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EFFECT OF ESSENTIAL PHOSPHOLIPIDS ON SOME PRODUCTIVE AND PHYSIOLOGICAL TRAITS OF LAYING HENS

By

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Abstract: *This study was designed to investigate the effect of essential phospholipids (EPL), as a hypocholestrolemic drug, on reducing cholesterol and lipid contents in the blood as well as in egg yolk and their effects on some productive and physiological traits of laying hens. A total number of 64 Bandarah hens at 30 weeks of age were used in this study for aperiod of 10 weeks. Birds were divided randomly into 4 experimental groups, 16 birds in each one. Group 1 was served as a control and fed the experimental diet without drug supplementation, while, groups 2, 3 and 4 were fed on the diets supplemented with 300, 400 and 500 mg EPL /kg diet, respectively.*

The results were summarized as follows:

- *Essential phospholipids supplementation had no significant effects on body weight, feed conversion, egg weight, egg mass and egg production percentage among all experimental periods. While, highest dose of EPL (500 mg/kg diet) in laying hen diets caused a significant ($P \leq 0.05$) decrease in feed consumption among all experimental periods from 30 to 40 weeks of age compared with other supplementation doses.*

- *There was no significant influence of EPL supplementation in Bandarah hen diets on egg albumen (%), yolk (%), shell (%), shell thickness, egg shape index, yolk index and Haugh units during the experimental period, except egg yolk index at 40 weeks of age which was significantly ($P \leq 0.05$) increased compared with the control group.*

- *Essential phospholipids supplementation at 300, 400 and 500 mg/kg diet in Bandarah laying hen diets significantly ($P \leq 0.05$) decreased serum total lipids by 4.5, 9.6 and 13.5 %; serum cholesterol by 26.56, 35.04 and 42.52 %; serum triglycerides by 7.68, 11.21 and 17.83% and serum low density lipoprotein by 6.14, 8.58 and 12.61% while, serum high density*

lipoprotein was significantly (P≤ 0.05) increased by 6.09, 7.82 and 10.37% respectively compared with the control group. Moreover, no significant effects were observed on serum GOT and GPT during the experimental period.

- *Essential phospholipids supplementation at levels of 300, 400 and 500 mg/kg diet in laying hen diets significantly (P≤0.05) decreased egg yolk total lipids contents by 7.52, 11.58 and 29.53% and egg yolk cholesterol contents by 29.71, 32.43 and 37.86%, respectively compared with the control group.*

- *Addition of EPL to the laying hen diets at levels of 300, 400 and 500 mg EPL/kg diet caused a significant (P≤0.05) decrease of liver total lipids content by 25.62, 37.01 and 53.02% and liver cholesterol content by 4.35, 14.22 and 22.87% respectively, while, bile volume of gall bladder was significantly (P≤0.05) increased compared with the control group.*

- *No significant effect was observed on fertility percentage and chicks weight by dietary EPL supplementation, while addition of 300, 400 and 500 mg EPL/kg diet significantly (P≤0.05) decreased hatchability percentage of fertile eggs by 6.68, 14.24 and 19.62%, respectively compared with the control group.*

- *Essential phospholipids supplementation at 400 and 500mg/kg diet significantly (P≤0.05) decreased the relative weight of liver and oviduct. Also, abdominal fat percentage of groups fed 300, 400 and 500 mg EPL/kg diet was significantly (P≤0.05) decreased by 8.71, 27.64 and 38.82%, respectively compared with the control group. While, EPL supplementation had no significant effect on ovary weight percentage, oviduct length and comb index.*

INTRODUCTION

High cholesterol levels in the human diet have been linked with increased incidence of atherosclerosis **(Friedman, 1968).** Hence patients with atherosclerosis and coronary heart disease are frequently advised to avoid consuming diets containing high cholesterol level. The cholesterol in yolk (> 90%) is present as free (nonesterfied) cholesterol, this is synthesized in the liver of the laying hen in response to estrogen stimulation and transported via blood to ovary. The lipoprotein (along with other yolk precursors) pass out of capillaries of the developing follicles, then taken up into the oocyte by receptor- mediated endocytosis **(Griffin, 1990).** Since egg yolk is one of the most concentrated sources of cholesterol content of

the egg, many trials used to reduce the cholesterol in egg yolk by different ways such as, genetic selection **(Becker *et al.*, 1977 and Kosba *et al.*, 2004)**; manipulation of layer diet components **(Bartov *et al.*, 1971 and James, 1978)** and administration of hypocholesterolemic drugs **(Clearenburg *et al.*; 1971; Bakir *et al.*, 1988; Cindie *et al.*, 1990; Chowdhury *et al.*, 2002; Szymezyk *and Pisulewski.*, 2003; El-Sheikh 2005 and Hanafy 2006)**

Essential phospholipids are highly purified phosphatidyl choline fraction isolated from soybeans; the substance is particularly rich in polyunsaturated fatty acid with linoleic acid accounting for approximately 70% (lipostabil booklet by Rhone- Poulenc Rorer, Nattermann, International GMBH .Germany) lekim and Betzin (1974).

Clearenburg et *al.* (1971) reported that the cholesterol content in egg yolk may be affected by environmental factors and can be lowered by 35% by feeding a plant sterol sito sterol $C_{29}H_{50}O$. Moreover, many studies were conducted to reduce egg yolk cholesterol content by using other unsaturated fatty acids. **Qota (2007)** found that addition of 2.5 and 5% linseed oil into the hen diets for 11 weeks gradually reduced ($P \leq 0.05$) total lipids and cholesterol levels in serum, liver and egg-yolk. **Vasko *et al.* (2005)** indicated that cholesterol in the egg yolk was significantly decreased in the groups fed flax and fish oil supplemented diets. **Caroll (1983)** showed that general dietary plant proteins are hypochlesterolemic in contrast to animal proteins such as casein. **Guenter *et al.* (1971)** reported that increasing the linoleic acid contents in laying hen diet decreased lipid content of egg yolk compared with those fed lower dietary levels of Linoleic acid.

