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Impact of Local Qazwan (*Pistacia Atlantica*) Fruit Powder and Oil in Broiler Diet as Natural Antioxidant on Growth, Behavior, Physiological and Antioxidant Status of Broiler

Mahbuba Abdulghani Mustafa [1] **Shokhan Mustafa Ahmed** [1]
[1] *Department of Animal Resources, College of Agricultural Engineering Sciences, Salahaddin University-Erbil, Kurdistan Region, IRAQ.*
*Corresponding Author: mahbuba.mustafa@su.edu.krd.

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ABSTRACT

This evaluated the high functional properties of using local Qazwan (Pistacia atlantica) unripe fruit powder and ripe fruit oil as antioxidant on body performance, morphohistology, hematology, antioxidant and immune status in broiler chicks' diet at age 35 days. 450 day-old broilers (Ross-308) were randomly distributed in 6 treatments (75 chicks for each one) as follows: T0- Control: without adding (basal diet), [synthetic antioxidant: T1- BHT 150 mg/kg basal diet (butyl-hydroxy-toluene)], [Natural antioxidant: T2 (2.5 g Qazwan fruit powder/ kg diet), T3 (5 g Qazwan fruit powder/ kg diet), T4 (0.5 ml Qazwan oil / kg diet), T5 (1 ml Qazwan oil/ kg diet)]. The results achieved significantly higher body performance, body weight, and body weight gain, production index (PI), and feasibility (economic profit), histomorphology (small intestine relative length villus width, villus length (VH), crypt depth (CD), and Goblet cells numbers), and antibodies titter against New castle diseases (ND), Infectious bursal diseases-Gambro (IB), and Infection bronchitis virus (IBV), Hormones (Thyroxin(T4), Triiodothyronine (T3), and Growth), protein profile (total protein, and Globulins), high-density lipoprotein cholesterol (HDL-C), and antioxidant enzymes activities (GSH-px, Superoxide dismutase (SOD), Total antioxidant capacity (TAC), and Catalase), also improvement in feed convention ratio (FCR). However, mortality percentage, birds' aggressiveness, lipid profile, triglyceride, total cholesterol high (TCH), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein (VLDL-C), malondialdehyde (MDA) had significantly decreased in all treatments of natural, and then synthetic antioxidant compared of T0 control group. Moreover, the livability percentage was non-significantly in all treatments. The oil additive of Qazwan then powder show the fulfillments compared with the BHT and the control.

***Keywords*:** Qazwan, body performance, behavior, physiological, immunity, broiler.

INTRODUCTION

The feeding factor for poultry should satisfy physiological needs as much as possible, which directly depends on its usefulness [1]. One of the primary priorities of poultry science and practice is the quest for alternative nutritional supplements aimed at ensuring optimal health, amount, and quality of produce. Since ancient times, herbs and a number of spices containing biologically active substances have been used in the form of drugs [2]. Antioxidants are important to capture free radicals, mitigate problems with stress, and ultimately improve the health status of poultry. These antioxidants may be endogenous or exogenous [3]. This wild pistachio is the most economically important tree in many parts of the Kurdish regions, including the Zagros Mountains, where it is managed as a valuable forest tree [4].

The Qazwan or Terebinth (*Pistacia atlantica*) fruits are considered edible, and they are an excellent source of oil [5]. *Pistacia atlantica* oil contains different bioactive components and essential oils. The herbal essential oils have been considered as the natural antibiotic alternative growth promoters due to their antimicrobial activities [6]. Terebinth is a flowering herb that belongs to the Anacardiaceae family [7]. Matured fruits of Terebinth are small globular, and dark greenish [8]. Herbs and herbal products are incorporated in poultry diets to replace synthetic products in order to stimulate, and promote the effective use of feed nutrients, which may subsequently result in more rapid body weight gain, higher production rates, and improved feed efficiency. Moreover, active components of herbs may improve digestion and stimulate the immune function in broilers [9]. Despite these numerous medicinal effects, the impacts of terebinth on the performance and immune response of poultry have not been studied comprehensively. Therefore, this study was designed to explore the potential of a dietary natural antioxidant supplement of local powder of Qazwan unripe fruit powder and its ripe fruit oil compared with the synthesis antioxidant BHT on body performance, behavior, histo-morphological, blood biochemistry and antioxidant status of broilers at age 35 days.

