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Research Article
The Effect of Adding Oak Bark Powder to the Diet on Some Productive and Immunological Characteristics of Broiler Chicks

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Abstract

Background and Objective: The current study investigated whether the addition of oak bark powder to poultry diets improved the production and immunological traits of broilers. The goal of farmers is to increase immunity to reduce the risk of different diseases and reduce the use of antibiotics, which negatively affect human and animal health. The attainment of this goal leads to an increase in profits for the broiler industry. We aimed to study the effect of oak bark powder on the productive, physiological and immunological characteristics of broiler chicks. **Methodology:** A total of 180 unsexed Ross chicks (initial weight of 41 g per chick) were raised in a closed house that was divided into pens, each of which was 3 m^2 and the chicks were randomly distributed to the pens. Four treatments with 45 chicks each were tested. Three replicates were carried out for each treatment. **Results:** The results showed that there were no significant differences in the final body weight, cumulative weight gain, total feed intake, total feed conversion ratio, mortality rate, economic figure and hemoglobin level of the chicks. However, the addition of oak powder had a significant effect on decreasing the incidence of Newcastle disease and infectious bursal disease. There was a significant increase in the number of blood cells for all levels of oak powder addition, resulting in a significant improvement in the number of red blood cells of the broiler chicks fed the 3% oak bark powder and a significant improvement in the number of white blood cells of the broiler chicks fed the 1% oak bark powder. **Conclusion:** Because the addition of oak bark powder improved the immunological and blood parameters of broiler chicks, it is recommended to add oak bark powder to broiler chick diets to enhance immunity and improve blood parameters in broiler chicks.

Key words: Body weight, broiler, oak bark, poultry feed, weight gain

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The wide use of drugs, antibiotics and growth stimulators in the poultry industry has led to numerous problems on many forms for both humans and animals in addition to increasing the economic cost of poultry production. Therefore, recent studies on poultry feeding are interested in finding efficient methods that depend on food supplements to enhance the growth rate and increase the immunity of birds, which enhances the production efficiency of birds. One of these methods is using grass and medicinal plants as food supplements because of their positive effect on improving the production performance of birds. Medicinal plants play crucial roles in medical and protective uses because their tissues contain many chemical compounds that greatly affect human and animal bodies. One of the Medicinal plants that positively affects the health and immune system of birds is oak, which can be characterized as strong, large and rigid trees. The plant is widespread in the area around the Mediterranean Sea and its fruits are used for human consumption. Oak is also found in other places around the world, such as North America, Europe and many parts of Asia. Many active substances are found in this plant, especially tannins and the cortex contributes approximately 10-15% of the tannins depending on trunk size.

Medical herbs were historically widely used in the poultry industry as an alternative to antibiotics and growth promoters in several cultures, such as in Sumerian, Chinese, Egyptian, Greek and Roman cultures[1-3]. Medicines and pharmaceuticals, including antibiotics and growth stimulants, have both physiological and health effects on animals and humans. Recently, some medicinal and aromatic plants and their extracts have been used in the poultry industry[4], where their natural chemicals have physiological and therapeutic effects on humans and animals[5]. The medicinal plants have also been used in poultry feed because they contain natural chemicals that have a proven ability to improve productive, physiological and immunological traits[6]. Many of these plants and their extracts have been used in poultry feed as alternatives to antibiotics and growth promoters. Rosemary, oregano[7], cinnamon leaves and bark, sour orange[8], fenugreek seeds[9], tumeric[10], anise[11] garlic[12], neem tree[13], Taurus and King's Wreath[14] have been used in poultry feed.

Oak bark consists of several tannins and phenolic compounds, such as vanillic acid, ellagic acid and gallic acid[15]. The plant bark can also be used as an anti-inflammatory agent because it is high in tannins, pectins and flavonoids, which have antimicrobial effects[16]. However, there is no information on the local use of oak bark powder in poultry feed. Thus, the present study was planned to determine the effect of adding different levels of *Quercus aegilops* powder to broiler chick feed on the productive and immunological characteristics of broiler chicks.