Hypocholesterolemic drugs may be classified according to their mode of action. Therefore, essential phospholipids (EPL) as hypocholesterolemic drugs, which increased cholesterol catabolism and excretion in the bile acid in human **(Blogasklonov *et al.*, 1986)**; rats **(Rozewicka and Kadlubowska., 1978)** and chickens **(Leuschner *et al.*, 1976, El-Sheikh 2005 and Hanafy 2006)**. The present work was designed to study the effect of different levels of essential phospholipids (EPL) as hypocholesterolemic pharmaceuticals in the laying hen's diet on some productive and physiological traits.

MATERIALS AND METHODS

Experimental Procedures

A total of sixty four laying hens of Bandara developed strain at 30 weeks of age were used in the present study. The birds were leg banded and randomly divided into four equal groups (16 hens/ group). The first group served as a control and fed the experimental diet without any drugs, while the second, third and fourth groups were fed diets supplemented with 300, 400 and 500 mg EPL/ kg diet respectively.

All hens were housed individually in layer cages in open –sided house. Essential phospholipids supplementation was continued for 10 weeks from 30 to 40 weeks of hens age. Feed and water were provided *ad-libitum* and the birds were exposed to 14 hours light daily throughout the experimental period. Composition and calculated analysis of the experimental diets are shown in Table 1. Fatty acids analysis of the experimental diet and fatty acids composition of EPL are shown in Tables 2 and 3.

Measurements and Studied Traits

All birds were individually weighed daily at 30, 32, 36 and 40 weeks of age. Feed consumption (g/ hen/ day) was recorded and feed conversion ratio was calculated daily for each group in treatments throughout the whole experimental period. Eggs were collected and recorded daily to calculate egg production percentage, eggs were individually weighed daily by gram and egg mass was calculated for each group of treatments.

At 30, 32, 36 and 40 weeks of age, blood samples were withdrawn from the brachial vein from five birds in each group. Blood samples were centrifuged at 3000 r.p.m for 20 minutes to separate serum samples which were stored at -18 °C until assay. Also, five eggs were randomly taken from each group at the same time of blood sampling for egg quality measurements (egg shape index, yolk index, albumen %, yolk % shell %, shell thickness (mm) and haugh unit).

At 36 weeks of age all hens in each group were artificially inseminated twice a week with 0.05 ml/ hen undiluted pooled semen. Semen was collected from 20 males of the same strain fed the experimental diets without drugs. Every week, (during the last three weeks of treatment) 50 eggs from each group were chosen randomly and incubated in Egyptian-mode hatchery according to the normal procedure. Fertility and hatchability

of fertile eggs percentages were calculated and hatched chicks were weighed.

At the end of the experimental period (40 weeks of age), five hens from each group were sacrificed to calculate relative weights of ovary, oviduct, abdominal fat and liver and oviduct length (cm). Also, bile volume of gall bladder (ml) was measured by tuberculin syringe. The comb index of each bird was calculated at slaughter test according to **Jones and Lamoreaux (1943)**.

Chemical Analyses:

The moisture contents of the experimental diets were determined in three replicates by drying at 105°C for 3 hours. The analyses of crude protein, ether extract and ash content were carried out according to **A. O. A. C. (1975)**. Nitrogen content of diet was determined by a Microkjeldahl method according to **Allen (1942)**.

The lipid samples of diet were extracted by Chloroform: Methanol (2:1) according to **Folch *et al.* (1957)**. Fatty acids composition of the experimental diet was determined using HPLC system **(KNAUER HPLC 64, Germany)**. While lipids were extracted from liver and egg yolk samples by chloroform: methanol (2:1) according to **Washburn and Nix (1974)** to determine total lipids and cholesterol concentrations. Serum samples were used to determine total lipids, cholesterol, triglycerides, high density lipoprotein (HDL), Low density Lipoprotein (LDL), Glutamic Oxaloacetic Tranaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) concentrations by spectrophotometer using available commercial Kits produced by Sentinel, Italy.

Statistical Analysis:

Data were subjected to the ANOVA using SAS software **(SAS, 1990)** when significant differences were found, means were compared using Duncan's multiple range test **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Productive Performance

Body weight

Results of body weights for Bandarah hens fed different levels of EPL at 30, 32, 36 and 40 weeks of age are given in Table 4. Body weight was not significantly affected by EPL supplementation. This result is in agreement with those reported by **El-Sheikh (2005)** who indicated that no

significant differences in live body weight when Gimmizah or Bandarah laying hens at 40 weeks of age were fed 300 and 1500 mg EPL/kg diet compared with the control group. Moreover, **Shafey (1998)** indicated that body weight was not significantly affected by 6 gm retinol or 20 gm sunflower oil supplementation in the laying hen diets. **Luhman *et al.* (1990)** showed that no significant influence on body weight due to another hypocholestrolemic drugs (11.7 gm of cholestipol and 35 mg lovastatin / hen / day) in laying hen diets. **Waldroup *et al.* (1986)** reported that addition of probucol as hypocholesterolemic drug up to 1% in laying hen diets did not show any influence on body weight.

We concluded that different levels of EPL had no significant effect on body weight of Bandarah hens during the experimental period.

Feed consumption, feed conversion and egg production traits

Results in Table 5 showed that high dose of EPL (500 mg) in laying hen diet caused a significant ($P \leq 0.05$) reduction in feed consumption among all experimented period compared with those for other groups. Supporting to our results, **Shang *et al.* (2004)** observed that feed consumption was decreased linearly ($P \leq 0.01$) when hens were fed corn-soybean meal diets containing 0, 1, 2, 3, 4, 5 or 6% conjugated linoleic acid. **Meluzi *et al.* (2003)** showed that feed consumption of laying hens was significantly lower in groups fed conjugated linoleic acid compared with the control group. **Sijben *et al.* (2002)** indicated that using three dietary concentrations of linoleic acid with vitamin E in laying hen diets decreased feed consumption. While **El-Sheikh (2005)** indicated that no significant effect on feed consumption due to feeding laying hens 300, or 1500 mg essential phospholipids /kg diet. Moreover, **Szymezyk and Pisulewski (2003)** indicated that dietary linoleic acid had no significant effect on feed consumption of laying hens. This indicated that the palatability of the diet was not changed by the addition of EPL.

