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Effects of Feeding Oak Acorn Flour on Hematology and Serum Biochemical Profile, and Carcass Characteristics of Japanese Quail

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THIS research was aimed to determining the influence of oak acorn flour on the body, liver and kidney weight, and some (hematological and biochemical) parameters of quail. One hundred quail birds (7 days old) were divided into five groups (n = 20 for each group). Group 1: Control group received a normal protein diet (NPD) containing no oak flour (0%). Groups 2, 3, 4, and 5 (experimental groups) received 5, 10, 15, and 20% oak flour in NPD, respectively. The results showed no significant differences in mean body and organ weight between treated and control groups, but except for the concentration of 5% showed significant increase in body weight over six weeks when compared with control. No significant differences were also recorded in the hemoglobin and packed cell volume in both treated and control groups. When compared to the control group, group 5 (20%) had a significant increase in the number of heterophils cells and a significant decrease in the number of lymphocytes. While other types of leucocytes showed no significant changes in their numbers in all groups. Treatment with oak acorn flour showed no significant effects on levels of all biochemical parameters enrolled in this study in all groups. In conclusion: Quail feeds could contain 20% oak acorn flour seemed to be save and without adverse effects on the body and organ weight, and all blood parameters. Oak acorns could be employed as a source of energy in a quail diet, and their nutritional value is equivalent to that of cereal grains.

Keywords: Oak acorn flour, Japanese quail, Hematology, Biochemical profile, Serum.

Introduction

The demand for white meat and egg proteins has increased due to their nutritional content and health advantages in comparison to red meat, and they are regarded as significant sources of human nutrition. Chicken nutrition is widely recognized as one of the most important factors influencing growth, immunity, and chick embryo quality [1]. The production of poultry is also affected by numerous issues, including the high starting cost of chicks, high nutritional costs, management, and the use of vaccines and antibiotics. To remedy these issues, the poultry business introduced quail as a new product (species). The quail is a dual-purpose bird that is highly disease- and weather-resistant and environmental-condition-resistant without the need for vaccines, and its meat and eggs have a high nutritional content that was used to resolve some of the issues mentioned above [2]. The antioxidant potential of medicinal trees and herbs has attracted considerable interest, and they are employed in the poultry industry to enhance metabolic, productivity, and mating performance [3]. Among a number of medicinal plants, species belonging to the genus Quercus (*Quercus aegilops*) are widely used in traditional medicine. This genus belongs to the family Fagaceae. It has over 600 species worldwide, which often differ in flowering and fruiting dynamics as well as maturity index [4]. Acorn is an important source of carbohydrate, lipid, protein, and tannin. The carbohydrate, protein, and lipid content of acorns has attracted attention for its use

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as a supplement in animal diets [5]. Proximate analyses have revealed the chemical composition of acorns to be similar to that of cereals; starch is the main component of acorns [6]. Therefore, acorns represent an important food source for a variety of animals, generally suitable for sheep, goat, and pig (Iberian pig) nutrition; they can also be used in ox, horse, rabbit, and poultry nutrition [7]. The low cost of acorns compared with barley suggests the substitution of acorns for barley at a maximum level of 25% would be economically advantageous [8]. In addition to its ecological significance (e.g., as food and shelter for mammals and birds), *Q. aegilops* also has economic and cultural significance, such as fuel, carbon, timber, and feed for animals [9]. In 2017, Ferreira and his colleague [10] reported that acorn extracts prevent chicken patties from oxidative damage and maintain organoleptic and qualitative characteristics throughout frozen storage and reheating. Approximately 90% of the forest cover in the Kurdistan Region of Iraq (KRI) is oak forests, with the remaining 10% being plantations, pine trees, riverine forests, and others (e.g*., Crataegus azaro*), which are frequently combined with oak forests [11]. 70% of the oak tree forests are composed solely of *Q. aegilops* [12]. Besides its ecological importance as the residence for various endemic and migratory species, *Q. aegilops* forest also has socio-economic values for example, as fodder for livestock, building material, medicine, charcoal, and firewood [13]. The purpose of this study was to determining the influence of oak acorn flour on the body, liver and kidney weight, and (some of hematological and biochemical) parameters of quail.

Material and Methods

Animals

One hundred (7-day-old) female *Coturnix coturnix* chicks with average weights of 9–10 g were obtained from the University of Mosul, Agricultural Department, Mousl, Iraq. This study was approved by the Animal Ethics Committee of Faculty of Science, University of Zakho (Code: AEC-014). These chicks were reared in cages (50 x 40 cm in width and 38 cm in height) and furnished with plastic feeders and drinks, electrical warmers, ventilators, and electronic thermometers. The home and its equipment were meticulously cleaned and sanitized. The illumination was provided continuously for the first week, then for 15 hours of light (9 hours of darkness for the age range of 8–35 days), then for 13 hours of light (11 hours of darkness for the age range of 36 days and higher). In the first week, the temperature in the home fluctuated between 32 and 34 °C and was then steadily dropped by 2 °C every week until it was eventually set between 24 and 26 °C. These animals were left in their cages for 7 days for adaptation.