MATERIALS AND METHODS

Field experience: The research was conducted in the poultry facilities of the Animal Production Department of the Faculty of Agriculture, University of Kufa from 16/3/2015 to 19/4/2015 to study the effect of an oak bark powder diet on the productive, physiological and immunological characteristics of broiler chicks.

Experimental plan: The chicks were fed with a starter diet from week 1-3 of their lives and then with a finisher diet until the end of week 5. Three levels of oak bark powder (1, 2 and 3%) were added to the feed of the broiler chicks. A standard diet with 0% oak bark powder was used as a control treatment.

Animal husbandry: A total of 180 unsexed Ross chicks (initial weight of 41 g per chick) were chosen and raised in a closed house, which was divided into pens, each of which was 3 m^2. The four treatments were randomly distributed to the pens, with 45 chicks per treatment. Each treatment was replicated 3 times (15 birds per replicate). The treatments were distributed on the ground and the ground was covered with a layer of sawdust that was approximately 7 cm thick. A 5 L inverted plastic waterer was used in each pen and was replaced by an automatic suspension waterer on the third week. Circular plastic feed trays with a diameter of 38 cm were used during the first week of the birds' lives and were then replaced with cylindrical feeders that were raised as the birds aged to reach their chest. Both water and feed were provided *ad-libitum*. The control diet was standard as shown in Table 1.

Table 1: Gross composition and calculated analyses of the experimental diet

	Diets	
Ingredients	Starter (%)	Finisher (%)
Ground maize	50.0	54.5
Wheat	12.0	12.0
Soybean meal (44% CP)	30.0	23.0
Protein concentrate	5.0	5.0
Sunflower oil	1.0	3.5
Limestone	1.0	1.0
Dicalcium phosphate	0.7	0.7
Salt	0.3	0.3
Total	100.0	100.0
Calculated composition		
Crude protein (%)	22.46	19.5
Metabolizable energy (kcal kg^{-1})	3013.00	3223.0
Energy: protein	134.00	165.0

Variables studied: The productivity traits were studied weekly from day 1-35 of age. The chicks were weighed weekly to measure body weight and the rate of weight gain was calculated by subtracting the initial weight from the final weight. Feed intake was measured by calculating the amount of feed provided and the amount remaining at the end of each week in addition to the cumulative amount of feed consumed and the feed conversion ratio was calculated by dividing the average amount of feed intake by the birds in a certain period by the average increase in live body weight of the birds for the same period. The total mortality rate was recorded as a percentage and the economic figure of the chicks was calculated according to Naji and Hana[17]. Blood samples via the wing vein were taken after the end of the experiment (35 days) from 4 birds (2 males and 2 females) of each treatment. The samples were divided into two parts. The first part was placed in a test tube containing a coagulation inhibitor (K-EDTA) for hemoglobin analysis, as indicated by Varley *et al.*[18] and for blood cell analysis, as demonstrated in Archer[19]. The number of white blood cells was calculated using glass microscope slides prepared for differential counting and the number of red blood cells was calculated using optical microscopy (Olympus Optical Co., Japan) according to Natt and Herrick[20]. The other subsample of blood was collected in K-EDTA-free test tubes to perform blood serum analyses for ELISA (BioTek Instruments, U.S.A.) titers against Newcastle disease and infectious bursal disease. The scale criterion for serum antibodies directed against Newcastle was quantified by selection using an indirect enzyme-linked immunosorbent assay (ELISA) at the Veterinary Hospital in Kufa City, Najaf Governorate.

Statistical analysis: The statistical analyses were carried out using SAS (version 9.1)[21]. A complete randomized design was used to assess the effect on the studied variables. The means were compared using Duncan's multiple range test[22] at a 5% level of significance ($p \leq 0.05$).