Feed conversion was numerically improved by addition of EPL in the diets of laying hens compared with the control group throughout the experimental periods (Table 5). These results are in agreement with those reported by **Bolukbasi and Erhan (2005)** and **Schafer *et al.* (2001)** who found that the effect of dietary conjugated linoleic acid on feed conversion of laying hens was not significantly affected. Moreover, **Kim *et al.* (2004)** showed that no significant effect on feed conversion was observed by addition of 0.03 or 0.06% lovastatin, simvastatine and pravastatin as hypocholesterolemic drugs in ISA brown hen diets at 40 weeks of age throughout the experimental period. Also, **Waldroup *et al.* (1986)** showed

that there was no significant impairment in feed utilization when probucol was added to the diet of laying hens.

Essential phospholipids had no significant effect on egg weight, egg mass and egg production percentage of Bandarah hens throughout the experimental periods (Table 5). Similar results were obtained by **Hanafy (2006)** who reported that injection of EPL at 150 or 300 mg/kg body weight of Gimmizah laying hens had no significant effect on egg production percentage. **Aydin *et al.* (2006)** showed that addition of 0.25 and 0.5% conjugated linoleic acid in Japanese quail hen diets does not influence egg weight and egg production percentage. **Cachaldora *et al.* (2005)** reported that the diet of laying hens with conjugated linoleic acid, fish oil and high-oleic sunflower oil did not affect egg production characteristics. **Zhao and Scheidele (1999)** stated that dietary linoleic acid had no significant effect on egg production. On the other hand, **Bolukbasi and Erhan (2005)** observed that sunflower oil and soybean oil negatively influence egg production in laying hens. **Waldroup *et al.* (1986)** indicated that addition of probucol as hypocholesterolemic agent in the laying hen diets up to 1% significantly reduced egg yolk cholesterol content without impairment of rate of egg production. Moreover, **Meluzi *et al.* (2003) and Schafer *et al.* (2001)** indicated that no significant effect on egg weight when conjugated linoleic acid supplementation in the laying hen diets. **An *et al.* (1997)** showed that no significant effect on egg weight by addition of safflower phospholipids to the laying hen diets.

Egg quality

Results in Tables 6 and 7 showed that there were insignificant differences in egg albumen (%), yolk (%), shell (%), shell thickness (mm), egg shape index, yolk index and Haugh units between laying hen groups fed diets supplemented with 300, 400 and 500 mg EPL/ kg diet and those of the control group during the experimental ages, except yolk index at 40 weeks of age (after 10 weeks of treatment) which significantly ($P \leq 0.05$) increased compared with the control group. These results are consistent with those reported by **Hanafy (2006)** who observed that injection of 150 or 300 mg EPL/kg body weight in Gimmizah hens had no significant effect on egg yolk (%), shell (%), shell thickness (mm), egg shape index and Haugh units during the whole experimental period (from 40 to 48 weeks of age). **El-Shiekh (2005)** indicated that no significant differences were observed in egg yolk percentage, shell thickness, yolk index and Haugh unit due to feeding diets containing 300 or 1500 mg EPL/kg diet to laying hens. **Crobas *et al.* (2001)** showed that no significant effect on egg yolk weight,

albumen weight and shell thickness of two strains of laying hens (ISA Brown and SCWL) due to feeding four sources of fat tallow oil, olive oil, soy oil and linseed oil. **Waldroup *et al.* (1986)** found that no significant effect on albumen quality due to probucal addition as a hypocholesterolemic agent in the laying hen diets.

Physiological Parameters

Serum characteristics

Results of serum total lipids, cholesterol, triglycerides, HDL, LDL, GOT and GPT concentrations of Bandarah hens fed different levels of EPL at 30, 32, 36 and 40 weeks of age are given in Tables 8 and 9. Differences in serum characteristics for all treated groups at 30 weeks of age (zero time) were insignificant. While after 2 weeks of treatment (32 weeks of age), serum total lipids, cholesterol and triglyceride were significantly ($P \leq 0.05$) decreased in groups fed 400 and 500 mg EPL/kg diet compared with the control group. At 36 and 40 weeks of age, EPL supplementation at 300, 400 and 500 mg EPL/kg diets significantly ($P \leq 0.05$) decreased serum total lipids, cholesterol and triglyceride concentrations compared with the control group. At the end of treatments, it is clear that the groups fed 300, 400 and 500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased serum total lipids by 4.5, 9.6 and 13.5% , serum cholesterol by 26.56, 35.04 and 42.52 % and serum triglyceride by 7.68, 11.21 and 17.83% respectively compared with the control group (Table 8). Similar result was obtained by **Hanafy (2006)** who found that injection of 300 mg EPL/kg body weight of Gimmizh laying hens at 40, 44 and 48 weeks of age significantly ($p \leq 0.05$) decreased serum total lipids , cholesterol and triglycerides compared with the control group. **El-Sheikh (2005)** indicated that laying hens fed 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.05$) reduced serum cholesterol by 7.7 and 18%; serum total lipids by 9.8 and 18.2% and serum triglyceride by 11.7 and 18.6% respectively compared with the control group after 10 weeks of treatment. **Vasko *et al.* (2005)** indicated that addition of omega- 3 polyunsaturated fatty acids from flax and fish oil in laying hen diets significantly decreased serum total lipids. **Kim *et al.* (2004)** found that feeding hypocholesterolemic drugs (0.06% lovastatin), reduced plasma total cholesterol significantly by 28%, also (0.03 and 0.06% simvastatin) plasma cholesterol by 36 and 53 (mg/dl), while (0.03% lovastatin) induced a greater than 50% reduction in plasma triglycerides compared with the control group. **An *et al.* (1997)** reported that dietary safflower phospholipids (crude and purified safflower phospholipids) significantly decreased serum cholesterol concentration in laying hens. **Sallmann and Schole (1977)**

indicated that serum cholesterol decreased by 20% in experimental group compared with the control group when 10% soya oil fed to laying hens.