Material and Methods

Location, ethics, and management: This work was conducted in a Grdarasha poultry farm/ College of Agricultural Engineering Sciences, Salahaddin University-Erbil/Iraq. 450-day-old broilers (Ross-308) were kept in floor pens of matching size (150×200 cm) and reared at 33, 28, and 26°C during the 1st, 2nd, and 3rd to 5th weeks, respectively. The birds were randomly distributed in 6 treatments, and 3 replicates were as T0- Control: without adding (basal diet), [synthetic antioxidant: T1- BHT 150 mg /kg basal diet (butyl-hydroxy-toluene)], [Natural antioxidant: T2 (2.5 g Qazwan unripe fruit powder/kg diet), T3 (5 g Qazwan unripe fruit powder/ kg diet), T4 (0.5 ml Qazwan ripe fruit oil/kg diet), T5 (1 ml Qazwan ripe fruit oil /kg diet)]. The average initial body weight was 43.1 g, and birds were provided water and feed *ad libitum*, Feed in pellet form and freshwater were provided *ad libitum*. The feed was prepared by a special feed company that includes: 3072, 3122 kcal/kg metabolizable energy, 22.5, 20% crude protein at starter (1-20 d) and grower (21-35 d) diets, respectively, as suggested in NRC [10], and lighting (22 h light: 2 h dark) was applied throughout the experimental period. The vaccination agenda consisted of Newcastle at 7 and 21 days, and IB at 14 days of rearing, as produced in the Ross-308 guide [11].

The chemical analysis of total antioxidant, phenolic and flavonoid compounds in Qazwan (Pistacia atlantica) unripe fruit powder, and ripe fruit oil were determined by High performance liquid chromatography (HPLC) as in Table 1.

Table 1. Results of chemical analysis of total (antioxidant, phenolic and flavonoid) compounds in Qazwan (Pistacia atlantica) unripe fruit powder and ripe fruit oil.

Characteristics	Unripe fruit	Ripe fruit
Total anti-oxidant (mg GA eq./g)	51.33	81.37
Total phenolics (mg GA eq./g)	40.71	49.25
Flavonoids (mg QE eq./g)	86.33	171.05

Body performance determination: On 35 days, 5 birds from each replicate were randomly selected, and body weight (BW), body weight gain (BWG), mortality, feed intake (FI), feed conversion ratio (FCR), production index (PI), and feasibility were determined [12].

Behavior observation Cameras were erected in all replicates of treatments to control and observe poultry behavior throughout 24 h a day. Determined the percentage of eating and drinking at set and up positions, walking, immobility, wings flapping, preening, pecking, feather pecking, and aggressiveness of birds [13].

Histomorphology of ileum: At age 35 days, three birds were averted by cervical displacement. Intestinal ileum sections were desiccated, transparent, and fixed in paraffin oil. Serial sections were cut at 5 µm and set on glass slides. For all tests, segments were deparaffinized in xylene and dehydrated in a graded alcohol series. Sections were observed by a light microscope mentioned by [14] to count goblet cell numbers, villus width and height, and crypt depth.

Blood biochemical determinations: Blood samples were collected in a heparinized test tube from the jugular vein, then centrifuged at 3000 rpm for 15 minutes to separate plasma samples, which were kept in Eppendorf tubes and frozen at 20-^{0} C until tests (Mustafa and Muhammed, 2020). Antibodies titer response against Newcastle disease virus (NDV), infectious bursal disease-Gambro (IB), and infectious bronchitis virus (IBV) [12] were measured by the ELISA kits from BioCompare. Thyroxin (T4), Triiodothyronine (T3), and Growth hormone concentrations were measured by ELISA. Total protein, albumin, globulin, and lipid profile (triglyceride, total cholesterol high (TCH), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein (VLDL-C), high-density lipoprotein cholesterol (HDL-C) were determined by ELISA according to the instructions of the kits included in the Buyer's Guide for Life Science Bio-compare. Glutathione peroxidase (GPx) and superoxide dismutase (SOD) enzyme activities were measured in serum using kits from Randox Laboratories Ltd., UK. [15].

Statistical analysis: Data were analyzed by the SAS Institute program [16] using CRD (Completely Randomized Design).

