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Influence of Dietary Oregano Plant Extract Supplementation on Growth Performance and Economic Efficiency of Broiler Chicks

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ABSTRACT

This study investigated the influence of oregano essential oils (OEOs) as common development promoters on the growth performance and cost economics of broiler chicks, 180 one day old chicks (Ross 308) classified into 3 groups (3 replicates, 20 birds /replicate). The experimental groups were as follows: group (1) control (basal diet), group (2) basal diet + 300 µl oregano essential oils extract per kg diet and group (3) basal diet + 600µl oregano essential oils extract per kg diet. The experiment lasted for 35days. Results showed that the body weight and weight gain of chicks fed diet contained 600 µl oregano essential oil / kg basal feed was higher significant (P≤ 0.05) than that fed diet contained 300 µl OEOs group and control group. Whereas feed consumption in the oregano supplemented groups was lower (P ≤ 0.05), resulting in a significantly increased feed conversion (P ≤ 0.05). The European chicken index increased in the group receiving 600 µl of OEOs compared to other groups. There was no significant change in feed cost between the supplemented and control group, but the group supplemented with 600 µl of OEOs showed greater growth and thus better net return. Also, the economic efficiency showed a greater difference in the 600 µl OEOs supplement group. It could be concluded that the use of 600 µl OEOs improved the overall performance and economic efficiency of broilers; therefore, it could be supplemented to broiler chicks.

1. INTRODUCTION

Oregano oil is a complex combination of volatile aromatic compounds that can be obtained from various types of oregano (Monu et al., 2016). Owing to existence of carvacrol and thymol, this oil is known to be antibacterial, antifungal and antioxidant (Govaris et al., 2010). It was shown to be preventive to many diseases and to have broad antibacterial properties (Gonçalves et al., 2013).

Botsoglou et al. (2002) said that if we remember that the restricted use of antibiotics encourages using alternative diets in the production of many species, the use of thyme essential oil will be more effective. Therefore, it is used to improve ileal digestibility in broilers. They also promote the bird's appetite and increase their weight (Isabel and Santos, 2009) show that some PFAs are sometimes thought to improve taste and palatability, which in turn improves chicken meat.

In feeding trials with broilers, several studies have shown conflicting effects of PFA. Fotea et al. (2010) examined the influence of OEO (0.3%, 0.7%, and 1%) and confirmed that the 1% level supports FCR. Roofchaee et al. (2011) stated that nutritional supplementation of oregano oil at 600 mg/kg reduced FI and higher FCR. As well, Vázquez et al. (2015) revealed that the addition of Mexican oregano oil (4% thymol + 60% carvacrol or 40% thymol + 20% carvacrol) improved the effects on FCR and body weight. The use of oregano oil in birds' weight loss plan will increase feed utilization by means of the stimulating digestion method. Additionally, there may be a few evidence that the usage of herbs, spices and one-of-a-kind plant extracts is appetizing and digestion stimulating. This information can give an explanation for the growing FI and enhancing FCR in broilers. Williams and Losa (2001) mentioned that a critical demand frequently prepared for oregano important oils are FCR development, which increases the amount of nutrients important for intestinal absorption, was higher in chickens fed a diet containing 600 µl/kg of oregano extract compared to control weight loss that may result from digestion (P<0.05) stimulation and stomach protection.

Hashemi et al. (2014) found that the development in FCR of broiler supplemented with OEOs May be associated with improved gut health and gut morphology. Al-Kassie (2010) studied the effect of OEOs on mortality in Hubbard chickens for six weeks and found an increase in mortality that may be due to immune action of OEOs, additionally, Fortun-Lamothe and Boullier (2007) reported that the usage of oregano extract lowering mortality in supplemented chicken due to optimization of immune device.

