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Effect of Adding Olive (*Olea Europaea L.*) Oil to Broiler Feed on Growth Performance and Mortality Rate

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تأثير إضافة زيت الزيتون (*Olea europaea L.*) الى علف دجاج اللحم على أداء النمو ومعدل النفوق

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Abstract

This study was conducted to investigate the effect of adding olive oil to broiler feed on growth performance and mortality rate. This study used 90 chicks of the Ross 308 strain that were randomly divided into 3 groups. Starting from the 15th day of age, the first group was fed a basal diet without olive oil (control treatment), and the second and third treatments were fed a basal diet supplemented with olive oil at a rate of 1% (OO1%) or 2% (OO2%), respectively and the experiment continued until the 45th day of age. The results showed that the treatments containing 1% and 2% olive oil were significantly superior ($P < 0.05$) to the control treatment in live body weight (LBW) in most of the experimental weeks of the study as well as in the final live body weight (FLBW), and the results of daily weight gain (WG) followed the same trend. The results of feed intake (FI) showed that the cumulative FI (during the entire experimental period) was significantly higher ($P < 0.05$) in the control treatment than in the other two treatments, which were equal. However, the cumulative feed conversion rate (FCR) was higher in the control treatment, followed by the OO1% and OO2% treatments, respectively, but without statistically significant differences. Mortality rates (MR) were significantly higher in the OO2% treatment compared to the control treatment, but the ratios in both treatments were within normal limits, while no mortality was recorded in the OO1% treatment throughout the experiment.

These results indicate that the addition of 1% olive oil achieved improved results in growth performance and survival rate of broiler chickens.

Keywords: Olive oil, Broiler, Live body weight, Feed intake, Mortality rates.

الملخص

أجريت هذه الدراسة لمعرفة تأثير إضافة زيت الزيتون إلى علف دجاج التسمين على أداء النمو ومعدل النفوق. استخدمت هذه الدراسة 90 كتكوتا من سلالة Ross 308 تم تقسيمها عشوائيًا إلى 3 مجموعات. وبدءًا من اليوم الخامس عشر من العمر، تم تغذية المجموعة الأولى على عليقة أساسية بدون إضافة زيت الزيتون (معاملة تحكم)، وتم تغذية المعاملتين الثانية والثالثة على عليقة أساسية مضافة لها زيت الزيتون بنسبة 1 % (*OO1%*) أو 2 % (OO2%) على التوالي واستمرت التجربة حتى اليوم الخامس والأربعين من العمر. أظهرت النتائج أن المعاملات المحتوية على 1% و2% زيت زيتون تفوقت بشكل معنوي ($P < 0.05$) على معاملة التحكم في وزن الجسم الحي (LBW) خلال معظم الأسابيع التجريبية للدراسة وكذلك في وزن الجسم الحي النهائي (FLBW)، واتبعت نتائج زيادة الوزن اليومية (WG) نفس الاتجاه. كما أظهرت نتائج تناول العلف (FI) أن FI التراكمي (خلال فترة التجربة بأكملها) كان أعلى بشكل ملحوظ ($P < 0.05$) في معاملة التحكم منه في المعاملتين الأخريين اللتان كانتا متساويتين، ومع ذلك كان معدل التحويل الغذائي التراكمي (FCR) أعلى في معاملة التحكم، تليها معاملتي (OO1%) و (OO2%)على التوالي، ولكن دون فروق ذات دلالة إحصائية. كانت معدلات النفوق (MR) أعلى بشكل ملحوظ في معاملة (OO2%) مقارنة بمعاملة التحكم، ولكن النسب في كلتا المعاملتين كانتا ضمن الحدود الطبيعية، في حين لم يسجل أي نفوق في معاملة (OO1%) طوال التجربة. تشير هذه النتائج إلى أن إضافة زيت الزيتون بنسبة 1٪ حققت نتائج أفضل في أداء النمو ومعدل البقاء في دجاج اللحم.

الكلمات المفتاحية: زيت الزيتون، دجاج اللحم، وزن الجسم الحي، العلف المتناول، نسبة النفوق.

1. Introduction

Poultry and its products are considered one of the most important sources that the world depends on for its food, as poultry meat and eggs are the largest global source of animal protein used for human consumption [1], in addition to the poultry sector's significant contribution to providing job opportunities and income for millions of workers. The poultry sector is the fastest growing agricultural sub-sector, especially in developing countries, and it contributes significantly to supporting nutrition and food security by providing protein, energy, and many nutrients during short production cycles and a high capacity to convert many agricultural by-products and food waste into meat and eggs suitable for human consumption [2,3].

