية، MDA والجلوبين المناعي G بين جميع المجموعات. من ناحية أخرى، أدى أضافةHRP بمستوى ٥٠ جم/كجم إلى انخفاض معنوي في عدد البكتيريا الكلي وعدد البكتيريا الضارة (Mackoncy and S.S) مقارنة بالمجموعات الأخرى. أظهر منطقة الاثني عشر في الطيور التي تتغذى على عليقة غذائية غنية بـ HRP زيادة في ارتفاع الخملات مقارنة بمجموعة الكنترول. وبناء على ذلك، نستنتج أن أضاف مسحوق الفلفل الحار بمستوي ٣٪ مفيدة للأداء الإنتاجي والصفات الميكروبيولوجية والحالة الفسيولوجية لبداري التسمين.