

## EFFECT DIFFERENT LEVELS OF TURMERIC ROOT POWDER TO DIET ON SOME TRAITS OF BROILER EXPOSED TO HEAT STRESS

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### ABSTRACT

This study was carried out in the poultry field in Jadiriya, affiliated with the Department of Animal Production / College of Agricultural Engineering Sciences - University of Baghdad. This experiment used 480 one-day-old, unsexed broiler chicks of the broiler breed (Ross-308) with an average weight of 39.8 g to investigate the effect of adding different levels of turmeric root (*CURCUMA LONGA*) powder to the diet on some characteristics and physiology of commercial broilers exposed to heat stress. Chicks were distributed randomly and equally between 4 treatments (120 chicks/treatment), and each treatment included 3 replicates, at a rate of (40 chicks/repeat). Chicks were fed on the starter, growth and final diet for up to 6 weeks, and at the end of the experiment, at 42 days old, 12 birds were selected from each treatment at a rate of 4/duplicate treatment. The birds were placed in their kennel within an isolated space in the breeding hall and exposed to a temperature of (36-39-42°C) for 3 hours. The results of the experiment showed a significant increase ( $P > 0.05$ ) in total protein, albumin, globulin and high-density lipoprotein. The results also showed a significant decrease in cholesterol, LDL, VLDL, GOT enzyme level, sodium and potassium concentration, heterophil cells and the ratio (H/L), and turmeric treatments did not show a significant effect on basal, acidic and monocyte blood cells, and the results indicated a significant increase in the values of PCV and HDL cells. White blood, lymphocytes, chlorine concentration, GSH-PX and CAT enzyme levels in the blood. It can be concluded from this study that the addition of turmeric root powder at a rate of 6.5% has a positive effect on improving some physiological characteristics of broilers exposed to heat stress.

Key words: turmeric, broilers, physiological characteristics, heat stress

حسين والحسني

مجلة العلوم الزراعية العراقية - 2022: 53(4): 950-957

تأثير مستويات مختلفة من مسحوق الكركم الى العلف على بعض صفات فروج اللحم المعرضة للإجهاد الحراري

علي صباح الحسني

محمد عبدالله حسين

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باحث

### المستخلص

نفذت هذه الدراسة في حقل الدواجن في الجادرية التابع لقسم الانتاج الحيواني / كلية علوم الهندسة الزراعية - جامعة بغداد. استخدمت في هذه التجربة 480 فرخ فروج لحم غير مجنسة عمرها يوم واحد من سلالة (روز 308) بمتوسط وزن 39.8 جرام. لمعرفة تأثير إضافة مستويات مختلفة من مسحوق جذور الكركم إلى العليقة في بعض الصفات الانتاجية والفسلجية للطيور المعرضة للإجهاد الحراري. وزعت الأفراخ عشوائياً وبالتساوي بين 4 معاملات (120 فرخ / معاملة) ، وتضمنت كل معاملة 3 مكررات بمعدل (40 فرخ / مكرر). تم تغذية الأفراخ على علائق البادئ، والنمو، والنهائي لمدة 6 أسابيع، وفي نهاية التجربة، عند عمر 42 يوماً ، تم اختيار 12 طائراً من كل معاملة بمعدل 4 طير / مكرر. تم وضع الطيور في مكان منعزل في قاعة التربية وتعريضها لدرجة حرارة (36-39-42 درجة مئوية) لمدة 3 ساعات. أظهرت نتائج التجربة زيادة معنوية ( $P > 0.05$ ) في البروتين الكلي، الألبومين، الجلوبيولين والبروتين الدهني عالي الكثافة. كما أظهرت النتائج انخفاضاً معنوياً في نسبة الكوليسترول، LDL، VLDL، مستوى إنزيم GOT، تركيز الصوديوم والبوتاسيوم، الخلايا المتغايرة ونسبة (H / L) ، ولم تظهر معاملات الكركم أي تأثير معنوي على خلايا الدم القاعدية والحامضية، وأظهرت النتائج زيادة معنوية في مكداس الدم PCV ، HDL ، الخلايا الليمفاوية، تركيز الكلور، مستويات إنزيم GSH-PX و CAT في الدم.