Poultry meat accounted for about 40% of global meat production, which reached 375 million metric tons in 2021[4]. Genetic improvement, development of management methods, and nutritional practices have led to a significant improvement in poultry meat production, especially in terms of cost, compared to the past twenty years [5]. Poultry meat in general and chicken meat in particular are characterized by their high nutritional quality and availability in addition to their reasonable prices, and therefore they are widely consumed worldwide [6, 7]. Thus, the scientific production of chicken meat is constantly increasing, after it was about 7.56 million tons in 1961, it is expected to reach 139.19 million tons in 2025 [8].

Feed costs, which reach 70%, constitute the highest costs in the broiler production process [9]. Therefore, the nutrition aspect receives great attention from researchers and nutritionists to search for the best and least expensive feeds. Feed additives are considered one of the promising technologies in broiler production, especially when the use of some antibiotics has been banned. Feed additives have been proven to achieve many goals, including increasing feed intake, stimulating digestion, improving feed efficiency, increasing growth performance, and reducing the incidence of diseases [10, 11].

Olive oil is one of the feed additives that has attracted the attention of poultry nutrition experts. It is extracted from the olive tree known by the scientific name (Olea europaea L.), which is considered one of the oldest cultivated trees in the world, as it was cultivated about 6,000 years ago in the Mediterranean basin, which includes the largest number of these trees and is considered the main source of olive oil in the world [12]. It has been confirmed that olive oil has many health benefits and is considered a carrier of essential oils in addition to having several biological properties, including the possibility of supporting immunity and its antibacterial effect in addition to its antioxidant effects [13]. Based on these benefits, this paper aims to evaluate the effect of adding olive oil on growth performance and mortality rate in broiler chickens.

2. Material and methods

2.1 Study location

The study was conducted during the winter of 2024 in the poultry farm of the Research Unit of the Department of Veterinary Medical Sciences Technology at the Higher Institute of Agricultural

Technology, Derna, Libya. Part of the farm was equipped and divided into treatments and replicates according to the requirements of the experiment**.**

2.2 Study design and birds

This study was conducted using the floor-rearing system, where 90 one-day-old broiler chicks of the (Ross 308) strain were used. The study began when the chicks reached 15 days of age and had an initial weight of (530.1 ± 0.1 g). These chicks were randomly divided into three treatments, each treatment consisting of 30 chicks divided into three replicates, each replicate consisting of 10 chicks. These treatments are the Control treatment (C) fed on a diet free of any olive oil addition, a second treatment fed on a diet with 1% olive oil added (OO1%), and a third treatment fed on a diet with 2% olive oil added (OO2%).

2.3 Study feeds

Starter feed (Table 2.1) was used for all chicks during the first phase of the study (1-14 days). Extra virgin olive oil was provided from the local Libyan markets to be used in preparing the study diets for the second phase of the study (15-45 days). These diets were prepared using a standard balanced diet (Table 2.2). There were three types of diets: a diet without any added olive oil, which is the control diet (C), a diet with 1% added olive oil (OO1%), and another diet with 2% added olive oil (OO2%).

Table 1: Chemical composition of starter feed used to feed chicks in the first stage (1-14 days).

Nutrient	Amount
Protein (%)	23
Fat (%)	3.67
Fiber (%)	1.9
Ash (%)	5.8
Moisture (%)	9.8
Metabolizable energy: ME (kcal/kg)	3000

Table 2. Chemical composition of basal standard feed used to feed birds in the second stage (15-45 days).

Nutrient	Amount
Protein (%)	21
Fat (%)	5.97
Fiber (%)	3.06
Ash (%)	5.8
Moisture (%)	11.3
Metabolizable energy: ME (kcal/kg)	3150

2.4 Preventive procedures

The floor and walls of the poultry farm were disinfected with calcium oxide before the arrival of the birds, and the feeders and drinkers were sterilized with chlorine. Upon receiving the chicks, they were given multivitamins (K3, B2, B12, calcium-D-pantothenate, and Niacin). On the seventh day, they were vaccinated against Newcastle disease by spraying the entire farm. The drinking water was used to administer the Gumboro disease vaccine on the tenth day, the bronchitis vaccine on the fourteenth day, and the Newcastle disease vaccine on the twenty-first day.