Besides, results in Table 8 shows that there was no significant effect of EPL on serum HDL and LDL levels at 30 and 32 weeks of age. At 36 weeks of age (after 6 weeks of treatment), although the differences between the groups were insignificant for serum HDL, it can be noticed the serum HDL for the groups fed EPL was higher than those of the control group. While, serum LDL of different groups fed EPL significantly ($P \leq 0.05$) decreased compared with the control group. At 40 weeks of age (after 10 weeks of treatment) all groups fed EPL at 300, 400 and 500 mg/kg diet significantly ($P \leq 0.05$) increased serum HDL by 6.09, 7.82 and 10.37% respectively compared with the control group, whereas serum LDL significantly ($P \leq 0.05$) decreased by 6.14, 8.58 and 12.61 % respectively compared with the control group. The present results are in agreement with those reported by **Hanafy (2006)** who indicated that injection of 150 or 300 mg EPL /kg body weight significantly ($P \leq 0.01$) increased serum HDL compared with the control group. **El-Sheikh (2005)** indicated that the addition of 300 and 1500 mg/ kg diet of laying hens significantly ($P \leq 0.05$) increased serum HDL by 16.6 and 25.9% respectively as a percentage of the control group after 10 weeks of treatment. **Bolukasi and Erhan (2005)** reported that addition of 3.32% olive oil in laying hen diets decreased total cholesterol and low density lipoprotein, while increased serum high density lipoprotein. **Celebi and Utlu (2006)** found that serum high density lipoprotein was significantly increased, while low density lipoprotein and very low density lipoprotein were significantly decreased due to addition of 4% flax seed oil in the ISA brown hen diets compared with the control group. **Scott and Jensen (1993)** reported that addition of d-a-tocotrienol to chicken diets decreased serum total cholesterol and low density lipoprotein.

Results in Table 9 indicated that serum GOT and GPT of Bandarah laying hens were not significantly affected by EPL supplementation. Similar results were reported by **Hanafy (2006) and El-Sheikh (2005)** who found that EPL did not significantly affect serum GOT and GPT levels of laying hens during the whole experimental period.

Egg yolk lipids

Results presented in Table 10 indicate that egg yolk total lipids and cholesterol contents at 30 weeks of age for all experimented groups were not statistically different. In addition, after two weeks of treatment at 32 weeks of age, supplementation the diet with 400or 500 mg EPL / kg diet significantly decreased egg yolk total lipids content compared with those in

other groups. While, egg yolk cholesterol contents of hens fed all levels of EPL significantly ($P \leq 0.05$) decreased compared with those for control group. At 36 and 40 weeks of age, all levels of EPL significantly ($P \leq 0.05$) had decreased egg yolk total lipids and cholesterol contents compared with the control group. Moreover, at the end of treatments the hens fed 300, 400 and 500 mg EP/kg diet caused a reduction in egg yolk total lipids by 7.52, 11.58 and 29.53% and egg yolk cholesterol contents by 29.71, 32.43 and 37.86%, respectively compared with the control group. Moreover, the reduction in cholesterol was more pronounced than total lipids. These results are in agreement with those reported by **Hanafy (2006)** who found that the injection of 300 mg EPL/kg body weight of Gimmizah laying hens for ten weeks significantly ($P \leq 0.05$) reduced egg yolk total lipids and cholesterol by 19.5 and 30.9%, respectively. **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.05$) reduced egg yolk cholesterol level by 18.4 and 34.8% and total lipids by 5.3 and 14.9%, respectively. **Kim *et al.* (2004)** indicated that addition of 0.03 and 0.06% pravastatin as a hypocholesterolemic drug in the diets of laying hens reduced total egg yolk cholesterol content by 11.1 and 19.6%, respectively compared with the control group. **Elkin and Rogler (1989)** reported that high dosage of lovastatin can decrease the cholesterol content in egg yolk by approximately 15%, the doses may be needed to be greater than those found to be effective for humans, because laying hens must synthesize much more cholesterol per kilogram of metabolic body weight. **Bakir *et al.* (1988)** reported that the addition of hypocholesterolemic drugs (Atromid-s) in the laying hen diets at two levels (100 and 200 mg Atromid-s/hen/day) reduced egg yolk cholesterol by 12 and 18% respectively compared with the control group. **Waldroup *et al.* (1986)** showed that addition of probucol (4.4-isopropyldinedithio)-bis(2.6-di-t-butyl-phenal) as a hypocholesterolemic agent in the laying hens diets up to 1% significantly reduced egg yolk cholesterol content by 7% without impairment of egg production rate, egg weight, shell strength, albumen quality or other production related parameters. **Helene *et al.* (1981)** indicated that egg yolk cholesterol was reduced after 2 weeks of feeding 5 ppm of azacholestone by 20 % of the total sterol and feeding 5 ppm of dizacholesterol for 2 weeks reduced egg yolk cholesterol to 45% of the total sterols, while after 4 weeks, egg yolk cholesterol was reduced to 36% of total sterols.

Liver lipids and bile volume of gall bladder

Results presented in Table 11 indicated that the hens fed 300, 400 and 500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased liver total lipids and cholesterol contents at the end of experimental period (40 weeks of age)

compared with the control group. It can be observed from these results that the hens fed 300, 400 and 500 mg EPL/kg diet decreased liver total lipids by 25.62, 37.01 and 53.02% and liver cholesterol contents by 4.35, 14.22 and 22.87%, respectively compared with the control group. These results are consistent with those reported by **Hanafy (2006)** who found that injection of 300 mg EPL/kg body weight of Gimmizah local hens for ten weeks, decreased liver total lipids and cholesterol by 13.6 and 38.9% respectively compared with the control group. Moreover, **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased liver cholesterol by 17.5 and 60.3 % compared to control group, respectively. Thus, the reduction in liver cholesterol level was more pronounced than liver total lipids. **Kim *et al.* (2004)** showed that liver cholesterol concentration was significantly decreased by 14.7 and 20.6% when hens fed diet with 0.03 and 0.06% pravastation respectively compared with the control group. **Elkin *et al.* (1999)** indicated that addition of lorvastatine, lovastatine or simvastatine in the diets of laying hens for 5 weeks decreased liver cholesterol concentration. **Naber *et al.* (1982)** found that the probucol as hypocholesterolemic agent in layer diets reduced total liver lipogenesis in vivo.