Results and Discussion

Body performance

Table 2, displays the results of the use of dietary Qazwan (*Pistacia atlantica*) fruit powder and oil as antioxidant on body performance, body weight, and body weight gain, which had significantly increased ($P \leq 0.01$) in the treatments T5, T3, T4, T2, and T1 compared with the T0 control. Also, feed intake ($P \leq 0.05$) had significantly increased in the treatments T5, T3, T4, and T2 compared with T1 (BHT), and the T0 control. Thus, the feed convention ratio (FCR) had significantly decreased (meaning improved) ($P \leq 0.01$) in the treatments T5, T3, T4, and T2 compared with T0 control group (basal diet). However, mortality percentage obviously lower in the treatments T5, T4, T3, and T2 compared with T1, and T0 control groups. Moreover, the production index (PI), and feasibility (economic profit) were significantly higher ($P \leq 0.01$) in the treatments of Qazwan fruit powder and oil additive compared with the control. However, the livability percentage was non-significant in all treatments. [17] emphasized that the compounds identified in the essential oil of terebinth play a positive active role in the prevention of many diseases; they also stated that these substances bind types of reactive oxygen by entering the tissues easily with a lipophilic effect and thus show antioxidant properties [18]. Mature fruits of terebinth include 35.26 - 47.52% ether extracts [19], 6.4% crude protein, and 1.5% crude ash [20]. There have been 0.1% essential oils [20], and 0.06-0.73% volatile fatty acids in fruits of terebinth [21]. It also contains macro- (Ca, K, P, Na, S, Mg), and microelements (Fe, Al, Cu,

Mn, Zn, Se, Cr, Co) [20] as well as tocopherols, tocotrienols, and sterols [19]. Pharmacologically active substances in the mature fruit of terebinth are α-pinene , limonene, α-felandrene, terpinolene, p-cymen-8-ol , and caryophyllene oxide [21]. It also contains phenolic, and flavonoids such as quercetin, and α-tocopherol, which are antioxidant compounds [22] that lead to improved body performance.

Table 2. The impact of dietary Qazwan (Pistacia atlantica fruit powder and oil as antioxidant on the body performance of small intestine ileum of broilers at age 35 days.

Traits	T0	T1	T2	T3	T4	T5	MSE
Body weight (g)	1985^{c}	2119^{b}	2279^{ab}	2378^{a}	2321^{ab}	2403^{a}	175.4
Body weight gain (g)	1941.3^{c}	2075.3^{b}	2235.3^{ab}	2334.3^{a}	2277.3^{ab}	2359.3^{a}	178.3
Feed intake (g)	2937.2^{b}	3096.3^{b}	3261.3^{a}	3333.4^{a}	3290.7^{a}	3329.0^{a}	257.5
FCR (g/feed/g BW)	1.513^{a}	1.492^{ab}	1.459^{b}	1.428^{c}	1.445^{bc}	1.411^{c}	0.114
Mortality%	2.5^{a}	2.33^{a}	1.75^{b}	1.5^{b}	1.5^{b}	1.0^{c}	0.082
Livability%	97.5^{a}	97.67^{a}	98.25^{a}	98.5^{a}	98.5^{a}	99.0^{a}	1.43
Production Index (PI)	365.5^{c}	396.5^{b}	438.5^{ab}	468.5^{a}	452.0^{ab}	481.7^{a}	19.83
Feasibility ($/kgLBW[1)]	1.03^{c}	1.23^{b}	1.35^{ab}	1.43^{a}	1.38^{a}	1.50^{a}	0.21

T0- Control: without adding (basal diet), [synthetic antioxidant: T1- BHT 150 mg/kg basal diet (butyl-hydroxy-toluene)], [Natural antioxidant: T2 (2.5 g Qazwan (Pistacia atlantica) unripe fruit powder/ kg diet), T3 (5 g Qazwan (Pistacia atlantica) unripe fruit powder/ kg diet), T4 (0.5 ml Qazwan (Pistacia atlantica) ripe fruit oil/ kg diet), T5 (1 ml Qazwan (Pistacia atlantica) ripe fruit oil/ kg diet)]. [1]Feasibility or Economic profit ($/ kg live body weight). ^{a,b,c} Means within rows with different superscripts differ significantly at ($P\leq 0.05$) & ($P\leq 0.01$).