Experimental design

These one hundred chicks were randomly divided into five groups (n = 20 for each group), as follows: Group 1: The control group received a normal protein diet (NPD) containing no oak flour (0%). Groups 2, 3, 4, and 5 (experimental groups) received 5% (50 g oak flour plus 950 g NPD), 10% (100 g oak flour plus 900 g NPD), 15% (150 g oak flour plus 850 g NPD), and 20% (200 g oak flour plus 800 g NPD) respectively.

The duration of treatment was extended from age of seven days to 45 days (that's mean 38 days). These animals were weighted every seven days until day 45 of age. The experimental work for this study was carried out in the Animal Breeding House, Department of Biology, Faculty of Science, University of Zakho.

Normal Protein Diet

Normal protein diets were purchased from the Amedi Factory in Duhok City. From the first day to the end of the experiment, 24% crude protein with 3025 kcal/kg metabolizable energy was administered to all quails. The main components of this diet were: energy (3025 kcal/kg); protein (24%); fat (5%); fiber (2.5%); calcium (1%); and phosphorus (0.65%).

Oak acorn collection

Oak acorns were gathered from the south of Zakho-Batoffa and dried in a room for about 15 days before being ground into flour. Use a local grinding machine for grinding, and the shells of the oak acorns were separated by a vibrating sieve, and the flour was then made finer with a microfine grinding machine. Following that, spread oak flour on clean plastic for about two days until completely dried to prevent fungi growth before storing in a dry place until use.

Blood sample collection

At the end of the experiments, 5 ml of blood was drawn from each chick's right jugular vein with a 23-gauge needle attached to a 5 ml syringe. According to the methods of Agina et al.[14], three ml of blood were taken and put into ethylene diamine tetra acetic acid (EDTA) tubes (1 mg/ml) for hematological determinations. The blood was

then gently mixed with EDTA to prevent clotting in these sample tubes, which were then properly labeled. The hematological determinations include estimation of the total count of white blood cells (WBC) and red blood cells (RBC); a complete blood count (CBC); hemoglobin (Hb); and a packed cell volume (PCV) test using standard procedures. RBC and WBC counts were carried out using the Neubauer hemocytometer method. The PCV and Hb were determined by the micro-hematocrit method [15].

While the remaining 2 ml of blood was put into test tubes without anticoagulant and was used for estimating some biochemical parameters. According to Wayne [16], the serum was obtained by allowing the blood sample to clot at room temperature for one hour, then, centrifuged for 10 minutes at 3000 rpm, serum was collected and stored at -20 °C for the determination of the serum cholesterol, total protein (T. protein), triglycerides, glucose and creatinine was carried out using a commercial kit manufactured by BIOLABO.

Dissection

At the end of the experiment, chicks in all groups were weighted with an electrical balance, slaughtered by cervical dislocation, dissected, and the liver and kidney were removed and weighted using a sensitive electrical balance.

Statistical analysis

GraphPad Prism 9.4.1.681 version one-way ANOVA was used to analyze parameter data [17].

Results

Total count of white and red blood cells

The results showed no significant differences (P>0.05) in the average number of WBC and RBC in the control and oak flour groups (5%, 10%, 15%, and 20%). (Table 1) and (Fig. 1).

TABLE 1. Total number of the WBC and RBC of Japanese quail fed with different concentrations of oak flour. (Mean ± SE) .

Treatment	RBC*10^6	WBC*10^3
Control	3.18±0.22^a	5.00±0.29^b
Oak 5%	2.97±0.18^a	4.78±0.11^b
Oak 10%	3.37±0.11^a	5.35±0.10^{ab}
Oak 15%	2.85±0.22^a	5.80±0.13^{ac}
Oak 20%	3.19±0.15^a	6.23±0.33^c

Similar letters within each column refer to the non-significant differences (P> 0.05), whereas different letters in the same column refer to significant differences (P< 0.05).

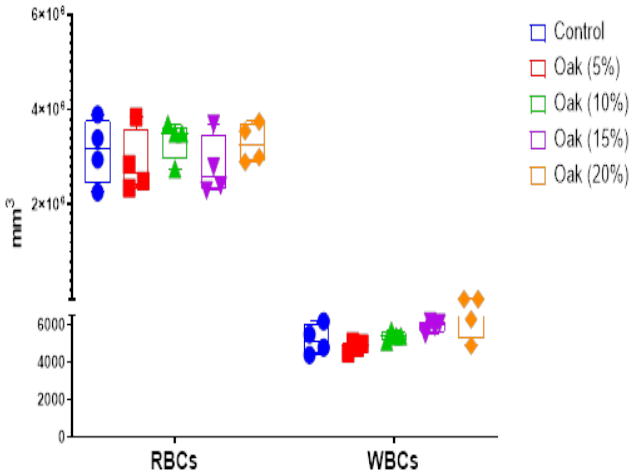

Fig. 1. Total number of the WBC and RBC of Japanese quail fed with different oak flour level.