كلمات مفتاحية: تركيز الصوديوم والبوتاسيوم، الكوليسترول، مسحوق الجذور

## INTRODUCTION

Climatic conditions directly affect poultry breeding, especially temperatures and humidity. The climate in Iraq is characterized by high temperatures on most days of the year, which has an impact on the overall performance of the poultry birds. The life of the organism is closely related to the nature of the environment in which it lives. The high growth rate and food conversion efficiency of modern broiler breeds make them more sensitive to high temperatures and more susceptible to heat stress (7). Several studies have shown that heat stress causes oxidative stress by decreasing the activities of antioxidants, which is one of the most important physiological changes in response to high temperatures, increasing the oxidative state and weakening the immune response of birds (22, 23). Given the difficulty of avoiding the disadvantages of climate change in general and temperature change in particular, scientists around the world have begun conducting studies and research on reducing the damage caused by exposure to high temperatures. From this point, research has turned towards natural compounds that have the ability to repair the damage caused by stress. In this regard, antioxidants such as vitamins, minerals and active compounds isolated from natural plants take precedence in this field (13). Among those medicinal herbs and spices is the turmeric plant (*Curcuma longa*), which has had a rich historical and scientific background for a long time. However, at the present time, solid scientific knowledge of the therapeutic and medical importance of the turmeric plant has grown, as well as of its high nutritional importance (25). The main medical part of the plant is the roots because they contain effective compounds. The most famous of these effective compounds for turmeric root powder and the most effective is curcumin, as studies have proven that the use of turmeric root powder in general and curcumin in particular has positive effects on the health of the organism due to its characteristic of various biological effects, most notably its role as an antioxidant (15). An anti-bacterial (4), an anti-inflammatory (14, 21), an anti-cancer (12) and an immune stimulant (1, 8) and other

therapeutic properties.

## MATERIALS AND METHODS

The experiment was conducted in the poultry field of the Department of Animal Production - College of Agricultural Engineering Sciences - University of Baghdad - Al-Jadiriya site for the period from 6/11/2020 to 12/18/2020. In this experiment, 480 unsexed one-day-old broiler chicks were used at an average weight of 39.8 g. Chicks were distributed randomly and evenly into 4 treatments (120 chicks/treatment), and each treatment included 3 replicates at a rate of (40 chicks/duplicate). Chicks were fed on the starter, growth and final diet with a crude protein level of 23.34, 21.28, 19.52 percent and a representative energy of 3045.71, 3162.26, 3215.96 kilo / kg feed, respectively (20). The experiment included the following treatments: T1 control treatment without any addition and T2, T3, T4 treatments of adding turmeric root powder at a concentration of 3.5, 6.5, and 9.5 gm / kg feed, respectively. The chicks were reared. A ground and continuous lighting system was used for a period of 24 hours a day. The conditions of the experiment are similar in terms of the floor area and distances of manholes and feeders for each treatment. At the end of the experiment, at the age of 42 days, 12 birds were selected from each treatment and 4 birds were duplicated, and the birds of each treatment were placed in their kennel within an isolated space in the breeding hall and exposed to a temperature of (36-39- 42°C) for 3 hours, according to the concentration of glucose, total protein, albumin, globulin, cholesterol, triglycerides, lipoproteins HDL, LDL, VLDL, the level of enzymes GPT, GOT, and electrolytes in the blood serum and the activity of GSH-PX and CAT enzymes, hematocrit values, hemoglobin, red and white blood cell counts, differential leukocyte count, and H/L ratio. The data from the experiment was analyzed using the complete random design (CRD) and the significant differences between the means were compared using Duncan's polynomial test, (9) and the statistical program SAS, (24), was used in the statistical analysis.

## RESULTS AND DISCUSSION

### 1- Concentration of glucose, total protein, albumin and globulin

From Table (1), which shows the effect of adding different levels of turmeric root powder to the diet on the concentrations of glucose, total protein, albumin and globulin, the results showed a significant increase ( $P > 0.05$ ) in the concentration of glucose treated T which reached ( $238.27 \pm 1.75$ ) and there are no differences between the addition treatments in the concentration of glucose, and a significant decrease in the concentration of total protein, albumin and globulin for the control treatment T1 ( $2.22 \pm 0.03$ ) and ( $2.16 \pm 0.05$ ) and ( $1.16 \pm 0.04$ ), respectively, while a significant increase in the concentration of albumin was observed in favor of Treatment T3 ( $2.36 \pm 0.02$ ).