Behaviour characteristics

The results in Table 3 show broiler chickens were significantly increased ($P\leq 0.01$) in the percentages of eating in an up position, walking, wings flapping, dust bathing, and preening in the treatments of dietary supplementation of Qazwan fruit powder and oil compared with the control T0. However, significant decreases ($P\leq 0.01$) in the percentages of eating and drinking at set positions, feather pecking, and aggressiveness, and there were also significant decreases ($P\leq 0.05$) in the percentage of drinking in an up position in the treatments of Qazwan fruit powder and oil supplementation. Otherwise, there were no significant differences among all the treatments in the percentages of immobility and pecking. Qazwan nice odor and taste may affect the brain by improving mood, eating foods, and improving overall health, and well-being associating it with positive mood and impact on the central nervous system; also, it plays a role in the modulation of behavioral and physiological processes, so it's used as an indicator to evaluate alterations in behavioral adaptation and reproduction [23].

Table 3. Impact of dietary Qazwan fruit powder and oil as an antioxidant on behaviour characteristics of broilers at age 35 days.

Traits		T0	T1	T2	T3	T4	T5	MSE
Eating %	Set	6.33 ^{a}	5.80 ^{ab}	5.03 ^{b}	4.29 ^{bc}	3.08 ^{c}	2.15 ^{d}	0.13
	Up	10.42 ^{c}	10.79 ^{bc}	11.75 ^{b}	12.52^{ab}	14.10 ^{a}	14.53 ^{a}	0.49
Drinking %	Set	4.26 ^{a}	3.92 ^{ab}	3.50 ^{b}	3.82 ^{b}	3.11 ^{bc}	2.89 ^{c}	0.25
	Up	20.73 ^{a}	22.03 ^{a}	19.28 ^{ab}	18.33 ^{b}	16.45 ^{b}	17.12 ^{b}	0.63
Walking %		5.33 ^{c}	6.19 ^{b}	7.44 ^{ab}	8.25 ^{ab}	9.50 ^{a}	9.33 ^{a}	0.38
Immobility %		20.35 ^{a}	20.29 ^{a}	20.15 ^{a}	19.40 ^{a}	18.92 ^{a}	19.72 ^{a}	0.73*
Wings flapping %		3.28 ^{c}	3.72 ^{bc}	4.67 ^{b}	5.13 ^{ab}	5.85 ^{ab}	6.13 ^{a}	0.28
Dust bathing %		4.22 ^{c}	4.83 ^{bc}	6.49 ^{b}	7.51 ^{b}	9.20 ^{a}	9.17 ^{a}	0.34
Preening %		5.37 ^{d}	7.03 ^{c}	9.33 ^{b}	10.29 ^{ab}	10.41^{a}	11.05 ^{a}	0.32
Pecking %		5.53 ^{a}	5.42 ^{a}	5.93 ^{a}	5.65 ^{a}	5.60 ^{a}	5.82 ^{a}	0.17*
Feather pecking %		7.89 ^{a}	6.33 ^{ab}	4.75 ^{b}	3.86 ^{b}	3.11 ^{bc}	1.58 ^{c}	0.08
Aggressiveness %		6.29 ^{a}	3.65 ^{b}	1.33 ^{bc}	0.95 ^{c}	0.67 ^{c}	0.45 ^{c}	0.05

* The same superscripts mean non-significant.

Histomorphology and antibodies titer against ND, IBD, and IBV.

The result of Table 4. Explains dietary Qazwan fruit powder and oil as antioxidant on histomorphology and antibodies titer against ND, IBD AND IBV, small intestine relative length, villus width, villus length (VH), crypt depth (CD), and Goblet cell numbers had significantly increased in all treatments of natural antioxidant (Qazwan fruit powder and oil), and synthetic antioxidant (BHT) additives compared with the T0 control group. However, VH/CD ratio was non-significant in all treatments. Also, the antibodies titer of Newcastle disease (ND), Infectious bursal diseases-Gambro (IB), and Infectious bronchitis virus (IBV) were significantly higher in all treatments of natural and synthetic antioxidant additives compared with the T0 control group.