Complete blood count (CBC)

The result of the differential count of blood was illustrated in Table (2) and Fig. (2), which revealed that, there is a significant increase ($p \leq 0.05$) in the percentage number of the heterophils in groups of 5, 10, 15, and 20% Oak flour as compared with the control group. While the percentage number of lymphocytes, monocytes, eosinophils, and basophils was decreased significantly ($p \leq 0.05$) in all oak flour treated groups compared to the control, the same table also indicated that the stress index was increased in all groups treated with oak flour compared with the control group. The stress factor was represented by increasing the ratio of heterophil/lymphocyte (H/L), where the concentration of 10% was 0.72 and the concentration of 20% was 0.75 compared to the control group, which scored 0.59.

Hemoglobin and Packed cell volume (PCV) test

The results of the blood statistical analysis showed that the levels of Hb and PCV in quails in control, and (5%, 10%, 15%, and 20%) oak flour feeding groups were not significantly different ($P>0.05$) if compared with control or compared within each oak flour treated group (Table 3, Figs. 3 and 4).

TABLE 2. Differential count percentage of Japanese quail blood feed with different concentrations of oak flour. (Mean ± SE).

Treatment	Heterophils	Lymphocyte	Monocyte	Eosinophil	Basophile	Stress index
Control	35.66±0.49^{b*}	60.33±0.33^{a**}	2.00±0.25^{a}	0.83±0.30^{b}	1.33±0.33^{b}	0.59
Oak 5%	39.71±0.28^{a}	56.85±0.34^{b}	1.57±0.29^{a}	0.85±0.26^{a}	0.85±0.26^{b}	0.69
Oak 10%	40.28±1.37^{a}	55.71±0.56^{b**}	0.85±0.26^{a}	0.71±0.18^{a}	1.0±0.30^{b}	0.72
Oak 15%	39.33±0.55^{a}	57.50±0.67^{b}	1.50±0.42^{a}	0.83±0.30^{a}	0.83±0.30^{b}	0.68
Oak 20%	41.50±1.20^{a*}	55.33±0.95^{b**}	1.66±0.21^{a}	0.66±0.49^{a}	0.83±0.40^{b}	0.75

Similar letters within each column refer to the non-significant differences ($P> 0.05$), whereas different letters in the same column refer to significant differences ($P< 0.05$).

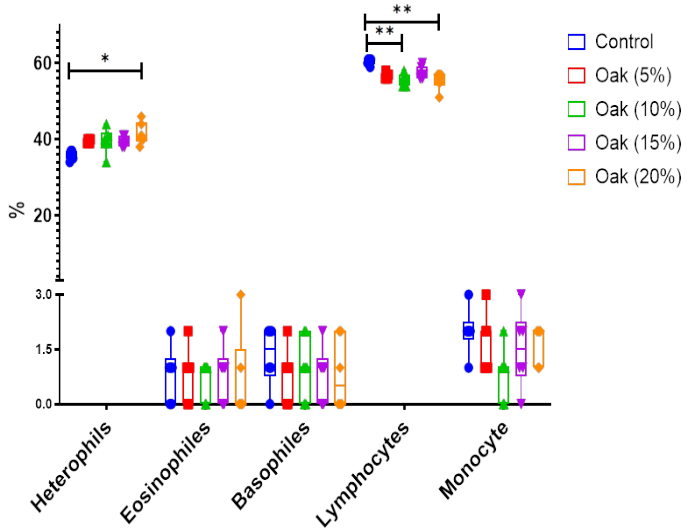

Fig. 2. Differential blood count of Japanese quail fed with different oak flour concentrations.

TABLE 3. Hemoglobin and packed cell volume of Japanese quail blood fed on different oak flour concentrations (Mean ± SE).

Treatment	PCV	Hb g/dl
Control	46.83±1.88[b]	15.16±0.74[b]
Oak 5%	41.28±3.05[b]	13.28±0.89[b]
Oak 10%	44.28±1.34[b]	14.42±0.52[b]
Oak 15%	41.16±1.75[b]	13.33±0.55[b]
Oak 20%	42.33±2.30[b]	13.83±0.94[b]

There are no significant differences (P>0.005) between each column of PCV and Hb Similar letters within each column refer to the non-significant differences (P>0.05), whereas different letters in the same column refer to significant differences (P< 0.05).