Various reports have been published on the effect of unsaturated fatty acids on liver total lipids and cholesterol contents, as **An *et al.* (1997)** reported that addition of safflower phospholipids in the laying hen diets at 6 weeks of age for seven weeks significantly decrease in liver cholesterol and triglycerides contents in all treated groups as compared with the control group. **Bragg *et al.* (1973)** indicated that the liver weight and lipid contents were decreased when linoleic acid was provided by soya or sunflower oil in the laying hen diets.

Besides, data in Table 11 showed that bile volume of gall bladder for groups fed 300, 400 and 500 mg EPL/kg diet had significantly ($P \leq 0.05$) increased compared with the control group. This observation is in accordance with those of **Hanafy (2006) and El-Sheikh (2005)** who found that EPL significantly ($P \leq 0.05$) increased bile volume of gall bladder throughout the experimental period compared with the control group due to injection of 150 and 300 mg EPL/kg body weight or addition of EPL at 300 or 1500 mg /kg diet in laying hen diets. **Imaizumi *et al.* (1982)** reported that a diet containing phospholipids reduced plasma cholesterol level in rats by increasing the transfer of cholesterol into bile as well as increasing excretion of feces neutral steroid. Moreover, **Sim *et al.* (1980)** indicated that addition of soya sterols (safflower oil or hydrogenated coconut oil) in the laying hen diets increased feces bile acid excretion. **Sim and Bragg (1978)**

reported that the anti-cholesterolegenic function of plant sterols in laying hen diets is due to an influence on cholesterol catabolism rather than cholesterol absorption, this factor appears to increase the degradation followed by excretion of degraded cholesterol in feces as bile acid and neutral sterol metabolites.

Fertility (%), hatchability (%) and chicks weight (g)

Results in Table 12 show that there were no significant differences in fertility percentage when hens fed 300, 400 and 500 mg EPL/kg diet were compared with the control group. While, hatchability percentage of fertile eggs for groups fed 300, 400 and 500 mg EPL/kg diet were significantly ($P \leq 0.05$) decreased by 6.68, 14.24 and 19.62%, respectively compared with the control group. Decreasing hatchability of fertile eggs for groups fed EPL may be due to lowering egg yolk total lipids and cholesterol content compared with the control group as illustrated for data shown in Table 10. These results are in agreement with those reported by **Hanafy (2006)** who observed that injection of 150 and 300 mg EPL/kg body weight of Gimmizah laying hens at 48 weeks of age significantly ($p \leq 0.05$) reduced hatchability percentage of fertile eggs by 12.4 and 12.9%, respectively compared with the control group. **Aydin *et al.* (2006)** indicated that addition of 0.5% conjugated linoleic acid to the Japanese quail laying hens significantly decreased hatchability percentage of fertile eggs, while no significant effect was observed on fertility percentage compared with the control group. **El-Sheikh (2005)** found that addition of 1500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased hatchability percentage by 19.99% compared with the control group, While, **Cunningham *et al.* (1974)** found a significant positive correlation between egg yolk cholesterol level and hatching of fertile eggs. Many studies indicated that lipid metabolism is an important aspect of chicken embryonic development because avian embryos derive over 90% of their caloric requirement from fatty acid oxidation. The embryo uses this energy for its growing and viability **(Boel, 1955)**. Also, **Connor *et al.* (1969)** showed that 90% of the cholesterol in the brain of the chicken embryo is synthesized but the cholesterol in the remainder of the body comes from the yolk might be related to embryonic development and consequently affect the hatching of chicks.

Results presented in Table 12 showed that there were insignificant differences in body weight of chicks produced from hens fed diet supplemented with 300, 400 and 500 mg EPL/kg diet compared to those for control group. These results are in agreement with **Hanafy (2006)** who

reported that injection of EPL did not impair hatched chick weight of Gimmizah laying hens.

Slaughter traits and comb index

Results presented in Table 13 showed that the groups fed 400 and 500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased the relative weight of liver and oviduct compared with the control group. This decrease may be due to the reduction of fat accumulation in these organs. These results are in agreement with those reported by **Maurice and Hensen (1978), Balnave (1975) and Bragg *et al.* (1973)** .Also, data presented in Table 13 indicated that EPL supplementation had no significant effect on ovary weight percentage, oviduct length and comb index for Bandarah laying hens after 10 weeks of treatment. These results are in harmony with data obtained by **Hanafy (2006) and El-Sheikh (2005)** who indicated that no significant effect on relative weight of ovary and oviduct length due to injection or addition of EPL in the diets of laying hens during the whole experimental period. While, results in Table 13 indicated that the groups fed 300,400 and 500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased abdominal fat percentage by 8.71, 27.64 and 38.82%, respectively compared with the control group. These observations are in accordance with those of **Hanafy (2006)** who indicated that injection of 150 and 300 mg EPL/kg body weight significantly ($P \leq 0.05$) decreased abdominal fat percentage in Gimmizah laying hens after 12 weeks of treatment compared with the control group. **El-Sheikh (2005)** found that addition of 150 and 1500 mg EPL/kg diet in laying hen diets significantly ($P \leq 0.05$) decreased abdominal fat percentage by 12.9 and 22.9% respectively after 10 weeks of treatment compared with the control group.

In conclusion, supplementing the laying hens deit with 500 mg EPL/Kg diet realized the best results in diminishing egg yolk cholesterol and total lipids without any adverse effect on chicken body weight, feed conversion, egg production, egg weight and egg quality. Therefore, we can recommend using eggs produced from chickens fed EPL in diets with the previous mentioned dose for human suffering from an increase of blood cholesterol, coronary heart diseases and atherosclerosis. Also, the use of this drug for producing hatching eggs is not recommended due to its adverse effect on hatchability percentage.

