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# EFFECT OF FEEDING DIFFERENT LEVELS OF EVENING PRIMROSE OIL (EPO) ON THE PRODUCTION PERFORMANCE AND SOME QUALITY TRAITS OF LAYING HENS EGG

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## Abstract

A research was conducted to estimate the effect of feeding different levels of Evening Primrose Oil (EPO) on production performance and egg quality traits in laying chicken diets. The experiment involving 240, ISA Brown laying chickens were randomly allotted to four treatments (each treatment 60birds, three replicates, and 20 birds per replicate) and were fed for 20 weeks divided into 5 periods included: period 1 (31-34 ), period 2 (35-38), period 3 (39-42), period 4 (43-46), and period 5 (47-50). The treatments were included: T1 (control) – basal diet without supplementation, T2 basal diet + 25% of EPO, T3 basal diet + 50% of EPO, T4 basal diet + 75% of EPO. Significantly, T4 showed an increase in weight of the egg during 39-42 weeks of the production period whereas an increase in the egg weight during 43-46 weeks and during 47-50 weeks in T2, T4 compared to T1, T2 was conducted. Furthermore, insignificant differences in proportion of the egg production and cumulative egg production for all treatments were noted. Feed intake was significantly ($p < 0.05$) decreased in T2, T3, T4 compared to T1 during the production period in additionat period 5, there was no significant difference between all the treatments in regard to feed conversion coefficient except for T2 where a significant decrease was detected. For egg quality traits, a significant improving was noted in average of eggshell thickness and the relative weight of eggshell moreover, insignificant differences between the treatments in the relative weight of albumen and albumen index were acknowledged.

***Key words :*** Evening Primrose Oil (EPO), production performance, production period, egg quality.

## Introduction

Increasing the acknowledgment in poultry nutrition and the modern biotechnology can create new nutritional approach that appropriate the requirements of layer chicken. The layer chickens are more susceptible to the infections due to the high metabolic rate or due to the weakness of the immune system (Cherian, 2013), which create the concentration on the nutrition supplementations that benefit the poultry production. Plant oils are one of the supplementations that used in poultry diets depend on their active content to enhance physical performance and the production. Many plant oils and their extracts have been used as a supplement in poultry diets oilssuch as corn oil, soybean oil, and sun flower oil. Evening Primrose Oil (EPO) is an extract of plant *Oenothera biennis* and a member of the Oenagracea family. Night star, Evening summer flower, and night willow are synonyms for plant *Oenothera biennis*. EPO was considered one of the Omega-6 oils and consist of saturated and unsaturated fatty acids. The saturated fatty acids included Palmitic acid 5.5-8% and Stearic acid 1-3%, whereas the unsaturated fatty acids consist of linoleic acid 60-80% and Oleic acid 6-18% in addition to linolenic acid as a gamma linolenic acid 9-15% (Kies *et al*., 1989; Muggli, 2005). Gamma linolenic acid was very important to protect the desaturase enzyme (which have a rule in linoleic acid metabolism) from decreasing due to many factors such as stress, age, diseases and decline of B6, zinc, magnesium (Lawson *et al*., 1985; Haffiner, 2006). Hence, EPO had the ability to prevent a decrease of desaturase enzyme to ensure the next steps of arachidonic acid and prostoglands manufacturing (Favati *et al*., 1991; Hathaway, 1999). Additionally, EPO was used as a medication for many diseases such as blood pressure, skin diseases, blood cholesterol decreasing, diabetes, respiratory disorders and arthritis (Brzeski *et al*., 1991; Keen *et al*., 1993; Brown, 1996; Schilcher, 1997). However, there is a dearth of information and

published scientific data on the use of EPO in poultry diets therefore, the main goal of the current study was evaluating the effect of feeding different levels of EPO in laying chicken diets and their effect on egg production and quality traits.