RESULTS AND DISCUSSION

The weekly body weights of the broiler chicks fed with different levels of oak bark powder are presented in Table 2. The results showed that there was a significant difference among the treatments during the first week of feeding, where the live body weights of the broiler chicks fed 1% oak bark powder were significantly higher than those of the other treatments including the control treatment. The body weights of broiler chicks fed 2% oak bark powder were significantly the lowest. After three weeks of feeding, there was a significant increase in the live body weight of the broiler chicks fed 1% and 2% oak bark powder compared with that of the group fed 3% oak bark powder and the control. The results of week four showed that the body weights of the broiler chicks fed the 2% oak bark powder and control diets were significantly higher than those of the other treatments. The data recorded on week five showed that there was no significant difference among the treatments. This result may be because the quantities of oak bark were not effective or that they had a significant effect on other characteristics such as physiological and immunological characteristics. These results were in agreement with those of Ibrahim *et al.*[14], who found that there was no significant difference in the live body weight of broiler chicks when liquid extracts from a borage plant and a Melilotus plant were added to drinking water. The results were also similar to those of Rahimi *et al.*[23], who reported that there was no significant difference in the mean body weight of broiler chicks fed coneflower, garlic or thyme plant extract diets.

For the diet with 1% oak bark powder, the body weight gain of the broiler chicks was higher than that of the chicks fed the control and 2% oak bark powder diets, whereas there was no difference in body weight gain between the broiler chicks fed 3% oak bark powder and the control after 7 days of treatment (Table 3). During the second and fifth week post treatment, there was no significant difference in the body weight gain of the broiler chicks among treatments. However, a significant increase in the body weight gain of the broiler chicks was recorded after 3 and 4 weeks of feeding, where the body weight gain of the broiler chicks fed 1 and 2% oak bark powder during week 3 and fed 3% during week 4 were higher than those of the chickens fed the other rates of oak bark powder. The data recorded on week five showed that there was no significant difference among the treatments.

Table 2: Effect of diets containing different levels of oak bark powder on the live body weight (g) of broiler chicks for 35 days

	Age/day				
Treatments	7	14	21	28	35
Control	126±0.43^{b}	355±1.45^{b}	747±5.77^{b}	1278±5.59^{a}	1724±12.70
1% oak bark powder	131±1.73^{a}	362±1.74^{ab}	783±2.8 ^{a}	1253±9.52^{b}	1738±12.41
2% oak bark powder	122±1.15^{c}	354±2.30^{b}	775±2.0^{a}	1266±3.17^{ab}	1701±21.93
3% oak bark powder	130±0.58^{a}	374±8.08^{a}	745±9.81^{b}	1257±11.44^{b}	1713±10.59

The same letters within each column indicate no significant differences at $p \leq 0.05$ using Duncan's test

Table 3: Effect of diets containing different levels of oak bark powder on the body weight gain (g) of broiler chicks for 35 days

	Age/days					
Treatments	0-7	14-Jul	14-21	21-28	28-35	0-35
Control	87±0.43^{b}	299±1.01^{b}	391±7.21^{a}	531±8.37	446±10.10	1684.00±12.70
1% oak bark powder	91±1.73^{a}	231±0.28^{a}	421±1.15^{c}	470±9.81	485±21.93	12.41±1699
2% oak bark powder	82±1.15^{c}	232±1.16^{a}	420±2.02^{bc}	492±2.88	435±25.11	21.93±1661
3% oak bark powder	90±0.58^{ab}	244±8.66^{c}	371±1.73^{ab}	512±11.2	456±4.04	10.59±1674

The same letters within each column indicate no significant differences at p≤0.05 using Duncan's test

Table 4: Effect of diets containing different levels of oak bark powder on broiler feed intake (g) for 35 days

	Age/days					
Treatments	0-7	14-Jul	14-21	21-28	28-35	0-35
Control	133±1.45	2.88±346	618.00±2.88	919±1.15^{ab}	950±7.73	2964±14.04
1% oak bark powder	132±0.57	1.44±343	3.75±605	925±2.88^{a}	948±3.44	2952±10.28
2% oak bark powder	134±1.15	1.44±344	612.00±6.06	918±2.02^{ab}	945±5.48	2945±16.09
3% oak bark powder	132±1.15	2.02±345	609.00±3.17	914±2.02^{b}	956±2.30	2955±11.37