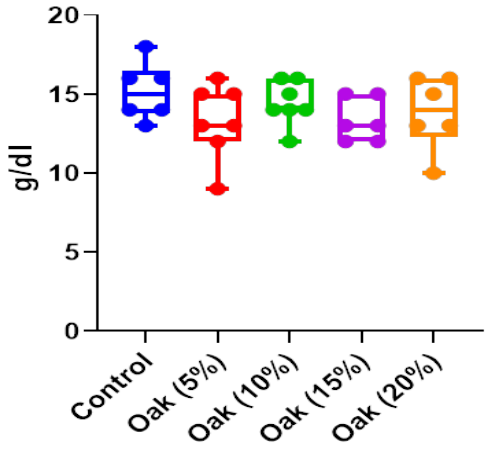

Fig. 3. Hemoglobin levels of Japanese quail fed with different concentrations of oak flour.

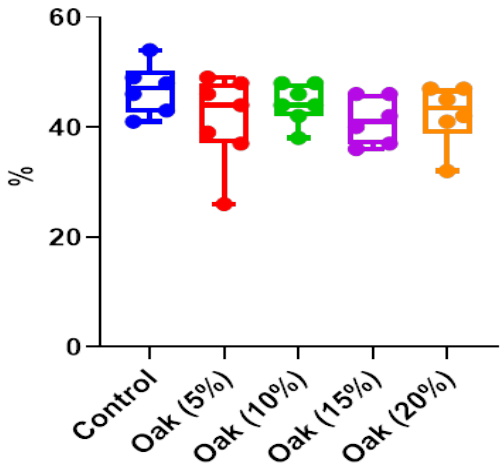

Fig. 4. Hematocrit levels (PCV) of Japanese quail fed with different concentrations of oak flour .

Biochemical blood serum analysis

As indicated in Table (4) and Fig. (5 and 6), no significant differences (P>0.05) were recorded in the levels of glucose, creatinine, T. protein, triglycerides, and cholesterol, in all groups of the experiment. But it was observed that there was a slight decrease (non-significant) in the level of glucose in the groups treated with acorn flour, compared to the control group, which recorded 129.75 mg/dl, and the lowest value for glucose was 110 mg/dl at the concentrations of 15% and 20%. The values of creatinine in the serum of Japanese quail fed with different concentrations of oak flour did not differ significantly in comparison with control group. Despite its slight increase, as it recorded the highest value at a 20% concentration was 0.66 mg/dl and its lowest value was 0.55 mg/dl in a group of 10% compared to the control group 0.46 mg/dl.

Carcass traits

Effect of oak acorn flour on body weight (BW)

In the first and third weeks of treatment, concentrations of 5 and 10% oak acorn flour resulted in a significant increase (P≤0.05) in mean BW when compared with other groups. While no significant increases (P>0.05) were recorded in the mean BW in the 2nd week of treatment between all groups, The result showed that the concentration of 15% caused a significant decrease in BW in comparison with other groups in the 4th week of treatment. The result of the 5th week of treatment also showed no significant alteration in the mean BW in all groups. After the 6th week of treatment, the concentrations of 5, 10, and 20% caused no significant alteration in BW compared with control. Except the concentration of 15% oak flour resulted in significant decrease in the BW (183.90±13.4) compared with control and 5,10 and 20% Oak (207.85 ±4.3; 207.95 ± 4.4; 194.85± 4.4 and 199.15 ±4.2) respectively, Table (5) and Fig. (7).

TABLE 4. Effect of different concentrations of Oak acorn flour on biochemical parameters of blood serums of female Quails. (Mean ± SE).

Treatment	Glucose	Creatinine	T. protien	Triglyceride	Cholesterol
Control	129.75±7.2^{b}	0.46±0.04^{b}	4.05±0.31^{b}	165.5±13.5^{b}	237.5±25.4^{b}
5% oak	128.62±8.1^{b}	0.56±0.06^{b}	3.78±0.17^{b}	169.3±11.4^{b}	238.6±16.76^{b}
10%oak	131.75±20.2^{b}	0.55±0.06^{b}	3.72±0.16^{b}	158.6±13.8^{b}	276.5±42.23^{b}
15%oak	110.87±8.3^{b}	0.62±0.06^{b}	3.82±0.18^{b}	151.2±3.8^{b}	244.5±21.47^{b}
20% oak	110.87±37.9^{b}	0.66±0.06^{b}	3.97±0.29^{b}	167.0±7.7^{b}	244.7±8.86^{b}

There is no significant differences (P>0.005) between each column Similar letters within each column refer to the non-significant difference (P>0.05), whereas different letters in the same column refer to significant differences (P< 0.05).