## Materials and Methods

The present study was carried out at the poultry research station in Animal Production Department, Agricultural Researches, Ministry of Agriculture, Baghdad- Abu Ghraib from 13-2-2017 to 2-7-2017 for 20 weeks (at the age between 31-50 weeks) divided into five stages (each stage 4 weeks). 240ISA brown layerhen were randomly allotted to four treatments (each treatment 60 birds, three replicates and 20 birds per replicate) and distributed into wire cages with 12 pin, per pin was 3*2 meter (length×width) and per pin represent one replicate. The treatments were included: T1 (control) – basal diet without supplementation, T2 basal diet + 25% of EPO, T3 basal diet + 50% of EPO, T4 basal diet + 75% of EPO. The chemical analysis followed the guide of QINGAO YUDA COMPANY in EPO content of fatty acids: Palmitic acid 6%, Stearic acid 1.8%, Oleic acid 6.3%, Linoleic acid 72.9%, and Gamma2 Linolenic acid 0.1%. Chickens were fed layer diets (table 1) and the average of production traits for production rate H.D%, egg weight, egg mass, weekly feed conversion ratio and then take the average for four weeks and for five stages in addition to measurement of the egg quality characteristics which consist of: thickness of the eggshell, relative weight of the eggshell, relative weight of albumen and albumen index. The experiment was of Completely Randomized Design CRD and all the data obtained in the present study were analyzed by SAS software (2001) with a comparison between the mean values was done by using Duncan's multiple range tests (1955).

**Table 1 :** Chemical composition and diet content of the experiment.

| Feed composition | Treatments % | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Corn | 55.8 | 55.55 | 55.55 | 55.2 |
| Wheat | 11.7 | 11.7 | 11.40 | 11.25 |
| *EPO | 0 | 0.25 | 0.50 | 0.75 |
| Soybean meal 48% protein | 18.5 | 18.5 | 18.55 | 18.8 |
| Protein concentration | 5.0 | 5.0 | 5.0 | 5.0 |
| Dicalcium phosphate | 1.0 | 1.0 | 1.0 | 1.0 |
| Limestone | 7.7 | 7.7 | 7.7 | 7.7 |
| Salt | 0.3 | 0.3 | 0.3 | 0.3 |
| Total | 100 | 100 | 100 | 100 |
| Chemical composition | T1 | T2 | T3 | T4 |
| Kcal/kg | 2792 | 2803 | 2814 | 2823 |
| Crude protein % | 17 | 16.9 | 16.9 | 17 |
| Lysine % | 0.92 | 0.92 | 0.92 | 0.92 |
| Methionine +cysteine | 0.68 | 0.68 | 0.68 | 0.68 |
| Linoleic acid | 1.29 | 3.48 | 1.66 | 1.83 |
| Calcium | 3.48 | 3.48 | 3.48 | 3.48 |
| Phosphorus | 0.38 | 0.38 | 0.38 | 0.38 |

Protein concentrate (Laycon-s special w) product from Al Wafi –Netherland, metabolic energy: 2125, crude protein: 40%, crude fat: 5%, calcium: 5%, phosphor: 2%, lysine:80.3%, methionine:85.2%, methionine+cestein29.3%, sodium: 2.2%, vitamin E: 500 ml/kg, ** Chemical composition for the diet content was according to NRC, 1994, * Evening Primrose Oil (EPO).

## Results and Discussion

Table 2 indicated a significant ($p<0.05$) improvement in average egg production at periods 1, 2 for treatment T1, T3, and T4 while, a significant decrease was showed in T2. At periods 3, 4, 5 and total experiment period, there was insignificant differences between treatments in the average of egg production. Regarding to the average of egg weight, a significant improvement was noted in T4 compared with T2, which recorded a significant decrease at period 3 with no difference with T1, T3 (table 3). Moreover, insignificant differences between treatments T1, T2, T3, and T4 in the average of egg weight for periods 1, 2, 4, 5 and total experiment period were detected. Table 4 illustrated that a significant improvement in the average of egg mass in T2 of period 5 compared to T3 that showed a significant ($p<0.05$) decrease in the average of egg mass with no significant difference with T1, T4. However, no significant differences between treatments were detected in regard to the average egg mass atperiods 1, 2, 3, 4, and total experiment period. Also, insignificant increase in the average of feed conversion coefficient for all periods in T1, T2, T3, and T4 was noted (table 5).