Table 1: Composition and calculated analysis of experimental diets for laying hens.

Ingredients	Percentages
Yellow corn	67.0
Soybean meal 44% CP	14.0
Wheat bran	6.0
Layer concentrate 48% CP [a]	8.0
Ground limestone	4.0
Sodium chloride	0.3
Mineral mix [b]	0.3
Vitamins [c]	0.4
Total (kg.)	100
Calculated :	
Crude protein %	16.5
ME (K cal/ kg)	2900
Calcium %	3.26
Av. Phosphorus %	0.32
Lysine %	0.62
Meth. + Cyst. %	0.51
Analyzed :	
Crude protein %	16.5
Ether extract %	3.16
Ash %	8.20
Moisture %	10.48

(a) Each 100 kg. contains: Crude protein, 48.8; M.E., 2100 K cal / kg; Crude fiber, 4.7%; Crude fat, 3.7 %; Calcium, 6.0 %; Av. Phosphorus, 3.17 %; Methionine, 1.4 %; Methionine + Cystine, 1.95 %; Lysine, 2.65 %; Salt, 3.3 %.

(b) Each kg. contains: Manganese 40mg. Zinc 45mg., Copper 0 .03 mg., Iodine 3mg., Selenium 0.1 mg., Iron 30mg

(c) Each kg. contains: Vit.A 20.000IU. Vit. D_3 2000ICU. Vit.E 400 mg., Niacin 20mg ,Vit. B_2 4.5mg., Vit.B_6 3.0 mg., Vit B_{12} 13.0mg..Choline chloride 100mg., and Vit. K 2.0mg.

Table 2: Fatty acids analysis of the experimental diet.

No	Component		Concentrate (%)
1	Caprylic	8 : 0	14.95
2	Caprice	10 : 0	8.90
3	Lauric	12 : 0	2.21
4	Myristic	14 : 0	16.51
5	Myristolic	14 : 1	19.35
6	Palmitic	16: 0	17.92
7	Palmitoliec	16 : 1	0.33
8	Stearic	18 : 0	8.75
9	Oleic	18 : 1	1.35
10	Linoleic	18 : 2	2.95
11	Linolenic	18 : 3	1.21
12	Arachidic	20 : 0	2.52

Table 3: Fatty acids composition (mol%) of essential phospholipids(EPL).

Fatty acids	Total (%)
C 16 : 0 palmitic acid	12.9
C 18 : 0 stearic acid	4.4
C 18 : 1 oleic acid	10.5
C 18 : 2 linoleic	66.5
C 18 : 3 linolenic acid	5.7

Table 4: Effect of essential phospholipids (EPL) supplementation in layer diets on body weights of Bandarah hens at different ages ($\bar{x} \pm$ S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	Body weight (kg)
30	Control	1.603 ±0.043
	300	1.604 ± 0.047
	400	1.614 ± 0.045
	500	1.608 ± 0.041
32	Control	1.615 ± 0.042
	300	1.602 ± 0.046
	400	1.614 ± 0.045
	500	1.594 ± 0.038
36	Control	1.621 ± 0.041
	300	1.595 ± 0.045
	400	1.583 ± 0.039
	500	1.575 ± 0.037
40	Control	1.634 ± 0.040
	300	1.583 ± 0.044
	400	1.572 ± 0.033
	500	1.558 ± 0.037

Table 5: Effect of essential phospholipids (EPL) supplementation in layer diets on feed consumption, feed conversion and egg production traits during the experimental periods ($\bar{x} \pm$ S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	Feed consumption g/hen/d	Feed conversion (kg/ kg egg)	Egg weight (g)	Egg mass g/hen/d	Egg production (%)
30-32	Control	115.29 ± 1.55 [a]	3.81 ± 0.27	45.84 ± 0.34	24.54 ± 1.63	54.88 ± 3.69
	300	114.92 ± 1.83 [a]	3.71 ± 0.20	45.58 ± 0.45	24.26 ± 1.16	54.33 ± 2.91
	400	113.89 ± 1.85 [a]	3.63 ± 0.14	45.38 ± 0.69	23.63 ± 0.85	53.83 ± 1.74
	500	106.86 ± 1.49 [b]	3.24 ± 0.17	45.25 ± 0.22	23.45 ± 1.15	53.19 ± 2.46
32-36	Control	118.65 ± 2.30 [a]	3.84 ± 0.08	47.88 ± 0.38	28.88 ± 0.62	58.65 ± 0.95
	300	117.78 ± 1.49 [a]	3.38 ± 0.25	47.48 ± 0.41	27.35 ± 1.45	58.10 ± 2.80
	400	116.52 ± 1.50 [a]	3.21 ± 0.10	47.45 ± 0.40	27.16 ± 0.93	57.79 ± 1.91
	500	112.00 ± 2.29 [b]	3.17 ± 0.12	47.28 ± 0.57	27.02 ± 0.94	57.14 ± 1.98
36-40	Control	123.42 ± 1.36 [a]	3.49 ± 0.05	50.88 ± 0.37	34.46 ± 0.64	67.62 ± 0.95
	300	121.43 ± 1.42 [a]	2.81 ± 0.04	50.40 ± 0.17	33.60 ± 0.11	66.67 ± 0.11
	400	120.30 ± 1.04 [a]	2.64 ± 0.12	50.22 ± 0.31	33.29 ± 1.03	66.16 ± 1.90
	500	118.24 ± 2.17 [b]	2.57 ± 0.05	50.18 ± 0.21	33.16 ± 0.84	65.72 ± 1.74