### **2-concentration of cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein and very low-density lipoprotein**

Table (2) shows a significant increase ( $P > 0.05$ ) in the concentration of cholesterol, LDL and VLDL in the control treatment, which reached ( $171.79 \pm 1.84$ ), ( $63.23 \pm 2.09$ ) and ( $39.23 \pm 1.17$ ), respectively, and a significant increase in the concentration of triglycerides and the HDL of treatment T3 reached ( $142.49 \pm 1.23$ ) and ( $63.84 \pm 2.41$ ), respectively. The results show that there was a significant decrease ( $P < 0.05$ ) in HDL concentration for treatment T1, which amounted to ( $49.01 \pm 0.43$ ), and a significant decrease in VLDL concentration for treatment T3. Where it reached ( $23.57 \pm 0.47$ ).

### **3- Enzymes (GPT, GOT, and ALP) and concentrations of Na, K and CL**

It is evident from Table (3) that there was a significant increase in the level of GPT, GOT and ALP enzyme activity in treatment T1 at the level ( $P > 0.05$ ), where it reached ( $62.31 \pm 3.07$ ), ( $202.90 \pm 9.10$ ) and ( $198.61 \pm 1.02$ ), respectively, while a significant decrease in the level of GPT enzyme and ALP was observed in treatment T2 at a level ( $P < 0.05$ ) that amounted to ( $56.35 \pm 4.16$ ) and ( $165.43 \pm 13.91$ ), respectively, and a significant increase in the treatment of T4 in the concentration of ALP amounted to ( $165.67 \pm 9.59$ ), and a significant decrease in the concentration of ALP GOT in favor of

treatment T4, which amounted to ( $52.93 \pm 2.37$ ) and the results showed a high increase. The concentration of Na and K for treatment T1 reached ( $565.60 \pm 8.40$ ) and ( $7.07 \pm 0.21$ ), respectively. There was also a highly significant increase in the CL concentration, which reached ( $96.55 \pm 0.21$ ), and a highly significant decrease in the K concentration, which reached ( $4.45 \pm 0.19$ ) in favor of transaction T4.

### **4- Hematocrit, hemoglobin, red blood cells and white pain cells**

The results of the specialized analysis showed in Table (4) the effect of adding different levels of turmeric root powder to the diet on PCV, hemoglobin Hb, the Number of red blood cells and the number of white blood cells in the blood plasma. The results showed a significant decrease ( $P < 0.01$ ) in the hemoglobin concentration and the number of red blood cells and white blood cell count for the T1 control were ( $23.77 \pm 0.46$ ), ( $5.86 \pm 0.69$ ) and ( $5.92 \pm 0.38$ ), respectively, and there was a significant decrease in T4 in hemoglobin concentration that amounted to ( $9.09 \pm 0.15$ ).

### **5-The differential number of white blood cells and the ratio of H / L**

Table (5) shows the effect of adding different levels of turmeric root powder to the diet on heterophil cells, lymphocytes, eosinophils, basophils, monocytes, and the ratio between heterophils to lymphocytes. The results indicated a significant and significant increase in the number of heterophils and the ratio between H/L for control treatment T1, which was ( $17.55 \pm 0.29$ ) and ( $0.24 \pm 0.005$ ), respectively.

### **6- Glutathione peroxidase and catalase enzymes**

The results of Table (6) showed that there was a significant increase ( $P > 0.05$ ) in the level of glutathione enzyme GSH-PX and catalase CAT in treatment T3 amounted to ( $92.83 \pm 0.99$ ) and ( $58.45 \pm 1.79$ ), respectively, and at the same level, a significant decrease in treatment T2 At 42 days of age, it reached ( $75.75 \pm 2.17$ ) for GSH-PX enzyme, and in the T4 treatment, it reached ( $39.38 \pm 0.92$ ) for CAT catalase.

**Table 1. Effect of adding different levels of turmeric root powder to the diet on glucose concentration (mg/dL) and total protein concentration (mg/dL) and concentration Albumin (mg/dL) and globulin (mg/dL) concentration at 42 days of age for the blood serum of broilers exposed to heat stress (general mean ± standard error).**