The natural herbs and oils may develop cells' immunity, increase the fighting ability of macrophage cells, and improve the action of T and B cells, which are responsible for the immune state [24]. The immune system plays a significant role in

conserving health and averting diseases. A healthy immune system assists broilers in fighting infections, prevents diseases, and reduces their development. In the future, constructing a balance between the growth rate and the activity of the immune system creates more demand for peak poultry production [25].

Table 4. Impact of dietary Qazwan fruit powder and oil as antioxidant on ileum histomorphology and antibodies titer against some diseases by ELISA of broiler at age 35 days.

Traits	T0	T1	T2	T3	T4	T5	MSE
S.I.R.L (cm)/g	1.209^{c}	1.257^{b}	1.339^{ab}	1.408^{a}	1.388^{a}	1.419^{a}	0.072
Villus width (µm)	138.2^{d}	146.3^{c}	168.6^{b}	181.0^{ab}	172.3^{ab}	189.5^{a}	4.71
Villus length (VH)	833^{c}	912^{b}	983^{b}	1245^{ab}	1179^{ab}	1336^{a}	22.5
Crypt depth (CD) (µm)	79.6^{d}	85.4^{c}	96.1^{b}	115.2^{ab}	119.0^{ab}	127.3^{a}	7.21
VH/ CD ratio	10.46^{a}	10.68^{a}	10.23^{a}	10.81^{a}	9.91^{a}	10.49^{a}	0.357
Goblet cells No^{1}.	9.08^{d}	10.64^{c}	12.19^{b}	13.55^{ab}	13.29^{ab}	13.87^{a}	0.63
ND (ng/ml)	2849^{d}	3655^{c}	4401^{b}	5131^{ab}	5011^{ab}	5933^{a}	358
IB (ng/ml)	2009^{d}	2813^{c}	3205^{b}	3417^{ab}	3219^{b}	3782^{a}	277
IBV (ng/ml)	1679^{c}	2105^{b}	2388^{b}	2710^{ab}	2711^{ab}	2949^{a}	198

S.I.R.L; Small intestine relative length, [1]number of goblet cells per mm of villus length. N.S: The same superscripts within columns means non-significant, a – c Means within columns with different superscripts differ significantly at ($P \leq 0.05$).
ND; Newcastle diseases, IB; Infectious bursal diseases-Gamboro, IBV; Infection bronchitis virus.

Hormones, protein, and lipid profiles in serum of broiler.

The result in Table 5 presents the use of dietary Qazwan fruit powder and oil as antioxidant on some hormones, protein, and lipid profiles in the serum of the broiler. Thyroxin (T4) had significantly improved in the treatments T5, T3, T4, T2 and T1, also, Triiodothyronine (T3) had significantly increased in the treatments T5, T3, T4, T2, and Growth hormone had significantly increased in the treatments T5, T3, T4 compared with T0 control group. In the same table total protein had significantly improved in the treatments T5, T3, T4, T2 and T1, and globulins had significantly increased in the T5, T3, and T4 compared with the T0. While albumin had no significant difference among all the treatments of the study. According to the lipid profile, the triglyceride, total cholesterol (TCH), low-density lipoprotein cholesterol (LDL-C), and very low-density lipoprotein (VLDL-C) had significantly decreased in all treatments of natural and synthetic antioxidant additives T5, T4, T3, T2 and T1 compared with T0 control group. However, high-density lipoprotein cholesterol (HDL-C) had significantly increased in the treatments T5, T3, T2, and T4 compared with T1 and T0.

Table 5. Impact of dietary Qazwan fruit powder and oil as antioxidant on some hormones (ng/100 ml), protein (g/100 ml) & lipid profile (mg/100 ml) in serum of broilers at age 35 days.