2.5 Administrative procedures

Feed and water were provided for each stage of the study using an ad libitum bird feeding system. Wood shavings were used as a Litter for the farm floor and were replaced as needed. The temperature was set at 34°C for the first week, then gradually reduced to about 32°C for the second week, about 28–30°C for the third week, and about 25°C throughout the remainder of the period with a relative humidity of about 60%. Lighting was continuous throughout the day until the end of the experiment.

2.6 Growth performance measurements

The study chicks were weighed individually at 15 days of age in each replicate of each treatment to calculate the mean initial weight (IW) which was about 530.1 ± 0.1g for all birds also the birds were weighed in the same way at the end of each week as well as on day 45 of age. The weekly mean live body weight (LBW), as well as the mean final live body weight (FLBW) of each replicate and for each treatment, were calculated according to the following equations:

$LBWR = LBWR/BNR$

$LBWT = LBWTR/NTR$

Where:
LBWR= mean live body weight of replicate birds
LBWR= Total live body weights of the replicate birds
BNR= Birds Number in replicate
LBWT = mean live body weight of treatment birds
LBWTR= Total means live body weights of treatment replicates
NTR= Number of treatment replicates
The mean daily weight gain (WG) during the study periods was calculated for each replicate in the treatment and then for each treatment according to the following equations:
WGR= $W2 - W1/NPD$
WGT= WGR/NTR

Where:
WGR= mean daily weight gain of the replicate in any period
W2= mean weight of replicate birds at the end of the period
W1= mean weight of replicate birds at the beginning of the period
NDP= Number of period days
WGT= mean daily weight gain of treatment in any period
WGR= Total means daily weight gain of replicates in the treatment
NTR= number of treatment replicates
By deducting the weight of the remaining feed from the weight of the feed provided to each replicate at the beginning and end of each study period, the mean daily feed intake (FI) was calculated (g/bird/day) for each replicate and then for each treatment considering dead birds. The mean daily feed conversion rate (FCR) was calculated {feed intake (g)/weight gain (g)) of each study period for each replicate and then for each treatment according to the following equations:
FCRR= FIR/WGR
FCRT= FIT/WGT

Where:
FCRR= mean daily feed conversion rate of the replicate in a study period
FIR= mean daily feed intake of replicate birds in a study period
WGR= mean daily weight gain of replicate birds in a study period
FCRT= mean daily feed conversion rate of the treatment in a study period
FIT= mean daily feed intake of the treatment in a study period
WGT= mean daily weight gain of the treatment in a study period

2.7 Mortality rate measurement

The number of dead birds in each replicate of each treatment was recorded throughout the study period, and the mortality rate (MR) was calculated as a percentage of the initial number of birds in each replicate and then in each treatment.

2.8 Statistical analysis

To evaluate the effect of adding different levels of olive oil to broiler diets, the Excel program was used to obtain the averages of the data recorded during the experimental periods of the study, namely live body weight, daily weight gain, feed consumption, feed conversion rate and mortality rate for each replicate and each treatment in the study. These averages were statistically analyzed using one-way analysis of variance (ANOVA) to test the differences between the averages at the significance level ($P<0.05$) using Duncan's test as a post hoc test. The final data were expressed as the mean ± standard error for all parameters tested.

3. Results

The LBW results shown in table (3) show that the treatments with 1% and 2% olive oil were significantly superior to the control treatment ($P < 0.05$) in most of the experimental weeks of the study as well as in FLBW. The daily weight gain results shown in table (4) also followed the same trend of the live body weight results.

Table 3. Effect of adding different levels of olive oil on live body weight (g/bird) to broiler feeds during experimental periods from day 15 to day 45 of age**.**

Groups	Age periods (days)					
	0-14 (IW)	15-21	22-28	29-35	36-42	0-45 (FLBW)
Control	530± 0.0	800.17±7.0^{c}	1306±07.78^{a}	1802.5±65.79^{c}	2245.05±180.19^{b}	2488.63±109.64^{b}
OO1%	530±0.0	811.17±8.5^{b}	1299±22.79^{a}	1830±62.78^{b}	2381.46±118.21^{a}	2537.74±163.0^{a}