Regarding the thickness of eggshell, table 6 showed that no significant differences between all treatments at periods 1, 3 while at period 2, a significant improvement was revealed in T1 when a significant decrease in the average of eggshell thickness was noted meanwhile, no significant difference between T3 and T4 in the average of eggshell thickness. Furthermore, a significant improvement in the average of eggshell thickness for T2 and T3 compared to T1, T4 was detected at stage 4. As for period 5, a significant ($p<0.05$) decrease in the average of eggshell thickness for treatments T2, T3, T4 compared with T1 in addition, a significant increase was noted in

**Table 2 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average of egg production (H.D% ± average of standard error) for classic Isa Brown laying chicken

| Treatments | Average of egg production H.D % | | | | | |
|---|---|---|---|---|---|---|
| | Periods / weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | a 0.15 ± 93.98 | a 0.62 ± 93.92 | a 0.62± 94.34 | a 0.21 ± 92.73 | a 0.46± 91.30 | a 0.32 ± 93.25 |
| T2 | b 0.77 ± 90.17 | b 0.51 ± 91.90 | a 0.53 ± 93.86 | a 0.56 ± 92.79 | a 0.21± 91.30 | a 0.21 ± 92.00 |
| T3 | a 0.67 ± 92.73 | a 0.44 ± 93.74 | a 0.85± 93.15 | a 0.40 ± 92.55 | a 0.58± 90.11 | a 0.66 ± 92.45 |
| T4 | a 0.46 ± 92.55 | a 0.56 ± 93.68 | a 0.53 ± 93.39 | a 0.60 ± 92.91 | a0.41 ± 90.11 | a 0.15 ± 92.52 |
| P | * | * | N•S | N•S | N•S | N•S |

[abc] Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

**Table 3 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average of egg weight (g ± average of standard error) of classic Isa Brown laying chicken.

| Treatments | Average egg weight/g | | | | | |
|---|---|---|---|---|---|---|
| | Periods /weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | a 0.12± 61.84 | a 0.39 ± 62.20 | ab 0.40 ± 63.51 | a 0.23 ± 62.07 | a 0.74 ± 62.63 | a 0.44 ± 62.45 |
| T2 | a 0.46 ± 62.75 | a 0.67 ± 62.99 | b 0.33 ± 62.30 | a 0.15 ± 63.03 | a 0.51 ± 63.33 | a 0.11 ± 62.88 |
| T3 | a 0.17 ± 61.84 | a 0.36 ± 62.56 | ab 0.31 ± 62.89 | a 0.66 ± 62.54 | a 0.39 ± 62.28 | a 0.24 ± 62.42 |
| T4 | a 0.22 ± 61.22 | a 0.54 ± 62.24 | a 0.42 ± 63.63 | a 0.73 ± 63.51 | a 0.36 ± 63.20 | a0.38 ± 62.75 |
| P | N.S | N.S | * | | N.S | N.S |

[abc] Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

**Table 4 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average of egg mass (g ± average of standard error) of classic Isa Brown laying chicken.

| Treatments | Average of egg mass /g | | | | | |
|---|---|---|---|---|---|---|
| | Periods / weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | a 0.96 ± 58.11 | a 0.42 ± 58.41 | a 0.42 ± 59.91 | a 0.26 ± 57.56 | ab 0.39 ±57.18 | a 0.35 ± 58.23 |
| T2 | a 0.73 ± 56.58 | a 0.85 ± 57.89 | a 0.03 ± 58.46 | a 0.39 ± 58.48 | a 0.37 ± 57.81 | a 0.23 ± 57.84 |
| T3 | a 0.44 ± 57.34 | a 0.61 ± 58.65 | a 0.80 ± 58.57 | a 0.41 ± 57.89 | b 0.67 ± 56.12 | a 0.64 ± 57.71 |
| T4 | a 0.27 ± 56.65 | a 0.28 ± 58.30 | a 0.32 ± 59.42 | a 0.70 ± 59.00 | ab 0.43 ±56.95 | a 0.26 ± 58.06 |
| P | N.S | N.S | N.S | N.S | * | N.S |

[abc] Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

**Table 5 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average of feed conversion coefficient (g ± average of standard error) of classic Isa Brown laying chicken.

