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Article

Effect of adding different levels of *Ganoderma lucidum* to broiler diets on physiological traits and meat oxidation indicators.

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ABSTRACT

This study was conducted in the poultry field of the College of Agricultural Engineering Sciences / University of Baghdad for the period from 10/15/2021 to 11/25/2021 in order to show the effect of adding different levels of Ganoderma lucidum to broiler diets on physiological traits and indicators of fat oxidation in meat. In it, 200 unsexed (Ross 308) chicks of one-day-old breed were used, with a starting weight of (40) g. The chicks were distributed and randomly divided into four treatments, with 50 birds for each treatment. One treatment included five replicates (10 birds/repeat) and the experiment treatments were T1, T2, T3, and T4. The percentages of adding reishi mushrooms were 0, 0.5, 1, and 1.5 g/kg of feed, respectively. The birds were fed for the duration of the experiment on three rations: the starter ration, the growth diet and the final diet. The results showed a significant increase ($P<0.05$) in the total protein concentration and globulin concentration for T4 treatment containing reishi mushroom by 1.5 g/kg compared with the control treatment. At the same time, the results indicated a significant decrease ($P<0.05$) in cholesterol and HDL in the serum of T4-treated birds compared to the control treatment. In addition, the results showed that the addition of reishi mushrooms to the diets in the proportions (1 and 1.5) g/kg led to a significant decrease ($P<0.05$)) in the concentration of malonaldehyde (MDA) and the value of peroxide in the meat compared with the control treatment after the storage period of 30 days.

Keywords: average body weight, weight gain, feed consumed, food conversion ratio, reishi mushrooms, major cuts.

INTRODUCTION

Organic nutrition is nowadays the focus of the diet for humans and agricultural animals, including poultry, where it positively affects the poultry industry in terms of increasing production. Improving the quality of products, whether eggs or meat, and its reflection on improving the level of health for humans is the main consumer of these products, and this is done by relying on organic feed and avoiding additives, growth stimulants, hormones and synthetic antibiotics [1]. Among the natural additives that have shown more interest in feeding domestic birds are food fungi, as they are an important source of active biological compounds of high nutritional value [2]. Food fungi are used as antimicrobial, anti-inflammatory, prevent tumor

growth, prevent atherosclerosis, lower blood lipids, immunosuppressive, and potent antioxidants that prevent oxidative stress and the formation of free radicals [3] The reishi mushroom is one of the fungi with high nutritional value, which began to be interested in its production and use as food and treatment, whether for humans or use in the diets of animals and domestic birds. It is known as the red mushroom (Ganoderma lucidum), which belongs to the group of nutritious (Basidae) fungi suitable for nutrition. Its cultivation has spread in Many countries of the world, and it is one of the most medicinal mushrooms that are of great interest in many countries. 4 reishi mushrooms contain triterpenes, saponins, steroids, alkaloids, ganodic acid and glucans-β and contain ergosterol that enhances immunity and contributes to detoxifying the organism. An important nutrient in reishi mushrooms is riboflavin. Niacin, vitamin D, and a good proportion of fiber and mineral elements, the most important of which is calcium , phosphorous, potassium, magnesium, copper, iron, zinc, selenium and for the reishi mushroom to contain all these effective compounds and nutrients necessary in the body of birds and its important role in activating immunity and its impact on improving the general health of poultry and the health of the digestive system and for its work as an effective antioxidant for the presence of many substances Effective by preventing the formation of free radicals and the occurrence of lipid peroxidation, which is the main cause of deterioration in meat quality and affects the color, flavor and nutritional value [5] Due to the lack of studies on the reishi mushroom and its use in feeding agricultural animals, including poultry, and because there are no studies in Iraq that dealt with the importance of mushrooms, their chemical composition and nutritional value, whether in human or animal nutrition, so this study was conducted to shed light on the possibility and importance of adding reishi mushroom powder to broiler diets and its effect on Some physiological characteristics and oxidation state of meat stored for 30 days, and whether reishi mushroom has an effect in maintaining the quality and quality of stored meat.