Treatments	**T0**	**T1**	**T2**	**T3**	**T4**	**T5**	**MSE**
Thyroxin(T4)	6.163^{d}	7.855^{c}	9.913^{b}	12.092^{ab}	11.763^{ab}	13.958^{a}	0.489
Triiodothyronine(T3)	0.819^{c}	0.948^{bc}	1.055^{b}	1.417^{ab}	1.236^{ab}	1.483^{a}	0.147
Growth hormone (GH)	99.52^{c}	101.39^{bc}	103.41^{bc}	108.33^{ab}	105.28^{b}	113.09^{a}	5.29
Total protein	2.95^{c}	3.47^{b}	3.90^{ab}	4.33^{a}	3.98^{ab}	4.46^{a}	0.372
Globulins	1.66^{b}	2.25^{ab}	2.66^{ab}	3.06^{a}	2.86^{a}	3.23^{a}	0.258
Albumin	1.29^{a}	1.22^{a}	1.24^{a}	1.27^{a}	1.12^{a}	1.23^{a}	0.094
TG	179.3^{a}	166.3^{b}	151.2^{c}	130.5^{d}	137.9^{de}	128.0^{e}	5.17
TCH	157.5^{a}	145.5^{b}	129.7^{c}	108.4^{de}	111.3^{d}	106.9^{e}	3.78
LDL-C	107.71^{a}	98.18^{b}	78.05^{c}	54.34^{d}	71.42^{cd}	50.91^{d}	3.05
VLDL-C	13.50^{a}	9.92^{b}	7.80^{c}	6.55^{c}	7.32^{c}	6.80^{c}	0.49
HDL-C	36.29^{c}	39.40^{c}	43.85^{ab}	47.21^{a}	42.66^{ab}	49.19^{a}	1.26

Serum antioxidant status and enzyme activitiy concentrations.

Table 6 show the using dietary Qazwan (*Pistacia atlantica*) fruit powder and oil as antioxidant on serum antioxidant enzyme activities concentrations of broiler, malondialdehyde (MDA) had significantly decreased in the treatments T5, T3, T4, T2, and T1 compared to the T0 control group. However, glutathione (GSH-px), superoxide dismutase (SOD), total antioxidant capacity (TAC), and catalase had significantly improved in the treatments T5, T4, T3, T2, and T1 compared with the T0 control group. The results of Qazwan analysis are in table 1. and its content of total antioxidants (51.33, 81.37), total phenolics (40.7, 49.25) and flavonoids (86.33, 17105) respectively in unripe fruit powder and ripe fruit oil had a positive effect on antioxidant enzyme activity concentrations in broiler serum, and the improvement in the immune status may be due to phytochemical compounds such as flavonoids and phenolics, which have strong antimicrobial and antioxidant properties that led to scavenging and redox possessing, also for their ability to neutralize and quench free radicals and pathogenic microbes attacking birds' digestive and immune systems [26].

Table 6. Impact of dietary Qazwan fruit powder and oil as antioxidant on serum of some enzyme activity concentrations of broilers at age 35 days.

	Antioxidant enzymes activities						
Treatments	T0	T1	T2	T3	T4	T5	MSE
MDA (µmol/ml)	16.83^{a}	12.64^{b}	10.85^{bc}	10.15^{c}	11.07^{bc}	10.03^{c}	0.612
GSH-Px (U/mL)	35.04^{d}	38.65^{c}	42.81^{b}	46.99^{ab}	47.10^{ab}	49.15^{a}	1.78
SOD (U/mL)	1.27^{c}	2.05^{b}	2.49^{b}	3.78^{a}	3.11^{ab}	3.96^{a}	0.206
TAC (U/mL)	20.62^{c}	23.09^{b}	25.10^{b}	27.00^{ab}	27.36^{ab}	28.69^{a}	2.04
CAT (U/mL)	3.47^{c}	5.63^{b}	6.11^{ab}	7.09^{a}	7.23^{a}	7.55^{a}	0.315

MDA: Malondialdehyde, SOD: Super oxide dismutase, TAC: total antioxidant capacity, GSH-Px: Glutathione Peroxidase, CAT: Catalase, a, b, c Means within columns with different superscripts differ significantly at ($P \leq 0.05$).

Conclusion

The results of using Qazwan (Terebinth) fruit powder and oil as natural antioxidants for scavenging free radicals also improves growth and thyroid hormone, which have a great role in regulating metabolism rate in the body, leading to increased body performance in broiler chicks, also improving positive behavior, BWG, and FCR, furthermore lowering mortality and negative behavior like aggressiveness, which reflects on the production index and feasibility of this experimental project. Likewise, it enhanced the immune response to viral diseases and increased antioxidant status, which could effectively scavenge oxygen free radicals, induce body oxidation decline system imbalance, lessen oxygen free radical damage to cells in mucosal tissues, and increase the absorbency of intestinal mucosa, thus efficiently preserving the structure and function of the intestinal barrier. Finally, the use of Qazwan fruit powder and oil plays an important role in broiler rearing.