Treat.s	Glucose	total protein	Albumin	globulin
T1	238.27± <sup>A</sup> 1.75	2.22± <sup>B</sup> 0.03	2.16± <sup>B</sup> 0.05	1.16± <sup>B</sup> 0.04
T2	215.19± <sup>B</sup> 1.82	3.18± <sup>A</sup> 0.14	2.23± <sup>AB</sup> 0.04	1.87± <sup>A</sup> 0.13
T3	213.68± <sup>B</sup> 1.36	3.15± <sup>A</sup> 0.16	2.36± <sup>A</sup> 0.02	1.94± <sup>A</sup> 0.09
T4	216.67± <sup>B</sup> 4.84	3.32± <sup>A</sup> 0.03	<sup>AB</sup> 0.03±2.28	1.87± <sup>A</sup> 1.06
morale level	0.05	0.05	0.05	0.05

T1 Control treatment without adding T4, T3, T2 treatments of turmeric root powder at Concentration of 3.5, 6.5, 9.5 g / kg of feed different letters within the same column indicate significant differences (P ≤ 0.05).

**Table 2. Effect of adding different levels of turmeric root powder to the diet on the concentrations of cholesterol (mg/dL), triglycerides (mg/dL) and high lipoproteins HDL (mg/dL), LDL (mg/dL) and VLDL (mg/dL) very low density lipoproteins at 42 days of age for broiler serum Meat subjected to heat stress (general mean ± standard error).**

Treat.s	cholesterol	triglycerides	HDL	LDL	VLDL
T1	171.79± <sup>A</sup> 1.84	132.86± <sup>B</sup> 1.58	49.01± <sup>B</sup> 0.43	63.23± <sup>A</sup> 2.09	39.23± <sup>A</sup> 1.17
T2	147.94± <sup>B</sup> 8.26	133.21± <sup>B</sup> 1.74	58.78± <sup>AB</sup> 1.13	38.47± <sup>BC</sup> 0.84	26.92± <sup>C</sup> 0.48
T3	140.85± <sup>B</sup> 1.97	142.49± <sup>A</sup> 1.23	63.84± <sup>A</sup> 2.41	40.97± <sup>B</sup> 1.72	23.57± <sup>D</sup> 0.47
T4	141.10± <sup>B</sup> 3.85	131.54± <sup>B</sup> 1.43	59.51± <sup>AB</sup> 0.32	41.83± <sup>B</sup> 3.38	33.46± <sup>B</sup> 1.06
morale level	.0.0	.0.1	.0.0	.0.0	.0.0

T1 Control treatment without adding T4, T3, T2 treatments of turmeric root powder concentration of 3.5, 6.5, 9.5 g / kg of feed different letters within the same column indicate significant differences (P ≤ 0.05)

**Table 3. Effect of adding different levels of turmeric root powder to the diet on the level of GPT (mg/dL), GOT (mg/dL), ALT (mg/dL) and concentrations Sodium (mg/dL), potassium (mg/dL) and chlorine (mg/dL) at 42 days (of age for the blood serum of broilers exposed to heat stress (general mean ± standard error).**

Treat.s	GPT	GOT	ALT	Na	K	C
T1	62.31± <sup>A</sup> 3.07	202.90± <sup>A</sup> 9.10	198.61± <sup>A</sup> 1.02	565.60± <sup>A</sup> 4.25	7.07± <sup>A</sup> 0.21	96.55± <sup>B</sup> 3.74
T2	56.35± <sup>B</sup> 4.16	175.44± <sup>B</sup> 3.19	165.43± <sup>B</sup> 13.91	655.34± <sup>B</sup> 26.41	5.15± <sup>B</sup> 0.16	106.60± <sup>A</sup> 2.18
T3	59.6± <sup>AB</sup> 1.21	185.43± <sup>B</sup> 8.74	192.95± <sup>AB</sup> 16.52	656.16± <sup>B</sup> 10.57	6.04± <sup>B</sup> 0.38	114.79± <sup>A</sup> 3.99
T4	52.93± <sup>B</sup> 2.37	178.70± <sup>B</sup> 7.20	165.67± <sup>A</sup> 9.59	558.38± <sup>B</sup> 8.40	4.45± <sup>C</sup> 0.19	112.47± <sup>A</sup> 3.03
Moral level	.0.0	.0.0	.0.0	.0.1	.0.1	.0.1

T1 control treatment without adding, T4, T3, T2 treatments of turmeric root powder at a concentration of 3.5, 6.5, 9.5 g / kg of feeThe different letters within the same column indicate the presence of significant differences (P≤0.01(P≤0.05).) N.S No significant differences within the column

**Table 4. Effect of adding different levels of turmeric root powder to the diet on hematocrit (%), hemoglobin (mg/dL) and red blood cells and white blood cells at the age of 42 days for the blood of broilers exposed to heat stress (general mean  $\pm$  standard error).**