MATERIALS AND METHODS

This study was conducted in the poultry field of the Department of Animal Production - College of Agricultural Engineering Sciences - University of Baghdad for the period from 10/15/2021 to 11/25/2021 to study the effect of adding different levels of the fungus Ganoderma lucidum to broiler diets on the relationship of broilers on physiological traits and indicators of fat oxidation in meat. This experiment used 200 one-day-age Ross 308 chicks, with an average primary weight of 40 g. The chicks were raised in a closed room consisting of 20 rooms. The chicks were distributed randomly on the stone, at a rate of 10 birds per room, assuming that each room was replicated. The chicks were fed on three diets and according to Table (1), from the age of one day, the birds were fed on a diet supplemented with Ganoderma lucidum at levels of 0.5, 1, 1.5 g/kg of feed and for the treatments T2, T3, and T4, respectively. It was compared with the control treatment (T1) without addition. Feed and water were given freely ad libitum for the duration of the experiment. The temperature was controlled using electric incubators, and the dwelling was equipped with continuous lighting, with the lighting cut off for one hour, to accustom the birds to the power outage. Blood samples were collected at the end of the sixth week of the experiment at the age of (42 days) by randomly taking 10 birds from each treatment. Blood samples were collected via the wing vein and placed in test tubes containing an anticoagulant, and the glucose concentration was measured according to [6]. The total protein concentration was measured according to method 7. In addition, the albumin was estimated as reported by [8], and globulin was measured according to an equation cited by [9]. In addition, it followed method [10] to measure the concentration of cholesterol. It followed the method [11] to measure the concentration of triglycer-

ides. I used methods 12, [13] and [14] to determine high-density lipoproteins, low-density lipoproteins and very low-density lipoproteins (HDL, LDL, and VLDL), respectively. The enzymes AST, ALT and ALP were also measured using the method of [15]. Thigh meat samples were collected after slaughtering the experimental birds at the age of (42) days by taking 10 birds from each treatment randomly and storing them at a temperature of (-20 C) for 30 days in order to estimate Malondialdehyde (MDA) according to the method [16] and the peroxide value (P.V.) and free fatty acids (FFA) according to both methods [17] and[18] respectively. The data of the experiment were analyzed using the complete random design (CRD) using the ready-made statistical program [19], and the significant differences between the means were compared using Duncan's polynomial test [20]

Ingredients (%)	**Types diets**		
	starter 1-14 d.	Grower 14-28 d.	Finisher 28-24.
Yellow corn	46.5	50	53
Wheat	10	10	10
Soybean meal [1]	33	29	26
Protein meal [2]	5	5	5
Vegetable oil	3	4	4.14
D.C.P	0.7	0.5	0.4
NaCl	0.1	0.1	0.1
Limestone	1.2	1.14	1.1
Methionine	0.25	0.13	0.13
Lysine	0.25	0.13	0.13
Total	100	100	100
Calculated Values[3]			
M.E. Kcal/ Kg Diet	3050	3160	3200
Crude Protein %	23	21.4	20.2
Crude Fiber %	2.7	2.6	2.6
Lysine %	1.52	1.31	1.23
Methionine + Cysteine %	1.13	0.97	0.94
Ca %	0.98	0.90	0.85
P %	0.48	0.44	0.42

Table 1. Percent composition of diets. [1] Soybean meal used an Argentine source of crude protein content by 48% and 2440 M.E. Kcal/ Kg. [2] Protein Meal User Product From Netherlands Origin (Brocon) Contain 40% Crude Protein 2107 Kcal / Kg M.E., Protein 5% Crude Fat 2.20% Crude Fiber 5%, Calcium 4.68% ,Phosphorus 3.85% Lysine 4.12%, Methionine 4.12%, Methionine Plus Cystine 0.42%, Tryptophan 0.38%, Threonine 1.70%. [3] Based on National Research Council recommendations (1994).

RESULTS

Table 2 shows the effect of adding different levels of reishi mushroom to the broiler diet on the concentration of glucose, total protein, albumin and globulin.) in the concentration of total protein in the blood of birds of the fourth treatment T4, which recorded 8.64 mg/100 ml of blood compared to treatment T1, but it did not differ significantly from T2 and T3, and T1 did not differ significantly (P<0.05) from T2 and T3, and there was a clear significantly excelled(P< 0.05) in the globulin concentration of treatment T4 compared to treatments T1, T2 and T3 as it recorded 5.76 mg/100 ml plasma. Both treatments, T2 and T3, did not differ significantly, and the control treatment, T1 did not differ significantly from T2 concerning globulin concentration.

Traits 100 mg/dl.	Treatment [1]				Sg.
	T_1	T_2	T_3	T_4	
Glucose	279.00±11.83	286.80±18.76	304.40±21.04	269.00±9.67	N.S.
Total protein	6.28± 0.07^{b}	7.05±0.20 ^{ab}	7.80±0.36 ^{ab}	8.64±0.14 ^{a}	*
Albumin	3.52±0.15	3.30±0.38	3.24±0.22	2.88±0.21	N.S
Globulin	2.76±0.17^{c}	3.75±0.45 ^{bc}	4.56±0.26 ^{b}	5.76±0.20 ^{a}	*

Table 2. Effect of adding different levels of reishi mushrooms to the diet (mean ± standard error) on the concentration of glucose, total protein, albumin and globulin in the blood plasma of broilers at 42 days of age.[1]Treatments T1, T2, T3, and T4 add the reishi mushroom in the following proportions (0, 0.5, 1, 1.5) g/kg, respectively.*Different letters within the same column indicate the presence of significant differences at the level of significance (P<0.05); N.S. means that there are no significant differences between the treatments.