Normally, improvement in European broiler index (EBI) resulted from better BW, livability and decreased FCR. Nutritional supplementation of OEO into broilers weight loss program may additionally exert beneficial impact on

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EBI as stated by way of numerous authors. For example, El-Ashram and Abdelhafez (2020) investigated the motivation of OEOs extract on broiler chickens and found that the EBI value was highest in the group supplemented with EO. This experiment aimed to estimate the influence of feeding essential oils of oregano on the growth performance and economic value of broilers.

2. MATERIAL AND METHODS

2.1. Approval Ethics

The animal husbandry and handling procedures during the experiments as directed by the Institutional of Animal Precaution Agency (NO BUFVTM 18-04-23) of the Faculty of Veterinary Medicine, Benha University

2.1. Poultry, housing and management

All birds were reared under the same environmental and management conditions. Healthy day-old broilers (Ross - 308), total 180, with average body weight (42.77gm); they were bought from commercial hatcheries.

Broilers were haphazardly distributed into three dietary treated groups, each group contained 60 chicks separated into three different replicates of 20 chicks each.

Group (1): Under control diet without supplementation.

Group (2): received control diet + 300µL of freshly prepared oregano essential oil extract per kg of diet.

Group (3): received control diet + 600 µL of freshly prepared oregano essential oil extract per kg of diet.

The broiler chicks got vaccinated against most infectious diseases affecting broilers.

2.2. The Oregano plant essential oils and its composition

The freshly organized vital oils of oregano plant extract were purchased from Rival pharm Egypt enterprise (aqueous extraction of oregano plant extract) and analyzed by HPLC at meats evaluation center at faculty of veterinary medicine, Benha University (Table 1).

Table 1 Chemical and physical analysis of oregano plant extract.

Parameter	Finding
A. Sensory Exam	
1. Color	Slight yellow
2. Odor	Fair fresh odor
3. Aspect	Clear
4. Abnormalities	Nothing
B. Physico-chemical Examination	
1. Solubility	Soluble in Ethyl alcohol
2. Optical rotation	-2°
3. Refractive index	1503
4. Carvacol (%)	61.4
5. Thymol (%)	2.7
6. α-terpineol (%)	1.9
7. Linalool (%)	4.1

2.3. Growth performance parameters

2.3.1. Body weight and body weight gain

Body weights of broilers groups were noted at the start of the experiment and every week to evaluate changes in body weight and growth patterns due to diet. The body weight gain (g / broiler) per week is calculated from the live weight difference obtained in two consecutive weeks. Average daily gain (ADG) (g/day/chicken) was assessed by divide up the whole-body weight by the sum of days

2.3.2. Relative growth rate (RGR)

The relative growth rate (expressed as a percentage) is calculated according to the following equation (Crampton & Lloyd, 1959):

$$RGR = \frac{100\,(W2-W1)}{1/2\,(W2-W1)}$$

2.4. Feed intake and feed efficiency

2.4.1. Feed intake (FI)

The chicks feed intake was determined by the difference between the weight of the feed delivered and the weight of the remainder then dividing that amount by the number of birds that were fed each day in each group (Wanger et al., 1983).

$$FI = \frac{weight\ of\ feed\ \ delived - weight\ of\ reminder}{number\ of\ bird\ in\ each\ group}$$

2.4.2. Feed conversion ratio (FCR)

Feed conversion ratio of chicks was calculated by dividing the amount of feed (g) in a week by the body weight (g) in the same week (Wanger et al., 1983).

$$FCR = \frac{feed\ \ intake\ (gm)\ /\ bird/\ week}{body\ \ weight\ gain\ (gm)/\ bird/\ week}$$

2.4.3. European broiler index

The European efficiency factor (EEF) was assessed with the following equation according to (Marcu et al., 2013).

$$EBI = \frac{viability\ (\%) \times ADG\ \ /\ chick\ (gm\ )}{10 \times FCR}$$

Where: ADG =Average daily gain /chick (gm).
FCR = Feed conversion ratio.