| Treatments | Average of feed conversion coefficient /g | | | | | |
|---|---|---|---|---|---|---|
| | Periods / weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | a 0.03 ± 1.98 | a 0.01 ± 1.96 | a 0.01 ± 1.92 | a 0.26 ± 57.56 | a 0.01 ± 1.99 | a 0.01 ± 1.96 |
| T2 | a 0.02 ± 2.03 | a 0.02 ± 1.95 | a 0.01 ± 1.94 | a 0.39 ± 58.48 | b 0.02 ± 1.92 | a 0.01 ± 1.95 |
| T3 | a 0.01 ± 2.01 | a 0.02 ± 1.94 | a 0.02 ± 1.95 | a 0.41 ± 57.89 | a 0.01 ± 1.99 | a 0.20 ± 1.97 |
| T4 | a 0.01 ± 2.03 | a 0.01 ± 1.95 | a 0.01 ± 1.91 | a 0.02 ± 1.90 | ab 0.01 ± 1.94 | a 0.01 ± 1.94 |
| P | N.S | N.S | N.S | N.S | * | N.S |

[abc] Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

**Table 6 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average of eggshell thickness (ml ± average of standard error) of classic Isa Brown laying chicken.

| Treatments | Average of eggshell thickness /ml | | | | | |
|---|---|---|---|---|---|---|
| | Periods / weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | a 0.003 ± 0.366 | a 0.003 ± 0.373 | a 0.00 ± 0.370 | b 0.003 ± 0.363 | b 0.003 ± 0.353 | b 0.001 ± 0.365 |
| T2 | a 0.003 ± 0.373 | b 0003 ± 0.353 | a 0.005 ± 0.370 | a 0.003 ± 0.376 | a 0.003 ± 0.376 | ab 0.001 ± 0.369 |
| T3 | a 0.005 ± 0.360 | ab 0.008 ± 0.363 | a 0.00 ± 0.370 | a 0.003 ± 0.383 | a 0.008 ± 0.376 | ab 0.001 ± 0.370 |
| T4 | a 0.005 ± 0.360 | ab 0.00 ± 0.370 | a 0.006 ± 0.383 | b 0.00 ± 0.360 | a 0.006 ± 0.383 | a 0.001 ± 0.371 |
| P | N.S | * | N.S | * | * | * |

[abc] Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

**Table 7 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average relative weight of eggshell (± average of standard error) of classic Isa Brown laying chicken

| Treatments | Average relative weight of eggshell | | | | | |
|---|---|---|---|---|---|---|
| | Periods / weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | c 0.02 ± 10.89 | c 0.04 ± 10.74 | b 0.06 ± 10.78 | c 0.03 ± 10.75 | a 0.04 ± 10.85 | d 0.00 ± 10.80 |
| T2 | b 0.00 ± 10.96 | b 0.04 ± 10.94 | a 0.04 ± 11.02 | b 000 ± 10.95 | a 0.04 ± 10.99 | c 0.01 ± 10.97 |
| T3 | a 0.01 ± 11.13 | a 0.02 ± 11.09 | a 0.02 ± 11.02 | a 0.00 ± 11.09 | a 0.03 ± 11.15 | a 0.00 ± 11.09 |
| T4 | a 0.02 ± 11.18 | ab 0.01 ± 11.00 | a 0.04 ± 11.03 | b 0.01 ± 11.00 | a 0.29 ± 10.79 | b 0.01 ± 11.06 |
| P | * | * | * | * | N.S | * |

[abc]Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

**Table 8 :** Effect of adding different levels of Evening Primrose Oil (EPO) on the average relative weight of albumen (± average of standard error) of classic Isa Brown laying chicken.