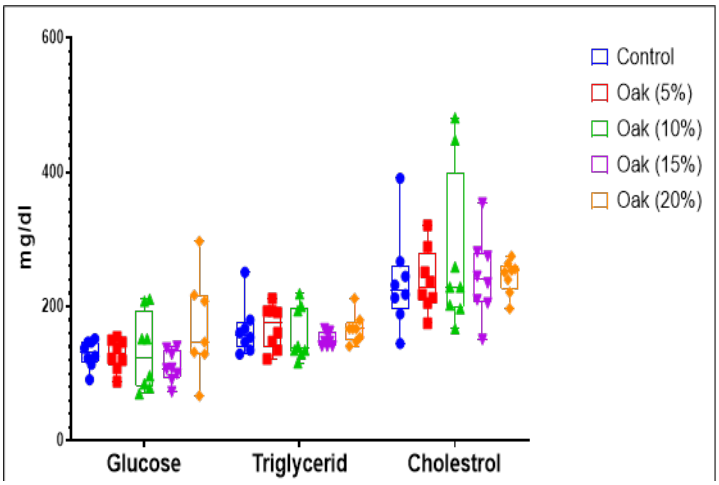

Fig. 5. Levels of the glucose, triglyceride and cholesterol in serum of the Japanese quail fed with different concentrations of oak flour.

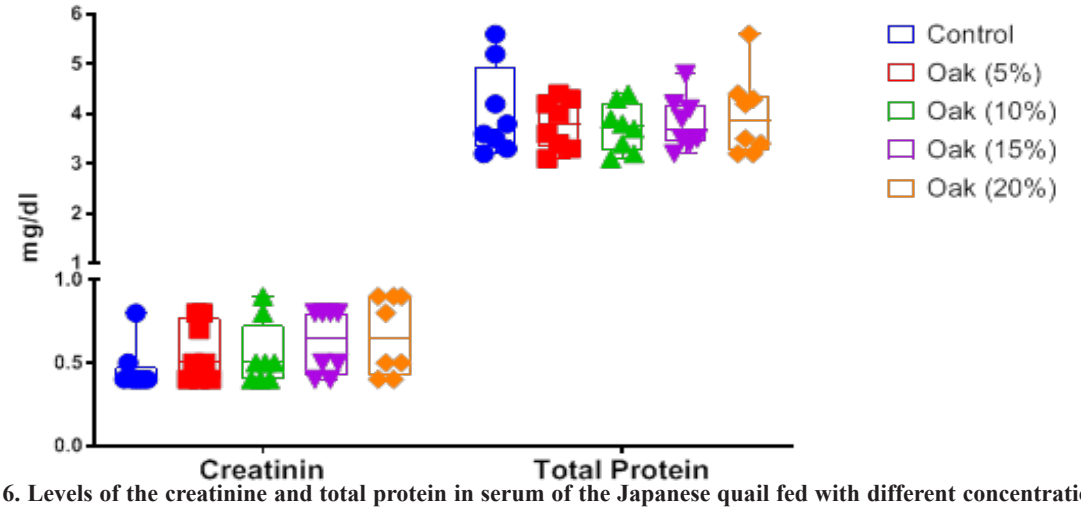

Fig. 6. Levels of the creatinine and total protein in serum of the Japanese quail fed with different concentrations of oak flour.

TABLE 5. Body weights of Japanese quail fed on different oak acorn flour concentrations (gram /bird/week). (Mean ± SE).

Treatment	Weeks					
	1st	2nd	3rd	4th	5th	6th
Control	35.85 ±.88^{b}	69. ±.8^{4}b	102.50 ±1.80^{ab}	144.20 ±1.76^{a}	187.90 ±2.54^{b}	207.85 ±4.3^{a}
Oak 5%	40.3 ±1.21^{a}	73 ±3.67^{b}	107.90 ±2.63^{a}	150.60 ±2.24^{a}	193.15 ±3.21^{b}	207.95 ± 4.4^{a}
Oak 10%	36.85 ±1.71^{ab}	77.15 ±1.77^{b}	110. ±2.18^{a}	143.10 ±3.50^{a}	184.40 ±3.52^{b}	194.85± 4.4^{ab}
Oak 15%	32.95 ±1.91^{b}	69.75 ±3.10^{b}	92.85 ±2.47^{b}	129.65 0±1.51^{b}	181.35 ±5.70^{b}	183.90^{b} ±13.4
Oak 20%	35.8 ±0.78^{b}	76. ±3.76^{b}	93.25 ±9.07^{b}	143.40 ±3.88^{a}	190.40 ±3.12^{b}	199.15 ±4.2^{ab}

There are no significant differences (P > 0.005) between each week's columns. Similar letters within each column refer to the non-significant differences (P>0.05), whereas different letters in the same column refer to significant differences (P< 0.05).