Table 3 shows the effect of adding reishi mushrooms in the form of fat to the blood of broilers, where the results showed a significant decrease (P<0.05) in the cholesterol concentration in the blood of T4-treated birds containing 1.5 g/kg feed of reishi mushrooms compared to treatments T1, T2 and T3. Also, there were no significant differences between all the experimental treatments with regard to the concentration of triglycerides in the blood, but there were significant differences in the characteristics of the concentration of high-density lipoproteins (HDL), as the treatments T1, T2, and T3 recorded a significant increase (P<0.05) compared to T4, which recorded the lowest concentration of high-density lipoprotein (HDL). As for the concentration of low-density lipoproteins (LDL) and the concentration of very low-density lipoproteins (VLDL), the results showed that there were no significant differences between all treatments for the concentration of these two traits in broiler blood plasma at 42 days of age.

Table 4 shows the effect of adding reishi mushrooms to broiler diets on the level of AST, ALT and ALP enzymes, as it was noted that there were no significant differences between all the experimental treatments.

Table 5 shows the effect of adding different levels of reishi mushrooms to the diet of broilers on some oxidation indicators of the stored meat for 30 days. Significant differences were found between the different treatments of the experiment for the concentration of Malondialdehyde (MDA), peroxide value (P.V.), and Free Fatty Acids (FFA).

Traits 100 mg/dl.	Treatment [1]				Sg.
	T_1	T_2	T_3	T_4	
Cholesterol	117.40±0.15 a	112.00±3.02 a	112.00±2.170 a	104.00±1.52 b	*
Triglycer-ides	86.60±0.93	85.00±1.92	84.20±5.50	83.60±4.32	N.S
HDL	84.08±1.62[a]	83.92±1.43[a]	84.18±2.64[a]	72.58±2.48[b]	*
LDL	16.00±1.70	11.08±1.43	10.98±1.84	14.70±1.89	N.S
VLDL	17.32±0.19	17.00±0.38	16.84±1.10	16.72±0.86	N.S.

Table 3. The effect of adding different levels of reishi mushrooms to the diet (mean ± standard error) on the concentration of cholesterol, triglycerides, HDL, LDL and VLDL in the blood plasma of broilers at 42 days of age.[1]Treatments T1, T2, T3, and T4 add the reishi mushroom in the following proportions (0, 0.5, 1, 1.5) g/kg, respectively.*Different letters within the same column indicate the presence of significant differences at the level of significance (P<0.05); N.S. means that there are no significant differences between the treatments.

Traits 100 mg/dl.	Treatment [1]				Sg.
	T_1	T_2	T_3	T_4	
AST	375.60±19.44	335.00±89.80	439.80±33.93	309.60±126.80	N.S
ALT	19.40±4.43	25.00±4.44	17.40±2.18	17.00±3.02	N.S.
ALP	190.12±59.50	229.82±81.63	139.76±53.88	224.38±93.17	N.S.

Table 4. The effect of adding different levels of reishi mushrooms to the diet (mean ± standard error) on the level of AST, ALT and ALP in the blood plasma of broilers at 42 days of age[1] Treatments T1, T2, T3, and T4 add the reishi mushroom in the following proportions (0, 0.5, 1, 1.5) g/kg, respectively.*Different letters within the same column indicate the presence of significant differences at the significance level (P<0.05). N.S. means that there are no significant differences between the treatments.

The results showed a significant decrease (P<0.05) in the concentration of MDA for meat-treated T3, to which reishi mushroom was added at a rate of 0.1 g/kg of feed compared to the rest of the experimental treatments, followed by treatment T4. It decreased significantly (P<0.05) from the control treatment T1. However, it did not differ significantly from T2, this treatment did not differ significantly from T1. T3 and T4 treatments recorded a significant decrease (P<0.05) in the value of P.V. compared to the control treatment T1, but they did not differ. Significantly compared to T2, which did not differ significantly from the control treatment T1. The results in Table 5 showed a significant decrease in the percentage of free fatty acids FFA in broiler meat of treated T1 birds compared to treatment T2. However, it did not differ significantly (P<0.05) from T3 and T4, and these two treatments did not differ significantly (P<0.05) from T2 in these traits.