OO2%	530.20±0.2	831.17±8.9[a]	1270.33±56.16[b]	1848.33±25.76[a]	2323.66±113.19[a]	2537.15±156.16[a]

IW: initial weight; FLBW: final live body weight; control: control diet; OO1%, OO2%: olive oil per kg of feed mixture, respectively; a,b,c: Means within the same column that followed by different superscripts are significantly different (P < 0.05).
Control: control diet; OO1%, OO2%: olive oil per kg of feed mixture, respectively; a,b,c: Means within the same column that followed by different superscripts are significantly different (P < 0.05).
The results of the FI shown in table (5) show that the two addition treatments were significantly higher (P < 0.05) in the first week compared to the control treatment, while in the second week the results were

Table 4. Effect of adding different levels of olive oil on daily weight gain (g/bird/day) to broiler feeds during experimental periods from day 15 to day 45 of age.

Groups	Age periods (days)				
	15-21	22-28	29-35	36-45	15-45
Control	38.60±1.01[c]	72.26±2.12[a]	70.93±8.95[c]	63.22[c]	63.18±3.54[b]
OO1%	40.17±1.23[b]	69.69±4.47[b]	75.86±10.86[b]	78.78[a]	64.77±5.26[a]
OO2%	43.00±1.30[a]	62.74±9.26[c]	82.57±6.06[a]	67.90[b]	64.74±5.04[a]

the opposite of these results.

As for the third week, FI in the OO1% treatment was higher than in the other two treatments, which were equal. As for the fourth week, the control treatment had the highest in the FI by a significant difference (P < 0.05), followed by the OO1% then OO2% treatments, respectively. The results indicate that the cumulative FI (during the entire experimental period) was significantly higher (P < 0.05) in the control treatment than in the other two treatments, which were equal.
Control: control diet; OO1%, OO2%: olive oil per kg of feed mixture, respectively; a,b,c: Means
Within the same column that followed by different superscripts are significantly different (P < 0.05).

Table 5. Effect of adding different levels of olive oil on daily feed intake (g/bird/day) to broiler feeds during experimental periods from day 15 to day 45 of age**.**

Groups	Age periods (days)				
	15-21	22-28	29-35	36-45	15-45
Control	89.62±0.88[b]	117.66±0.80[a]	140.07±2.38[b]	161.74±5.55[a]	130.61±2.06[a]
OO1%	91.57±0.06[a]	116.21±2.22[b]	141.71±0.27[b]	154.28±7.12[b]	128.69±2.42[b]
OO2%	91.26±0.39[a]	116.28±1.54[b]	144.06±3.48[a]	149.83±5.45[c]	127.73±1.58[b]

The results in **table (6)** show that the FCR in the first week of the experiment was the highest with a significant difference (P < 0.05) in the control treatment, followed by the OO1% and OO2% treatments, respectively. As for the second week, the order of the results was the opposite of these results. As for the third and fourth weeks, the FCR was higher with a significant difference (P < 0.05) in the control treatment than in the other two treatments, which were equal. The results show that the cumulative FCR (during the entire experimental period) was higher in the control treatment, followed by the OO1% and OO2% treatments, respectively, but without significant differences.

Table 6. Effect of adding different levels of olive oil on feed conversion rate (gram feed/gram daily weight gain) to broiler feeds during experimental periods from day 15 to day 45 of age**.**

Groups	Age periods (days)				
	15-21	22-28	29-35	36-45	15-45
Control	2.32±0.08[a]	1.63±0.06[c]	2.00±0.21[a]	2.72[a]	2.07±0.09
OO1%	2.28±0.07[b]	1.67±0.09[b]	1.90±0.25[b]	2.10[b]	2.00±0.12
OO2%	2.12±0.07[c]	1.90±0.29[a]	1.75±0.12[b]	2.28[b]	1.98±0.12

Control: control diet; OO1%, OO2%: olive oil per kg of feed mixture, respectively; a,b,c: Means within the same column that followed by different superscripts are significantly different (P < 0.05).
It is clear from figure (1) that the MR was significantly higher (P < 0.05) in the OO2% treatment than in the control treatment, while no dead birds were recorded in the OO1% treatment throughout the experiment period.