2.5. Economical evaluation

Total production costs were calculated including (Singh et al., 2018):

Total cost per chick = chick price (at the start of experiment, L.E) + Total feed cost + Management of chick (L.E).

Total revenue per chick (L.E) = litter return + final BW (kg) X selling price of kg chick live BW presented in the market (27 LE per kg meat).

Net revenue per chick (L.E) = Total revenue per chick - total cost per chick (L.E)

$$Economic\ efficiency = \frac{net\ revenue\ per\ chick}{total\ cost\ per\ chick\ (L.E.)}$$

$$Relative\ economic\ efficiency = \frac{Economic\ efficiency\ of\ each\ experiment\ group}{economic\ efficiency\ of\ the\ control\ group} X\ 100$$

2.6. Statistical analysis

The statistics attained from the experiment were made with the SPSS software program and the analysis of variance method was used. Differences in means ± SEM were tested for significance using Duncan's multiple range tests (Duncan, SPSS Student Version 10.0.7, and June 2000). ($P<0.05$) level difference was considered significant

3. RESULTS

3.1. Growth performance parameters

Results in table (2) represent growth parameters (BW, BWG, RGR) during the experiment. There was no a significant ($P\geq 0.05$) increase in body weights (BW) of birds between all groups at initial, 1st, 2 nd and 4th week, it

was noticed that BW at 3 rd and 5 th week at group (3) showed the highest value than the other two groups.

The obtained data of body weight gain (BWG) at 1 st and 2nd week revealed that there was no significant (P ≥ 0.05) difference in BWG between groups. While in 2 nd -3rd and 3rd- 4th week results showed a significant increase (P ≤ 0.05) in BWG of supplemented groups with OEOs compared to control group. Cumulative BWG revealed a significant increase (*P*< 0.05) in group (3).

Results concerning relative growth rate (RGR) at 1st, 2nd and 3 rd week data revealed that there is no significant effect (*P >0.*05) between all groups. At week 3- 4 there was significant (*P*< 0.05) decrease in groups (2), (3) compared to group (1) but at week 4-5 and the final RGR is significantly (*P ≤ 0.*05) increased in group (3) compared to groups (2,1). The group (3) recorded the highest value of the European Broiler Index (EBI) (423.2) followed by group (2) (370.57) and group (3) recorded the lowest value (338.03).

Table 2 Effect of feeding two different concentration of oregano plant extract (300µl per kg diet) and (600 µl per kg diet) on (weekly) BW (gm), BWG, RGR and EBI of broiler chickens