a, b = Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

Table 6: Effect of essential phospholipids (EPL) supplementation in layer diets on relative weight of albumen, yolk, shell and shell thickness at 30, 32, 36 and 40 weeks of age ($\bar{x} \pm$ S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	Albumen (%)	Yolk (%)	Shell (%)	Shell thickness (mm)
30	Control	58.11 ± 1.84	30.77 ± 1.84	11.11 ± 0.01	0.388 ± 0.016
	300	58.47 ± 1.36	30.43 ± 0.94	11.10 ± 0.67	0.366 ± 0.014
	400	58.67 ± 1.30	30.00 ± 0.87	11.33 ± 0.54	0.344 ± 0.005
	500	58.59 ± 1.47	29.74 ± 1.21	11.49 ± 0.46	0.352 ± 0.010
32	Control	57.39 ± 1.62	30.64 ± 1.32	11.98 ± 0.35	0.394 ± 0.002
	300	58.56 ± 0.72	30.25 ± 0.38	11.19 ± 0.36	0.398 ± 0.005
	400	57.75 ± 0.72	30.33 ± 0.50	11.92 ± 0.49	0.400 ± 0.004
	500	58.34 ± 0.73	29.96 ± 0.56	11.68 ± 0.37	0.402 ± 0.004
36	Control	58.08 ± 0.54	30.74 ± 0.47	11.17 ± 0.49	0.362 ± 0.010
	300	58.19 ± 1.01	30.36 ± 1.20	11.45 ± 0.57	0.360 ± 0.001
	400	58.49 ± 1.20	30.19 ± 0.90	11.32 ± 0.69	0.354 ± 0.005
	500	58.40 ± 0.91	29.99 ± 0.67	11.61 ± 0.47	0.354 ± 0.002
40	Control	57.99 ± 1.21	30.69 ± 0.70	11.55 ± 0.60	0.408 ± 0.002
	300	58.30 ± 0.67	30.34 ± 0.86	11.35 ± 0.39	0.418 ± 0.004
	400	58.17 ± 0.45	29.94 ± 0.42	11.88 ± 0.20	0.402 ± 0.004
	500	58.90 ± 1.07	28.19 ± 1.19	11.61 ± 0.45	0.404 ± 0.006

Table 7: Effect of essential phospholipids (EPL) supplementation in layer diets on egg shape index, yolk index and Haugh unit at 30, 32, 36 and 40 weeks of age ($\bar{x}$ ± S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	Egg shape index	Yolk index	Haugh unit
30	Control	74.40 ± 0.51	44.60 ± 0.40	85.67 ± 0.40
	300	75.80 ± 0.20	42.60 ± 0.75	84.59 ± 0.50
	400	74.80 ± 0.40	42.60 ± 0.40	85.31 ± 0.87
	500	74.40 ± 0.60	43.20 ± 0.58	85.41 ± 0.78
32	Control	75.80 ± 0.20	44.80 ± 0.20	85.80 ± 0.91
	300	74.60 ± 0.75	43.20 ± 0.92	84.96 ± 0.41
	400	75.60 ± 0.40	44.00 ± 0.63	85.33 ± 0.47
	500	74.80 ± 0.58	44.20 ± 0.37	85.27 ± 0.40
36	Control	75.40 ± 0.24	42.80 ± 0.80	85.74 ± 0.61
	300	75.80 ± 0.20	43.60 ± 0.75	84.80 ± 0.44
	400	75.20 ± 0.49	45.00 ± 0.37	85.24 ± 0.17
	500	75.20 ± 0.38	44.60 ± 0.40	85.37 ± 0.43
40	Control	75.20 ± 0.80	41.60 ± 0.60 [b]	85.22 ± 0.71
	300	75.20 ± 0.37	43.40 ± 0.24 [a]	85.37 ± 0.88
	400	75.80 ± 0.20	43.80 ± 0.20 [a]	85.71 ± 0.76
	500	75.80 ± 0.30	43.00 ± 0.55 [a]	85.37 ± 0.54

a, b = Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

Table 8: Effect of essential phospholipids (EPL) supplementation in layer diets on serum total lipids. cholesterol, triglycerides, high density lipoprotein (HDL) and low density lipoprotein (LDL) at 30, 32, 36 and 40 weeks of age ($\bar{x} \pm$ S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	Total lipids (mg/dl)	Cholesterol (mg/dl)	Triglycerides (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
30	Control	1323.46 ± 10.23	210.80 ± 5.18	125.72 ± 1.33	24.04 ± 0.47	171.66 ± 0.93
	300	1324.16 ± 8.95	210.96 ± 2.43	125.98 ± 1.80	24.14 ± 0.17	171.76 ± 1.09
	400	1327.50 ± 5.85	211.44 ± 3.88	125.76 ± 0.82	24.04 ± 0.22	171.90 ± 0.48
	500	1330.76 ± 4.54	211.40 ± 3.54	125.86 ± 0.93	23.72 ± 0.46	171.78 ± 1.00
32	Control	1323.36 ± 7.02 [a]	216.38 ± 6.04 [a]	125.84 ± 1.94 [a]	24.12 ± 0.30	172.84 ± 1.82
	300	1295.70 ± 18.59 [ab]	205.34 ± 3.91 [ab]	121.44 ± 1.53 [ab]	24.44 ± 0.54	169.96 ± 2.05
	400	1261.24 ± 18.93 [bc]	194.84 ± 2.81 [b]	118.84 ± 1.52 [bc]	24.86 ± 0.53	168.62 ± 1.96
	500	1229.82 ± 14.82 [c]	179.90 ± 5.62 [c]	113.84 ± 1.68 [c]	25.0 ± 0.37	166.94 ± 1.41
36	Control	1327.72 ± 8.34 [a]	222.24 ± 4.91 [a]	126.82 ± 1.45 [a]	24.22 ± 0.19	174.60 ± 1.84 [a]
	300	1282.64 ± 17.90 [b]	187.48 ± 2.07 [b]	119.45 ± 1.68 [b]	25.24 ± 0.42	169.12 ± 1.19 [b]
	400	1231.34 ± 17.26 [c]	166.52 ± 2.24 [c]	116.02 ± 1.44 [b]	25.66 ± 0.56	165.66 ± 1.75 [b]
	500	1199.58 ± 7.53 [c]	151.58 ± 2.93 [d]	107.80 ± 1.62 [c]	26.32 ± 0.78	159.84 ± 1.82 [c]
40	Control	1332.04 ± 7.14 [a]	227.38 ± 3.53 [a]	127.40 ± 2.07 [a]	24.30 ± 0.23 [b]	175.20 ± 2.03 [a]
	300	1271.96 ± 17.43 [b]	166.98 ± 2.32 [b]	117.62 ± 1.45 [b]	25.78 ± 0.31 [a]	164.44 ± 1.67 [b]
	400	1204.18 ± 2.47 [c]	147.70 ± 3.62 [c]	113.12 ± 0.94 [b]	26.20 ± 0.54 [a]	160.16 ± 1.19 [b]
	500	1152.08 ± 16.60 [d]	130.70 ± 3.12 [d]	104.68 ± 1.55 [c]	26.82 ± 0.71 [a]	153.10 ± 1.41 [c]