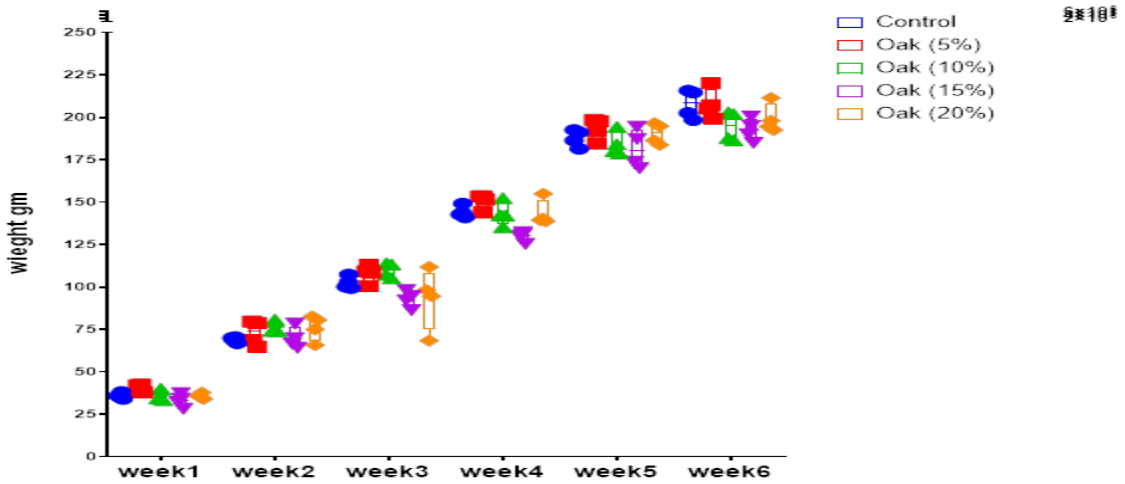

Fig.7. Body weights of Japanese quail groups fed with different oak flour concentrations.

Liver and kidney weight

Table (6) and Fig. (8), indicated that treatment with 5%, 10%, 15%, and 20% oak acorn flour had no significant influences (P > 0.05) on the liver and kidney weights if compared between each other or with the control group.

Discussion

The application of alternative feed ingredients in poultry diets leads to a decrease in performance, usually due to anti-nutrition factors. Therefore, considerable efforts were exerted to determine the appropriate levels of alternative food components in poultry meals and strategies to reduce the negative effects on animals [18]. In light of the harmful effects of oak tannins, different physical, chemical, and biological methods were used to mitigate their harmful effects on poultry [19]. Among the strategies that have been applied to alternative foods are dehulling, heat treatment, the extrusion method, cooking, soaking, germination, and solvent extraction [20]. Akkan and Akkan [21] indicated that the shell of oak seeds contains high concentrations of tannin, estimated at 10 times more than what is found in the seeds. The dehulling method was used in the present study in order to mitigate deleterious effects, so positive results were observed in general, and no negative effects were observed at the hematological and biochemical levels. Except for some parameters enrolled in the present study, the results showed some significant changes either (decrease or increase) in the effects of oak flour. This result, as mentioned by Hammod et al.[22], may be due to the fact that the quantities of oak used were not effective or that they had a significant effect on other characteristics such as physiological and immunological characteristics.

TABLE 6. Liver and kidney weights of Japanese quail fed on different oak acorns concentrations. (Mean ± S.E).

Treatment	Liver	Kidney
Control	4.90±0.64^{b}	0.78±0.08^{b}
Oak 5%	5.27±0.80^{b}	0.82±0.11^{b}
Oak 10%	4.59±1.07^{b}	0.70±0.07^{b}
Oak 15%	4.93±0.89^{b}	0.76±0.07^{b}
Oak 20%	5.57±1.160^{b}	0.79±0.10^{b}

Similar letters within each column refer to the non-significant difference (P<; 0.05), whereas different letters in the same column refer to significant differences (P<t; 0.05).

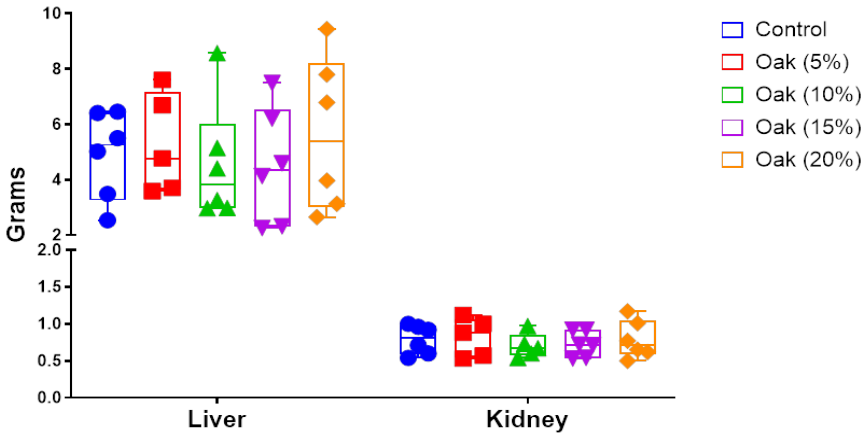

Fig. 8. Liver and kidney weights of Japanese quail fed with different oak flour concentrations.