Treat.s	PCV	Hb	RBC	WBC
T1	23.77 $\pm$ <sup>B</sup> 0.46	10.17 $\pm$ <sup>A</sup> 0.19	5.86 $\pm$ <sup>B</sup> 0.69	5.92 $\pm$ <sup>B</sup> 0.38
T2	29.00 $\pm$ <sup>A</sup> 0.28	10.34 $\pm$ <sup>A</sup> 0.18	6.23 $\pm$ <sup>A</sup> 0.21	8.60 $\pm$ <sup>A</sup> 0.56
T3	29.14 $\pm$ <sup>A</sup> 0.38	29.14 $\pm$ <sup>A</sup> 0.38	6.24 $\pm$ <sup>A</sup> 0.12	9.52 $\pm$ <sup>A</sup> 0.50
T4	28.92 $\pm$ <sup>A</sup> 0.46	9.09 $\pm$ <sup>B</sup> 0.15	6.13 $\pm$ <sup>A</sup> 0.14	8.03 $\pm$ <sup>A</sup> 0.37
morale level	.0.1	.0.0	.0.1	.0.0

T1 control treatment without adding, T4, T3, T2 treatments of turmeric root powder at concentration of 3.5, 6.5, 9.5 g / kg of feed. The different letters within the same column indicate the presence of significant differences ( $P \leq 0.01$ ).

**Table 5. Effect of adding different levels of turmeric root powder to the diet on the nucleus and on heterotrophic /lymphocyte ratio at 42 days of age in the blood of cells, lymphocytes, eosinophils, basophils, and monocyte-raised broilers exposed to heat stress (general mean  $\pm$  standard error).**

Treat.s	Hetrophils	Eosinophils	Basiophils	Monocytes	Lymphocytes	H /L
T1	17.55 $\pm$ <sup>A</sup> 0.29	0013 $\pm$ .004	40.2 $\pm$ .0.0	6016 $\pm$ .0.0	72.00 $\pm$ <sup>B</sup> 0.41	0.24 $\pm$ <sup>A</sup> 0.005
T2	15.60 $\pm$ <sup>B</sup> 0.33	0000 $\pm$ .01.	4004 $\pm$ .016	606. $\pm$ .01.	73.22 $\pm$ <sup>A</sup> 0.46	0.21 $\pm$ <sup>B</sup> 0.006
T3	15.82 $\pm$ <sup>B</sup> 0.27	0000 $\pm$ .016	4011 $\pm$ .04.	6000 $\pm$ .042	73.43 $\pm$ <sup>A</sup> 0.47	0.21 $\pm$ <sup>B</sup> 0.003
T4	15.80 $\pm$ <sup>B</sup> 0.40	0022 $\pm$ .042	4006 $\pm$ .01.	603. $\pm$ .04.	72.68 $\pm$ <sup>A</sup> 0.42	0.21 $\pm$ <sup>B</sup> 0.006
morale level	0.1	N.S	N.S	N.S	.0.1	.0.0

T1 control treatment without adding, T4, T3, T2 treatments of turmeric root powder at a concentration of 3.5, 6.5, 9.5 g / kg of feed the different letters within the same column indicate the presence of significant differences ( $P \leq 0.01$ ) ( $P \leq 0.05$ ) N.S. There are no significant differences within the same column

**Table 6. Effect of adding different levels of turmeric root powder to the diet on levels of Glutathione peroxide and catalase at 42 days of age for serum of broilers raised under heat tolerance conditions (general mean  $\pm$  standard error).**

Tre	GSH-PX	CAT
T	54.24 $\pm$ <sup>D</sup> 1.82	26.39 $\pm$ <sup>D</sup> 1.78
T	75.75 $\pm$ <sup>C</sup> 2.17	46.20 $\pm$ <sup>B</sup> 0.75
T	92.83 $\pm$ <sup>A</sup> 0.99	58.45 $\pm$ <sup>A</sup> 1.79
T	83.22 $\pm$ <sup>B</sup> 1.11	39.38 $\pm$ <sup>C</sup> 0.92
morale level	.0.0	.0.0