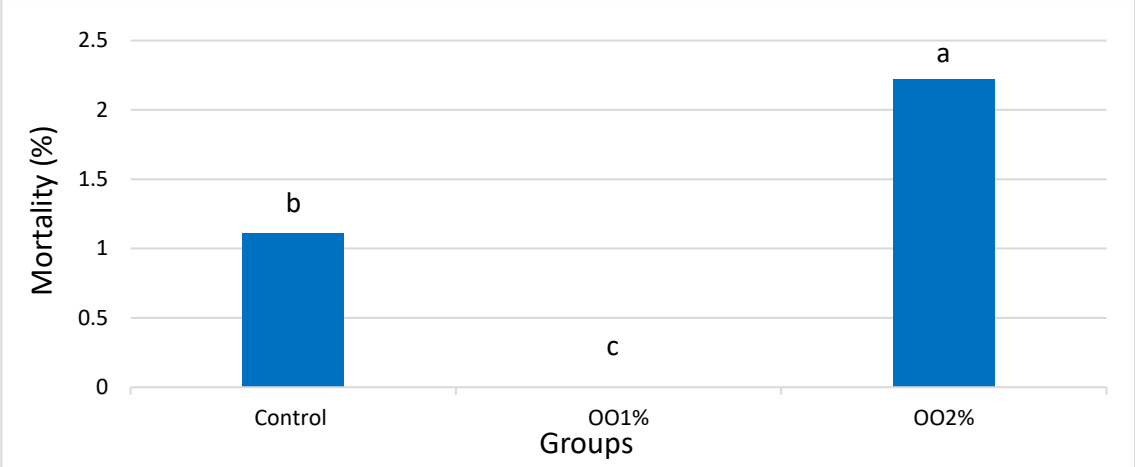

Figure 1. Effect of adding different levels of olive oil on mortality rate (%) to broiler feeds during experimental periods from day 15 to day 45 of age. Control: control diet; OO1%, OO2%: olive oil per kg of feed mixture, respectively; a,b,c: Means of columns with different superscripts are significantly different ($P < 0.05$).

4. Discussion

The present study showed that adding 1% and 2% olive oil to the feed significantly improved ($P < 0.05$) the FLBW and the daily WG. The results of this study are consistent with the results of several other studies, which showed that the addition of olive oil to broiler feed at 1% led to a significant improvement in growth parameters and feed efficiency [14, 15]. The results of this study are also similar to the results reached by [16] which showed that feeding broiler chickens with extra virgin olive oil at a rate of 2.5% of the feed resulted in a significant improvement ($P < 0.05$) in FLBW and daily WG. This improvement in growth performance may be attributed to the effective effect of olive oil on slowing down the rate of passage of digestion products through the digestive tract, which results in increased absorption of nutrients, which leads to increased utilization of them [17,18]. In addition to the positive effect of olive oil in facilitating the digestion and absorption of all nutrients, including vital fats and soluble vitamins, studies indicate that about 55-66% of polyphenols in olive oil are absorbed, especially in the intestine [15]. The results showed that the average daily FI throughout the experimental period was equal in the OO1% and OO2% treatments and significantly ($P < 0.05$) lower than the control treatment, but the FCR in the two supplementation treatments was significantly ($P < 0.05$) better during most weeks of the study compared to the control treatment. The results of this study agreed with the results of the study [19], which stated that adding olive oil to bird feed at a rate of 2% led to obtaining a higher LBW in addition to improving the FCR. The results of this study were also consistent with the findings of [20], which showed that adding extra virgin olive oil to broiler feed significantly increased feed efficiency and weight gain. The ability of olive oil to improve growth as well as FCR can be explained by the effective role of olive oil in increasing the ability to digest nutrients by enhancing the role of digestive enzymes and microbial diversity in addition to improving gut health [21].

Mortality rates were significantly higher in the OO2% treatment compared to the control treatment, but the ratios in both treatments were within normal limits, while no mortality was recorded in the OO1% treatment throughout the experiment. This result may be attributed to the fact that adding olive oil to broiler feed may play a role in supporting the health and performance of birds [22, 23]. It has also been shown that adding olive oil to broiler feed improves kidney function, peripheral blood levels, and immune response.

5. Conclusion

The results of this study showed that adding 1% olive oil to broiler feed led to a significant improvement in final live body weight and daily weight gain. It also led to a reduction in feed intake while improving the feed conversion rate, in addition to enhancing the survival rate. Based on these results, the study recommends adding 1% olive oil to broiler feed and conducting further research to reach the maximum possible benefit from using olive oil in broiler production.

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