Items	Period/week	Group (1) control	Group (2) fed diet containing 300µl (OEOs) per kg diet	Group (3) fed diet containing 600 µl (OEOs) per kg diet	p-value
BW (gm)	0 week	42.44 ^{a} ±0.09	42.77 ^{a} ±0.17	42.56 ^{a} ±0.04	0.139
	1 week	130.52 ^{a} ±4.5	139.67 ^{a} ±4.75	141.83 ^{a} ±3.99	0.238
	2 week	413.12 ^{a} ±6.48	423.47 ^{a} ±8.81	423.25 ^{a} ±8.88	0.614
	3 week	821.22 ^{b} ±7.92	854.55 ^{ab} ±15.46	877.17 ^{a} ±8.03	0.032
	4 week	1441.8 ^{a} ±18.83	1439.1 ^{a} ±5.84	1464.8 ^{a} ±8.08	0.337
	Whole BW	2002.2 ^{b} ±12.26	2025.4 ^{b} ±40.9	2091.8 ^{a} ±17.34	0.022
BWG	0-1 Week	88.72 ^{a} ± 4.75	100.68 ^{a} ± 1.36	99.28 ^{a} ± 3.96	0.113
	1-2 week	282.68 ^{a} ± 7.62	279.44 ^{a} ± 7.7	281.42 ^{a} ± 4.99	0.946
	2-3 week	408.1 ^{b} ± 4.9	453.25 ^{a} ± 15.17	453.92 ^{a} ± 6.04	0.026
	3-4 week	633.52 ^{b} ± 11.78	578.27 ^{b} ± 4.64	587.58 ^{a} ± 0.46	0.004
	4-5 week	510.48 ^{b} ± 9.39	532.39 ^{b} ± 42.13	627 ^{a} ± 9.74	0.039
	Whole BWG	1923.5 ^{b} ± 18.85	1959.7 ^{b} ± 12.15	2049.2 ^{a} ± 17.33	0.004
RGR	0-1 week	102.93 ^{a} ± 2.94	108.45 ^{a} ± 0.42	107.6 ^{a} ± 1.91	0.200
	1-2 week	104.02 ^{a} ± 2.67	98.75 ^{a} ± 0.79	98.11 ^{a} ± 1	0.094
	2-3 week	66.14 ^{a} ± 0.89	68.32 ^{a} ± 1.09	69.83 ^{a} ± 1.34	0.141
	3-4 week	55.66 ^{a} ± 0.44	50.29 ^{b} ± 0.62	50.19 ^{b} ± 0.34	0.000
	4-5 week	29.86 ^{c} ± 0.64	32.72 ^{b} ± 0.65	35.44 ^{a} ± 0.3	0.001
	whole RGR	191.68 ^{b} ± 0.04	191.7 ^{b} ± 0.07	192.02 ^{a} ± 0.06	0.009
EBI		338.03 ^{b} ±5.9	370.57 ^{b} ±11.73	423.2 ^{a} ±12.04	0.003

The mean ± standard error of different labels in the same row is different at (P<0.05).

3.2. Feed intake (FI) and FCR

Table 3 showed that at 1st, 2nd, 3th and 5th week there was a significant (P < 0.05) reductions in FI of OEO groups (2, 3) compare to group (1) showing the highest value of FI. At 4th week there is no significant difference between groups. There was a significant (*P* < 0.05) increase in total FI of the control group than treated groups.

Results revealed that there was no significant (*P* > 0.05) difference in FCR between group's at1 st week and 3rd-4 th week. Although FCR showed significant (*P ≤ 0.*05) improvement during the 1 st- 2 nd, 2nd -3rd week, 4th-5 th week and total FCR week in group (3) compared to group (1 and 2).

3.3. Economic efficiency

Table (4) shows results of economic efficiency in relation to the dietary supplementation of OEOs in the broiler diets. There is no significant difference in total feed cost between all groups (p≥ 0.05). The net economic return revealed significant (*P ≤ 0.*05) higher profit in group (3) (19.35 LE) than other groups. However no significant difference was observed between group (2) (18.11 LE) and group (1) (17.30 L.E). Moreover, there was a significant (*P ≤ 0.*05) increase in economic efficiency in supplemented groups, and the highest value was recorded in group (3) (0.50), followed by group (2) (0.47) and group (3) showed the lowest value (0.45). Also, there was a significant (*P ≤ 0.*05) increase in relative economic efficiency in group (3) compared to group (2, 1) and the highest value was observed in group (3) (111.11).

Table 3 Effect of feeding of two different concentration of oregano plant extract (300µl per kg diet) and (600 µl per kg diet) on feed intake (gm) and feed conversion ratio of broiler chicken during the experiment