T1 Control treatment without adding, T4, T3, T2 treatments of turmeric root powder at concentration of 3.5, 6.5, 9.5 g / kg of feed different letters within the same column indicate significant differences ( $P \leq 0.05$ ). The significant increase ( $p > 0.05$ ) in glucose in the control treatment under heat stress conditions compared to the addition treatment may have occurred as a result of the increase in the activity of the enzymes ALT and AST in the liver of birds, which in turn encourages the process of manufacturing glucose from

non-carbohydrate sources (gluconeogenesis), especially from protein. This leads to an increase in the process of protein catabolism to provide the necessary amino acids and then convert them into ketones that are used to build glucose (28), and the increase in glucose concentration for the control treatment may be due to the increase in free radicals such as reactive oxygen species ROS and glutathione GSH, catalase CAT, and others, and that raising the level of free radical formation causes damage to pancreatic cells and thus

irregular release of the hormone insulin (responsible for maintaining a normal glucose level in the blood serum), which causes an increase in the level of this sugar in the blood serum (16). The decrease in the glucose level for the additional treatments is due to the role of turmeric as an antioxidant that scavenges free radicals, thus reducing the damage of oxidative stress. (18). A significant increase in serum proteins was shown by adding turmeric powder to poultry rations under heat stress conditions with the findings of (17). Turmeric supplementation improved the levels of total protein, albumin and globulin and restored liver function, which indicates the hepatotoxic effect of turmeric. In serum fats, which are cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein, and very low-density lipoprotein in the blood serum, the results of the experiment showed a significant increase in the levels of triglycerides, HDL and VLDL and a significant decrease in the concentration of cholesterol and LDL when adding turmeric powder to the diet. These results are what were mentioned by (5, 19) and agreed with the findings of (13). These changes in bird serum lipid concentrations may be due to the effect of turmeric and its role as an antioxidant that scavenges free radicals formed by oxidative stress by enhancing the activity of antioxidant enzymes in the body such as glutathione peroxidase (PX-GSH) and catalase (CAT) in the serum of birds exposed to stress is thermogenic, as well as the role of the active compound curcumin in turmeric in stimulating the activity of cholesterol 7-hydroxylase, which works to reduce cholesterol metabolism. As for the liver enzymes, the results showed a significant decrease in the levels of GPT and GOT for the turmeric addition treatments compared with the control treatment, which differed with what was reached by (11) (and agreed with what was stated by (29) that the use of turmeric in poultry feed has Reduce the incidence of inflammation and damage to organ cells, especially the liver and kidneys, which may reduce the levels of liver enzymes GPT and GOT. This is due to the role of turmeric in enhancing the activity of antioxidants in the body related to the activity of the enzymes glutathione peroxides (GSH-

PX) and catalase CAT, and maintaining the manufacturing function of the liver. The results of adding turmeric powder showed a decrease in the concentration of sodium and potassium and an increase in the concentration of chlorine. (2006) an increase in the need for potassium under conditions of heat stress, which causes panting, which leads to a loss of carbon dioxide CO<sub>2</sub>, HCO<sub>3</sub>, and ketones, especially potassium, and confirmed by (6), the concentrations of sodium and potassium in the blood decrease while chlorine increases at high temperatures, which leads to an imbalance of electrolytes in the blood. The additional treatments showed a significant superiority in the values of PCV, RBC and WBC, and the values of Hb were not significantly affected in the heat stress conditions. These findings are consistent with those of (10), and this is attributed to the role of turmeric in enhancing the protection of cell membranes from heat stress damage and, as a result, maintaining cell integrity (26). As for the ratio between heterogeneous cells and lymphocytes, the experiment treatments showed a significant superiority in the proportion of lymphocytes to the treatment of turmeric addition and a highly significant decrease in the proportion of heteroblasts compared with the control treatment during the heat endurance experiment. This is due to the effective role of the antioxidant turmeric in protecting tissues from the effect of free radicals on birds, thus reducing the H/L ratio, as well as its role in activating the immune system (1). As for the enzyme glutathione peroxidase and catalase enzyme, the results showed a significant superiority in the activity of each of GSH-PX and CAT for the third addition treatment at a concentration of 6.5 g / kg compared to the rest of the other treatments, because curcumin, the active substance in turmeric, increases the role of antioxidants and prevents damage to membrane cells by scavenging free radicals resulting from oxidation, which provides a protective mechanism against oxidative stress and lipid oxidation (27). It also has the ability to initiate the biosynthesis of antioxidant enzymes as well as the role of curcumin in counteracting corticosteroid hormones secreted under the influence of

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