The same letters within each column indicate no significant differences at p≤0.05 using Duncan's test

Table 5: Effect of diets containing different levels of oak bark powder on the feed conversion ratio (feed/gain) of broilers during a 35-day experiment

	Age/days					
Treatments	0-7	14-Jul	14-21	21-28	28-35	0-35
Control	1.53±0.08^{b}	0.01±1.51	1.58±0.02^{b}	1.73±0.2^{c}	2.14±0.25	1.76±0.81
1% oak bark powder	1.45±0.03^{c}	0.05±1.48	1.44±0.01^{c}	1.97±0.03^{a}	1.97±0.19	1.74±0.51
2% oak bark powder	1.63±0.08^{a}	0.03±1.48	1.45±0.08^{c}	1.87±0.01^{b}	2.20±0.13	1.78±0.62
3% oak bark powder	1.47±0.02^{bc}	0.05±1.42	1.64±0.01^{a}	1.78±0.03^{bc}	2.10±0.32	1.77±0.28

The same letters within each column indicate no significant differences at p≤0.05 using Duncan's test

The effect of adding different levels of oak bark powder on the weekly and cumulative feed consumption of the broiler chicks is presented in Table 4. The results showed that there were no differences in feed intake among the treatments every week post treatment. The absence of a significant difference in cumulative feed consumption indicates that the oak bark was palatable. This outcome confirms the findings of Abd Al-Jaleel[10], who found that there was no significant difference in feed intake when turmeric powder was added to the broiler chick diet compared to that of the control. Similarly, Ocak *et al.*[24] reported that there was no significant difference in the feed consumption rate when dry peppermint and thyme leaf powder was added to broiler diets.

Table 5 shows the weekly and cumulative feed conversion ratios of the broiler chicks in the control and experimental groups with different levels of oak bark powder. During the first week, there was a significant increase in the feed conversion ratio of the broiler chicks fed 2% oak bark powder compared with that of the chicks fed the control and 1 and 3% oak bark powder diets. However, there was no significant difference in the feed conversion ratio between the control and experimental groups in week 2 and 5. The results showed that there was a significant improvement in the feed conversion ratio for the 3% oak bark powder diet compared to that for the other treatments during the third week. In addition, a significant improvement in the feed conversion ratio for the broiler chicks fed 1% oak bark powder compared to that of the other experimental groups and control group was recorded in week 4.

These results were consistent with those of Taha *et al.*[13], who reported that there was no significant difference in the FCR when different levels of neem seed powder were added to broiler chick diets.

Table 6 shows the effect of different levels of oak bark powder on the mortality rate and economic figure of the broiler chicks. There were no significant differences among the treatments. These results may be due to the use of an integrated preventive program and the ability to follow the necessary precautions during research. Additionally, the total mortality rate of the broiler chicks fed the different levels of oak bark powder was very low and was 0% in treatment 4. This result may be related to the presence of substances that act as antibiotics in the oak bark, which improved the health of the birds. This improvement decreased the mortality rate of the birds fed oak bark powder, which was reflected in the economic figure of those birds. These results agreed with those of Al-Baldawy *et al.*[8], who reported no significant differences when cinnamon bark powder or sour orange leaves and bark were added to the broiler chick diets. Similarly, the results were in agreement with those of Al-Maliki[25],

Table 6: Effect of diets containing different levels of oak bark powder on the mortality rate and economic value of broilers during a 35-day experiment

Treatments	Mortality (%)	Economic figure
Control	4.47±2.23	10.30±267.6
1% oak bark powder	2.23±2.23	3.55±279.3
2% oak bark powder	2.23±2.23	12.48±267.5
3% oak bark powder	0.00±0.00	1.77±278.0

The same letters within each column indicate no significant differences at $p \leq 0.05$ using Duncan's test

Table 7: Effect of diets containing different levels of oak bark powder on the level of antibody titers against Newcastle disease virus (NDV) and infectious bursal disease (IBD) in broilers during a 35-day experiment