Item	Period/week	Group (1) fed control diet	Group (2) fed diet containing 300 µl (OEOs) per kg diet	Group (3) fed diet containing 600 µl (OEOs) per kg diet	P- value
FI (gm)	0-1 week	137.17 ^{a} ± 1.92	124.58 ^{ab} ± 3.21	111.67 ^{b} ± 7.26	0.025
	1-2 week	352.4 ^{a} ± 2.21	350.92 ^{a} ± 1.88	313.33 ^{b} ± 6.05	0.001
	2-3 week	650.33 ^{a} ± 6.21	639 ^{ab} ± 1	623.1 ^{b} ± 10.36	0.085
	3-4 week	893.84 ^{a} ± 17.4	882.75 ^{a} ± 11.45	872.89 ^{a} ± 20.21	0.692
	4-5 week	966.54 ^{a} ± 13.94	915.05 ^{b} ± 7.17	908.83 ^{b} ± 10.72	0.018
	Whole feed intake	3022.47 ^{a} ± 18.38	2913.72 ^{b} ± 16.69	2837.3 ^{b} ± 33.4	0.005
FCR	1 week	1.56 ^{a} ±0.09	1.24 ^{a} ±0.04	1.37 ^{a} ±0.32	0.548
	1-2 week	1.25 ^{a} ±0.04	1.25 ^{a} ±0.03	1.11 ^{b} ±0.04	0.059
	2-3 week	1.59 ^{a} ±0.01	1.41 ^{b} ±0.05	1.37 ^{b} ±0.04	0.011
	3-4 week	1.41 ^{a} ±0.05	1.53 ^{a} ±0.01	1.5 ^{a} ±0.03	0.129
	4-5 week	1.9 ^{a} ±0.06	1.74 ^{ab} ±0.16	1.45 ^{b} ±0.04	0.058
	Total FCR	1.54 ^{a} ±0.05	1.51 ^{ab} ±0.02	1.4 ^{b} ±0.04	0.095

The mean ± standard error of different labels in the same row is different (P<0.05).

Table 4 Effect of feeding of two different concentration of oregano plant extract (300µl per kg diet) and (600 µl per kg diet) on economic efficiency of broiler chickens.

Items	Group (1) fed control diet	Group (2) fed diet containing 300 µl (OEOs) per kg diet	Group (3) fed diet containing 600 µl (OEOs) per kg diet	P-value
Number of chicks	60	60	60	-
Price per chick (LE)	11	11	11	-
Final body weight(gm)	2002.2 ^{b} ±12.26	2025.4 ^{b} ±40.9	2091.8 ^{a} ±17.34	.022
Average daily feed intake (gm)	86.36 ^{a} ±0.53	83.25 ^{b} ±0.48	81.07 ^{b} ±0.95	.004
Vaccination (LE)	1.1111	1.1111	1.1111	-
Drugs (LE)	0.833	0.833	0.833	-
Rent	1	1	1	-
Total feed	22.46^{a}±0.26	22.09 ^{a} ±0.13	21.912^{a} ±0.13	.186
Cost (LE)per chick				
Total cost per chick (LE)	38.80 ^{a} ±0.26	38.429 ^{a} ±0.13	38.25 ^{a} ±0.13	.186
Selling price (LE)	27	27	27	-
Total return per chick	55.73 ^{b} ±0.33	56.35 ^{b} ±1.10	58.14 ^{a} ±0.47	.022
Total revenue per chick	17.30 ^{b} ±0.39	18.11 ^{b} ±1.16	19.35 ^{a} ±0.73	.028
Economic Efficiency	0.45 ^{b} ±0.01	0.47 ^{b} ±0.03	0.50 ^{a} ±0.22	.038
Relative economic efficiency%	100 ^{c} ±0.00	104.44 ^{b} ±2.31	111.11^{a} ±4.68	.029

The mean ± standard error of different labels in the same row is different (P<0.05).

4- DISCUSSION

Our results revealed that the supplementation of broilers diet with 600 µl of OEO improves body weight and administration of approximately 300 µl of OEO improved final BWG at 4-5 weeks of follow-up age. This result is similar to Bahakaim et al. (2020) who investigated the influence of addition of 600 µl OEO to chicken diets and observed that chicken fed 600 µl OEO had higher body weight (P<0.05) than chicken fed 300 µl OEO and control diet. Skoufos et al. (2016) suggested that this result may be due to the performance improvement of OEO-supplemented broilers diet that may be affected up to the height of intestinal villi and limiting intestinal pathogens, increases the absorption of the area and improves the digestion and absorption of nutrients.