| Treatments | Average relative weight of albumen | | | | | |
|---|---|---|---|---|---|---|
| | Periods / weeks | | | | | |
| | 1 (31-34) | 2(35-38) | 3(39-42) | 4(43-46) | 5(47-50) | Total period (31-50) |
| T1 | a 0.12 ± 64.27 | a 0.16 ± 64.33 | a 0.12 ± 63.53 | a 0.05 ± 63.57 | a 0.02 ± 63.79 | a 0.02 ± 63.79 |
| T2 | b 0.01 ± 63.29 | b 0.01 ± 63.44 | b 0.11 ± 63.02 | b 0.05 ± 62.96 | b 0.14 ± 62.32 | b 0.07 ± 63.00 |
| T3 | b 0.01 ± 63.08 | c 0.01 ± 62.81 | b 0.12 ± 62.72 | c 0.09 ± 62.29 | c 0.01 ± 61.92 | c 0.00 ± 62.57 |
| T4 | b 0.11 ± 63.18 | c 0.00 ± 62.97 | b 0.01 ± 62.73 | d 0.05 ± 62.69 | c 0.07 ± 61.87 | c 0.05 ± 62.69 |
| P | * | * | * | * | * | * |

[abc]Means with different superscripts within the same column differ significantly (*p < 0.05), ns: p > 0.05

T4 at total experiment period with no significant differences between T3, T2 whereas T1 had a significant decrease in the average of eggshell thickness. Table 7 revealed that a significant ($p<0.05$) improvement in the average relative weight of eggshell at periods 2, 3, 4 in treatments T2, T3, T4 compared to T1, which showed a significant decrease in the average relative weight of eggshell trait atperiods 2, 3, 4 while insignificant differences between all treatments at period 1 was detected. For total experiment period, a significant improvement in the average relative weight of eggshell in T2, T3, and T4 was acknowledged with higher mean recorded in T3 compared to T2, T4 while a significant decrease in T1 was found.

The obtained result of this study emphasized a significant improvement in the average relative weight of albumen in T1 for all periods compared with T2, T3, and T4 which showed significant decrease (table 8). As for the average of albumen index, table 9 indicate that insignificant differences were found at periods 1, 4 and 5 while a significant improvement ($p<0.05$) at period 2 in treatments T1, T2, and T4 with no significant differences among them compared with T3 which had a significant decrease in the average of albumen index. Additionally,

a significant improvement was noted at period 3 in T1 compared with T3 and T4, which detected a significant decrease ($p<0.05$) in addition, an insignificant difference in the average of albumen index in T2 compared with T1 was revealed. For total experiment period, a significant improvement in T1 and insignificant difference between T1 and T2 were demonstrated, whereas T3, T4 showed a significant decrease ($p<0.05$) in the average of albumen index with no significant difference compared with T2. Possibly, the improvement in production performance can be attributed to the active content of EPO (Gamma linoleinic acid GLA) which have a direct effect on liver cells especially on peroxisome proliferator activated receptor gamma (PPAR-y) which responsible of producing the immune proteins in addition to increase the prostaglandins (PGF2a) that related with egg production (Sang-oh *et al.*, 2014). Grobas *et al*. (2001) indicated that feeding laying hens with diets supplemented with different levels of lipids led to increase the egg weight which in turn increase fatty acids deposition in egg yolk (Whitehead, 1995). Moreover, lipid proportion in the egg can be attributed to the correlation between the nutritional system and egg traits besides, the egg weight can be affected by the supplementation of lipids. March and Macmillan (1990) and Whithead *et al*. (1993) detected that oils rich in lenoleic acid increased weight of egg when supplemented to the diets. Also, the improvement in eggshell traits can be attributed to the increase of prostaglandins manufacturing from fatty acid metabolism which in turn increase steroid hormones that in charge on calcium deposition inside bones through egg production period. Furthermore, estrogen hormone increase the calcium in blood plasma by some changes inside the kidney which consist of increasing the activity of Adenyl cyclase enzyme by increasing parathyroid hormones which responsible of regulatingcalcium and phosphorus level in the blood, increasing number of the hormone receptors, increase the production of vitamin D that necessary in calcium absorption and calcium level in the blood plasma which reflex the effect on egg shell composition (El-Araoussi *et al*., 1993). Calcium can be considered as the main material used for composition of the eggshell and obtained from the dietsor from the calcium stock in the bone marrow (Keshavarz and Nakajma, 1993). Additionally, important effect of vitamin D on the improving of calcium absorption was found which increased calcium level in the eggshell (Bar *et al*., 1999). It can be concluded that EPO improved some of production traits for chicken such as egg weight and egg mass at some stages of the production period in addition to improving the egg quality traits which consist of eggshell thickness and the relative weight of eggshell.

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