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تأثير مسحوق وزيت ثمارالبطم(*Pistacia atlantica*) المحلي في عليقة دجاج اللحم كمضاد أكسدة طبيعي على أداء الجسم وسلوكه والحالة الفسيولوجية ومضادات الأكسدة

محبوبة عبدالغني مصطفى [1] **شوخان مصطفى أحمد [1]**

قسم الثروة الحيوانية، كلية علوم الهندسة الزراعية، جامعة صلاح الدين - أربيل، إقليم كردستان، العراق.

الخلاصة

قيّمت هذه الدراسة الخصائص الوظيفية العالية لاستخدام مسحوق وزيت ثمار البطم المحلي كمضاد أكسدة طبيعي على أداء الجسم، و السلوك والخصائص الشكلية والنسيجية، والخصائص الدموية، ومضادات الأكسدة، والحالة المناعية في عليقة فروج اللحم بعمر 35 يومًا. تم توزيع 450 فرخة فروج اللحم روز-308 عشوائيا في 6 معاملات (كل معاملة 75 فرخة) كانت كما يلي: ***T0*** معاملة السيطرة: بدون إضافة (العليقة القياسية)، مضادات الأكسدة الاصطناعية: ***T1***-(بيوتيل هيدروكسي تولوين)، ***BHT 150*** ملغم / كغم عليقة قياسية، مضادات الأكسدة الطبيعية: ***T2*** 2.5 غم مسحوق فاكهة البطم/ كغم عليقة قياسية، ***T3- 5*** غم من مسحوق فاكهة البطم / كغم عليقة قياسية، ***T4 : 0.5*** مل من زيت البطم /كغم عليقة قياسية، ***T5 : 1*** مل مزيت القزوان /كغم عليقة قياسية . قد حققت النتائج ارتفاعا ملحوظا في أداء الجسم، ووزن الجسم، وزيادة وزن الجسم، ومؤشر الإنتاج (***PI***)، والجدوى (الربح الاقتصادي)، و سلوك الطير والشكل النسيجي (طول الأمعاء الدقيقة النسبي وعرض الزغابات، وطول الزغابات (***VH***)، وعمق القبو (***CD***)، وعدد خلايا الكأسية ، والأجسام المضادة ضد مرض النيوكاسل (***ND***)، وأمراض الجراب المعدية - جامبرو (***IB***)، وفيروس التهاب الشعب الهوائية المعدي (***IBV***)، والهرمونات الثيروكسين (***T4***)، وثلاثي يودوثيرونين (***T3***)، والنمو، البروتين الكلي، والجلوبيولين، وكوليسترول البروتين الدهني عالي الكثافة (***HDL-C***)، وأنشطة إنزيمات مضادات الأكسدة (***GSH-px***، وفائق أكسيد ديسميوتاز (***SOD***)، والسعة الكلية لمضادات الأكسدة (***TAC***) ، والكاتالاز، وكذلك تحسن في نسبة معامل اتحويل الغذائي (***FCR***)، في حين انخفضت نسبة الوفيات، و السلوك السلبي للطير، ومستوى الدهون الثلاثية، الكوليسترول الكلي (***TCH***)، وكوليسترول البروتين الدهني منخفض الكثافة (***LDL-C***)، وكوليسترول البروتين الدهني منخفض الكثافة جدًا (***VLDL-C***)، والمالوندايالديهايد (***MDA***) بشكل ملحوظ في جميع معاملات مضادات الأكسدة الطبيعية، ثم الاصطناعية، مقارنةً بمعاملة السيطرة ***T0*** علاوة على ذلك، كانت نسبة الحيوية غير معنوية في جميع المعاملات. في معظم صفات الدراسة أظهرت اضافة زيت البطم ثم مسحوقه تفوقًا ملحوظًا مقارنةً بمضاد الاكسدة الاصطناعية ***BHT*** ومجموعة السطرة

الكلمات المفتاحية: البطم، النمو، السلوك، الفسيولوجي، المناعة، دجاج اللحم.