Contrary to this study, Lewis et al. (2003) said that the use of oregano did not affect broiler rearing performance.

During the period (0-5 weeks), the data analyzed in this study revealed that the total FI of the control group was significantly higher (P ≤ 0.05) compared to the treated groups. The FI decrease observed in the OEO group maybe because of essential oils has a pungent odor, making the flavor of the feed less appealing to birds, smells and flavors are present according to Abdel-Wareth et al. (2012) These results were differed from Bahakaim et al. (2020) who mentioned that adding 300 µl and 600 µl of OEOs to the kg diet didn't affect feed intake in either group.

Overall, the broiler chicks in this study fed on diet contained 600 µl of oregano essential oil followed by 300 µl of OEO followed by the control group, with improvement in total FCR. Most recent studies were reviewed by Brenes & Roura (2010), who settled that improvement in FCR in most studies was due to reduction in FI without changing BWG. In this experiment, the improvement in final FCR was not only accompanied by a decrease in FI, but also increased BWG at the OEO participation level. This result may be due to digestive and intestinal protection.

Conversely, cross et al. (2007) stated that the addition of 1 g/kg OEO to broiler diets did not affect these functions. They attributed OEO's lack of growth support is due to the absence of thymol and carvacrol in the essential oils used in their studies.

The final RGR was significantly increased in the supplemented OEOs group as compared with the control group. Our results were confirmed by Hassan et al. (2004) and Bunyapraphatsara (2007) who's noted that adding herbs and spices to broiler diets improves growth and development.

In our study, European Broiler Index (EBI) was recorded the highest significant value in the group fed 600 µl OEO (423.2), followed by the 300 µl OEO feeding group (370.57) and the control group recorded the lowest value (338.03). These results might be due to progressive, eventual BWG and decreased FCR in the control group. These results are consistent with El-Ashram and Abdelhafez (2020) who examined the effects of the combination of OEO essential oil and anise in broilers and found that the most significant effect on EBI was conflated with EO supplementation.

Similar results regarding EBI were found in Arczewska-Wlosek and Swiatkiewicz (2012) study, in which an EO mixture enclosing thyme and oregano was added to chicken feed and there was an improvement in EBI in supplemental groups.

All economic activities were more significant in the 600 µl OEOs supplemented group showed the highest value (0.50), followed by 300 µl OEO group (0.47) and the control group was the lowest (0.45). In addition, the relative economic performance increased significantly (P ≤ 0.05) in the groups supplemented with 600 µl OEO, 300 µl OEO compared to the control group, with the highest values observed in the group supplemented with 600 µl OEOs (Relative economic efficiency 111.11). Our findings are consistent with Puvaca et al. (2016) who recorded weight loss, where broilers supplemented with OEO, they have lower feed rates per kg body weight.

In addition, Oleforuh-Okoleh et al. (2014) noted that the highest revenues and profits came from birds supplemented with feed fortified with essential oils. The increased overall return of OEO-fortified chickens compared to non-OEO-supplemented chickens can be assigned to improved feed efficiency, which results in higher growth and better feed-

to-weight ratio increase, resulting in higher returns (Singh et al., 2018).

5. CONCLUSION

This study concluded that dietary supplementation of oregano essential oil extract as a growth promoter helps improve performance. Blends of essential oil can be added to poultry feed in place of synthetic ingredients to promote or facilitate the use of quality nutrients that can lead to weight gain, increased production and improved nutrition. The contribution of OEOs to feed increases feed conversion ratio (FCR) and the marked increase in metabolic rate may result from a combination of different effects such as increased digestion, antimicrobial effects of essential oils, and expansion of intestinal absorption. Adding OEO to broiler diets can increase body weight, thereby improving economic performance, reducing feed intake and improving feed utilization and feed conversion.

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