The results of the current study for blood analysis showed that the normal number of RBCs in quail birds was $3.18x10^6/mm^3$, which agreed with the results of some authors [23, 24], they recorded that the number of this type of blood cell was $3.8x10^6/mm^3$, $3.2x10^6/mm^3$, respectively. But this result was not agreed with the results obtained by [25], they mentioned that the total normal number of RBC was approximately $2x10^6/mm3$, and Deka and Borah [26], recorded the number was $4.04x10^6/mm^3$ for RBC. The current result also showed that the normal number of WBCs for quail birds in the control group was $5x10^3/mm^3$, while many researchers [23,24,26] reported that the normal number for WBC ranges between $20\text{-}40x10^3/mm^3$, $24x10^3/mm^3$, and $3.77x10^3/mm^3$ respectively. This inconsistency may be due to several factors, including genetics (species and strain), exposure to heat and stress environments (uncomfortable cages), method of handling with birds, maintenance systems, production period (starter, growth, and layer), and lighting program, which affect the levels of blood cells in poultry [27].

Results of the total count of RBC and WBC for groups treated with oak flour were similar and without significant differences ($P>0.05$) between them and the control group; this may be, as indicated by Frias et al.[28], due to the oak fruit being free from the shell (rich in tannin) that was removed by the dehulling method. But the result of the present study was not in agreement with the result of Kvan et al.[29] their results indicated that treatment with oak acorns resulted in a decrease in the number of WBCs (but the variation was not statistically significant). While Hammod et al. [22] reported that oak acorns resulted in a significantly increased number of RBCs and WBCs,No significant changes in the values of Hb and PCV were also recorded between groups treated with oak flour and the control group. This result may be due to the amount of food stress was not sufficient to cause a noticeable change in the levels of Hb and PCV. This result may be due to the Hb and PCV values being stable during the first six weeks in juvenile birds [30]. These results were in agreement with Rezaei and Semnaninejad [18], where they did not notice any significant differences in Hb values between broilers fed oak fruits and the control group fed NPD.

When analyzing WBCs differentially, there were significant differences in some types of WBCs at the level ($p<0.05$) compared to the control group. It was noted that at a concentration of 20% oak flour, a higher percentage of heterophils and a lower percentage of lymphocytes were recorded compared to the control group and a concentration of 10% Oak flour resulted in increased the number of heterophils but did not significantly reduce the number of lymphocytes, and the stress factor represented by the H/L ratio increased. These results may indicate food stress caused by the presence of anti-nutrition factors represented by tannins and flavonoids in oak flour added to poultry meal.

Chemical blood analysis values in birds such as T. protein, glucose, cholesterol, triglycerides, creatinine, and others are important clinical indicators of health status because they reflect the functional responses of birds towards exogenous substances such as animal diets [31]. Tawfeek and his colleagues [32] reported that stress factors affect the level of glucose in the serum and stimulate the process of gluconeogenesis of fats and proteins, which determines the level of glucose in the blood and increases the levels of triglycerides.

In the current study, the chemical analysis of blood recorded no significant differences between the groups treated with oak flour at concentrations of 5%, 10%, 15%, and 20%, and the control group that was given NPD. It was observed that there was a slight decrease in the level of glucose in the groups treated with acorn flour, compared to the control group. Perhaps this result is due to the fact that the oak flour contains carbohydrates that can be digested and utilized, and this is what Paswan and Sahoo [33] found when they used oak leaf flour with straw at concentration (63.6%), the organic matter, carbohydrates and proteins significantly increased ($p<0.001$) compared to the concentrations of (42.5%) and the control group (which used straw only). Or the oak used in the current study is free of toxic tannin, as these results agreed with some authors[34], (2018), they concluded that the grinding, drying and heat process reduces the effect of tannin by 71% in beans. No significant differences also were observed in the triglycerides in the treated groups compared to the control group. The results of previous studies indicate that there is a close relationship between glucose and triglycerides during nutritional stress. Parta and his colleagues [35], reported that malnutrition in quail birds leads to a decrease in blood glucose, and thus increases the level of triglycerides in the blood

through lipid analysis [31]. These interpretations also confirm the results of the current study with regard to cholesterol, as no significant changes were observed between the groups treated with acorn flour and its different concentrations, and the control group fed NPD.