Treatments	Antibody titers against NDV	Antibody titers against IBD
Control	1451±26^{b}	1389±469^{c}
1% oak bark powder	1378±210^{b}	2856±872^{b}
2% oak bark powder	1534±68^{b}	7793±346^{a}
3% oak bark powder	2417±84^{a}	722±4789^{a}

The same letters within each column indicate no significant differences at $p \leq 0.05$, using Duncan's test

Table 8: Effect of diets containing different levels of oak bark powder on the hematological indices of broilers during a 35-day experiment

Treatments	PCV (%)	Hb (g dL^{-1})	RBC (106 μL^{-1})	WBC (103 μL^{-1})
Control	37±0.57^{c}	8.95±0.89	2.40±0.18^{b}	8.40±0.34^{b}
1% oak bark powder	39±0.58^{b}	9.45±0.03	2.28±0.07^{b}	10.95±0.43^{a}
2% oak bark powder	40±0.00^{b}	9.20±0.05	2.38±0.1^{b}	8.95±0.37^{b}
3% oak bark powder	43±0.58^{a}	10.90±1.44	3.25±0.5^{a}	8.00±0.11^{b}

The same letters within each column indicate no significant differences at $p \leq 0.05$ using Duncan's test

who found that there was no significant difference in economic figure when broilers were fed diets containing 500 or 750 g/tsp licorice root powder.

The results presented in Table 7 show the effect of using different levels of oak bark powder on the level of antibodies against Newcastle disease and infectious bursal disease. The level of antibodies directed against Newcastle disease was significantly higher ($p \leq 0.05$) in the birds fed the 3% oak bark powder diet than those of the other experimental treatments. With respect to the level of antibodies directed against infectious bursal disease, it was noted that there was a significant increase in the experimental treatments compared with the control treatment. The significant improvement in the level of antibodies directed against both Newcastle and infectious bursal disease may be due to the presence of active substances found in oak bark powder that increases the immunity of the birds. The results of the present study were similar to those reported by Al-Obaidi[26], who found an improvement in the level of antibodies directed against both Newcastle and infectious bursal disease when adding different levels of ground black cumin seeds.

Table 8 shows the packed cell volume (PCV), level of hemoglobin (Hb), red blood cell count (RBC) and white blood cell count (WBC) in the blood of the broiler chicks at 35 days. The results showed that there was a significant increase ($p \leq 0.05$) in the number of blood cells in the broiler chicks fed 3% oak bark powder compared with that of the other experimental treatments and the control diet. There was no significant difference in hemoglobin level among all experimental treatments, although there were differences in the blood cell counts among the different addition treatments. The birds fed the 3% oak bark powder had the highest red blood cell count compared with the birds in the other experimental treatments. However, the birds fed the 1% oak bark powder had the highest white blood cell count compared to that of the broiler chicks fed the 0, 2 and 3% oak bark powder. In general, most of the hematological parameters were significantly improved in favor of the use of oak bark powder in broiler chick diets. This result may be due to improved bird health due to the presence of some active ingredients in the oak bark added to the diet. These results agreed with those of Al-Nasrawi[27] who showed that there were no significant differences in the hemoglobin level but significant improvements in the packed cell volume and red blood cell and white blood cell counts of broiler chicks fed a diet with the addition of Roselle (*Hibiscus sabdariffa*) flowers. In regard to the results of this study, we can conclude that 3% oak bark powder is a suitable level in poultry diets to improve the immunity and health status of the birds without any negative effects; therefore, we recommend using this level of oak bark powder.

CONCLUSION

The results indicated that there was no significant effect of oak bark powder on the final live body weight, cumulative body weight gain, feed consumption, food conversion ratio or economic figure chicks, while the addition of 3% oak bark

powder to the poultry diet led to an increase in the level of antibodies against Newcastle disease and infectious bursal disease, as well as packed cell volume and red blood cell count.

SIGNIFICANCE STATEMENT

The current study helps researchers discover the positive effects of the use of oak bark powder in poultry diets because oak bark powder contains many active compounds that contribute to bird health and enhance production traits. The use of oak peel powder has not been of interest to many researchers in previous studies.

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