Traits	Treatment [1]				Sg.
	T_1	T_2	T_3	T_4	
MDA (mg/kg meat)	0.0012±0.0584 a	0.0005±0.0422 b	0.0005±0.0254 c	0.0005±0.0336 b	*
P.V. (meq /kg meat)	0.02±4.96^{a}	0.01±3.16^{ab}	0.01±2.02^{b}	0.008±2.19^{b}	*
FFA (%)	0.19±0.39^{b}	0.009±0.72^{a}	0.006±0.51^{ab}	0.006±0.62^{ab}	*

Table 5. Effect of adding different levels of reishi mushrooms to the diet on the oxidation indicators of broiler meat (mean ± standard error) stored for 30 days[1] Treatments T1, T2, T3, and T4 add the reishi mushroom in the following proportions (0, 0.5, 1, 1.5) g/kg, respectively .*Different letters within the same column indicate the presence of significant differences at the significance level (P<0.05). N.S. means that there are no significant differences between the treatments.

DISCUSSION

The increase in total protein and globulin may be due to the reishi mushroom's balanced containment of most essential and non-essential amino acids, as well as a group of natural antioxidants such as phenols, β-glucans, triterpenes, alkaloids and ergosterol, which work to increase protein metabolism and production of proteins, including immune proteins. Which works to raise the concentration of total protein and immunoglobulin, as it provides protection against catabolic reactions in the body through its antioxidant activity and its effect on protein synthesis [21] and that the blood content of cholesterol is affected by several factors, including food additives, and that the ability to absorb cholesterol depends largely on the nature of the materials used in the diet, as the occurrence of this moral decrease as shown in Table 3 is due to the content of the reishi mushroom on unsaturated fatty acids, polysaccharides and triterpenes Phenols, tocopherols, saponins and steroids such as Ergosterol, Stellasterol, Ganodermaside A, Ganodermaside B, Ganodermaside C, Ganodermaside D Which has a role in inhibiting cholesterol synthesis through its role as a natural antioxidant, helping to curb the activity of free radicals and stopping the chain reaction by providing protection against H2O2 that causes oxidative stress by reducing the oxidation reactions of unsaturated fatty acids. It also works to protect tissues from the dangers of peroxides and free radicals, as saponins have an important role in reducing the level of cholesterol in the blood plasma through several mechanisms or blocking the absorption of bile acids [22] as well as the soluble dietary fiber in mushrooms leads to the formation of viscous gels such as glucans that inhibit the absorption of cholesterol and the amounts of high-density lipoproteins [23].

The reason for the significant decrease in the values of oxidation indices MDA, P.V., FFA for thigh meat stored in freezing for 30 days may be due to the role of reishi mushrooms added to broiler diets, which prevented the process of oxidation rancidity decomposition of fats and fatty acids in the stored meat. The polysaccharides in the reishi mushroom can inhibit free radicals and decompose H2O2 into water and oxygen to break the lipid oxidation reaction and increase the activity of antioxidant enzymes, as well as their ability to restrict oxidation-stimulating metal ions (2+Fe, Cu+2) and inhibiting the free radical chain. This prevents the chain reaction of unsaturated fatty acids. Reishi mushrooms also contain glycopeptides, a group of amino acids linked by β-glycosidic bonds that reduce ROS formation and thus preserve meat for a longer storage period and from oxidation and rancidity without deteriorating its qualities [24]. The reason may be due to the low oxidation state in the stored meat due to the treatments in which the reishi mushroom was added because the mushroom contains high concentrations of vitamins that have a role in preventing oxidation of meat as it adds an increased effect to other antioxidants, including vitamins E, C and tocopherol. Vitamin E is

one of the fat-soluble vitamins that works to break the chain inside the cell membrane and plays an important role in protecting fatty acids from lipid peroxide and thus preventing their damage. Vitamin C is one of the important antioxidants soluble in water and extracellular fluids and can restrict Ros in the aqueous phase before it can attack and oxidize fats [25]. The significant decrease in oxidation indicators may be due to phenolic compounds in reishi mushrooms, which can inhibit free radicals by donating a hydrogen atom or an electron. Free radicals maintain and maintain cells in animal tissues [26] In addition to the fact that the reishi mushroom is a source of unsaturated fatty acids, including linoleic acid, which is characterized by its important role in preventing the formation of free radicals through its association with glutathione peroxidase in broiler meat stored for 30 days, which prolongs the storage period of meat without affecting its characteristics and preserving it from oxidation as a result of storage [27].

CONCLUSION

It can be concluded from this study that adding reishi mushrooms to 1.5 g/kg feed has a role and importance in improving the physiological traits of blood serum and increasing the storage period of chicken meat without deteriorating its quality.

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