The values of creatinine in the serum of Japanese quail did not differ significantly despite its slight increase, as it recorded the highest value at a 20% concentration of 0.66 mg/dl and its lowest value of 0.55 mg/dl in a group of 10% compared to the control group that recorded 0.46 mg/dl. These values may indicate no damage occurred, neither at the muscular level nor at the renal level [36], and if damage was found, it was mild. The values of total protein also showed no significant differences among the groups treated with oak flour. This result could be explained by the fact that the proteins in the diet were sufficient to feed the quail birds, so the acorn flour at a concentration of 20% had no effect on protein levels in the blood. But the present result was not in agreement with the results of Tayeb et al.[2], they showed that treatment with oak leaves at a concentration of 10gm/kg caused a significant increase ($P \leq 0.05$) in serum total protein in male quail.

Body, liver and kidney weights are indicators to carcass traits that reveal the effect of oak flour on quail birds. Throughout the current investigation, the addition of oak acorn flour to the NPD at levels of 5%, 10%, 15%, and 20% had no passive influence on bird weights, except for some variation as indicated in the result, this may be due to the palatability of oak acorns, which resulted in the birds accepting the taste and flavor of oak acorns and not rejecting the diet, resulting in normal growth parameters. Historically, oak acorns had been fed to goats, sheep, and cattle without any negative effects being observed [37]. The result of the present study is in agreement with the results obtained by Maidala et al.[38], they found no significant differences in the body weight gain of broiler chicks fed a corn-based diet or those fed germinative sorghum-based diets. But the result of the present study does not agree with the results obtained by Saeidi et al.[39], because their results indicated that dietary inclusion of oak (150 and 200 g/kg diet) significantly reduced body weight gain overall (days 1–42) and resulted in worse finishers and overall feed conversion ratios.

The result of the present study also indicated that treatment with different concentrations oak acorn flour had no significant influences on the liver and kidney weights if compared between each other or with the control group. This result was in agreement with the results of some investigators[8], which indicated that the tannin content of the oak acorn had no negative impact on the health of (*Coturnix coturnix*) Japanese quail[39], also reported that the liver and pancreas weights were not significantly influenced by the oak level (150 & 200 g/kg diet).

In conclusion: according to the findings of the present study, quail feeds could contain up to 20% oak acorn flour without adverse effects on the body weight, organ weight, and all blood parameters. Oak acorns could be employed as a source of energy in a quail diet, and their nutritional value is equivalent to that of cereal grains.

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Conflict of Interest
The authors declare no conflict of interest.

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تأثير تغذية دقيق البلوط على أمراض الدم والصورة الكيميائي الحيوي للمصل، والخصائص الجسديه لطائر السمان الياباني

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يهدف هذا البحث إلى تحديد تأثير دقيق البلوط على الجسم ووزن الكبد والكلى وبعض المقاييس (الدموية والكيميائية الحيوية) للسمان، تم تقسيم مائة طائر السمان (عمر 7 أيام) إلى خمس مجموعات (ن = 20 لكل مجموعة). المجموعة الأولى: تلقت المجموعة الضابطة وجبة غذائيًا بروتينيًا طبيعيًا (NPD) لا يحتوي على دقيق البلوط (0٪). تلقت المجموعات 2 و 3 و 4 و 5 (مجموعات تجريبية) 5% و 10% و 15% و 20% من دقيق البلوط في NPD ، على التوالي. أظهرت النتائج عدم وجود فروق ملحوظة في متوسط وزن الجسم والعضو بين المجموعتين المعاملة والضابطة ، باستثناء التركيز ٥٪ حيث أظهر زيادة معنوية في وزن الجسم على مدى ستة أسابيع بالمقارنة مع المجموعة الضابطة. كما لم تسجل فروق ذات اهميه في الهيموجلوبين وحجم الخلايا المكدسة في كل من المجموعتين المعالجة والضابطة. بالمقارنة مع المجموعة الضابطة ، المجموعة ٥ (تركيز ٢٠٪) اظهرت زيادة معنوية في عدد الخلايا المتباينة وانخفاض معنوي في عدد الخلايا الليمفاوية. بينما لم تظهر الأنواع الأخرى من الكريات البيض أي تغيرات كبيرة في أعدادها في جميع المجموعات. لم تظهر المعاملة بدقيق البلوط أي تأثير معنوي على جميع المقاييس البيوكيميائية المسجلة في هذه الدراسة في جميع المجموعات. في الختام: يمكن أن تحتوي أعلاف السمان على ٢٠٪ دقيق بلوط دون اي آثار ضارة على الجسم ووزن الأعضاء وجميع مقاييس الدم. يمكن استخدام دقيق البلوط كمصدر للطاقة في نظام غذائي للسمان ، وقيمته الغذائية تعادل قيمة حبوب الحبوب.

الكلمات المفتاحية: دقيق البلوط ، السمان الياباني ، أمراض الدم ، صورة الكيمياء حياتية ، مصل.
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