a, b, c, d = Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

Table 9: Effect of essential phospholipids (EPL) supplementation in layer diet on serum glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) at different ages ($\bar{x} \pm$ S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	GOT (I.U/L)	GPT (I.U/L)
30	Control	73.78 ± 0.56	4.36 ± 0.31
	300	73.60 ± 0.41	4.50 ± 0.19
	400	73.60 ± 0.40	4.40 ± 0.35
	500	73.66 ± 0.34	4.56 ± 0.29
32	Control	73.78 ± 0.61	4.66 ±0.19
	300	74.08 ± 0.70	4.26 ± 0.31
	400	74.04 ± 0.35	4.72 ± 0.31
	500	74.32 ± 0.51	4.66 ± 0.38
36	Control	73.90 ± 0.39	4.18 ± 0.33
	300	74.12 ± 0.81	4.72 ± 0.07
	400	74.32 ± 0.48	4.96 ± 0.16
	500	74.36 ± 0.47	4.74 ± 0.22
40	Control	73.94 ± 0.20	4.72 ± 0.44
	300	74.32 ± 0.69	4.82 ± 0.33
	400	74.08 ± 0.39	4.94 ± 0.44
	500	74.56 ± 0.35	4.92 ± 0.25

Table 10: Effect of essential phospholipids (EPL) supplementation in layer diets on egg yolk total lipids and cholesterol content at different ages ($\bar{x} \pm$ S.E.).

Age (wks)	Supplementation dose (mg EPL/kg diet)	Total lipids (mg/g yolk)	Cholesterol (mg/g yolk)
30	Control	252.30 ± 2.78	13.34 ± 0.26
	300	245.12 ± 2.15	13.52 ± 0.19
	400	252.48 ± 2.15	13.66 ± 0.22
	500	252.58 ± 1.94	13.70 ± 0.53
32	Control	253.34 ± 1.92 [a]	13.78 ± 0.40 [a]
	300	250.88 ± 3.04 [a]	12.54 ± 0.08 [b]
	400	240.10 ± 3.97 [b]	12.26 ± 0.16 [b]
	500	239.32 ± 3.46 [b]	11.94 ± 0.16 [b]
36	Control	254.78 ± 1.96 [a]	13.76 ± 0.26 [a]
	300	241.36 ± 2.18 [b]	10.96 ± 0.18 [b]
	400	237.30 ± 2.09 [b]	10.66 ± 0.14 [b]
	500	188.74 ± 2.56 [c]	9.84 ± 0.13 [c]
40	Control	257.06 ± 3.12 [a]	14.00 ± 0.59 [a]
	300	237.74 ± 3.32 [b]	9.84 ± 0.23 [b]
	400	227.30 ± 2.83 [c]	9.46 ± 0.31 [b]
	500	181.16 ± 2.69 [d]	8.70 ± 0.23 [c]

a, b, c, d = Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

Table 11: Effect of essential phospholipids (EPL) supplementation in layer diets on liver lipids and bile volume of gall bladder at end of the experimental treatment ($\bar{x} \pm$ S.E.).

Supplementation dose (mg EPL/kg diet)	Total lipids (mg/g liver)	Cholesterol (mg/g liver)	Bile volume (ml)
Control	5.62 ± 0.22^{a}	254.00 ± 2.32^{a}	0.93 ± 0.05^{c}
300	4.18 ± 0.22^{b}	242.94 ± 2.40^{b}	1.35 ± 0.06^{b}
400	3.54 ± 0.29^{b}	217.88 ± 2.15^{c}	1.75 ± 0.22^{a}
500	2.64 ± 0.32^{c}	195.90 ± 4.93^{d}	1.90 ± 0.11^{a}

a, b, c, d = Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

Table 12: Effect of essential phospholipids (EPL) supplementation in layer diets on fertility, hatchability and chick weight at the end of treatments ($\bar{x} \pm$ S.E.).

Supplementation dose (mg EPL/kg diet)	Fertility (%)	Hatchability Of fertile eggs(%)	Chick weight (g)
Control	92.20 ± 1.10	86.87 ± 7.8^{a}	33.47 ± 0.41
300	93.33 ± 1.93	81.07 ± 4.11^{b}	34.45 ± 0.28
400	91.10 ± 1.1	74.5 ± 3.93^{c}	34.33 ± 0.43
500	92.20 ± 1.1	69.83 ± 7.96^{d}	34.61 ± 0.38

a, b, c, d= Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

Table 13: Effect of essential phospholipids (EPL) supplementation in layer diet on some slaughter characteristics of Bandarah hens at end of the experimental treatment ($\bar{x} \pm$ S.E.).

Supplementation dose (mg EPL/kg diet)	Liver weight (%)	Ovary weight (%)	Oviduct weight (%)	Oviduct length (cm)	Abdominal fat weight (%)	Comb index
Control	2.80 ± 0.13 ^{a}	0.34 ± 0.04	2.55 ± 0.05 ^{a}	59.43 ± 2.33	3.22 ± 0.03 ^{a}	1.88 ± 0.38
300	2.63 ± 0.05 ^{ab}	0.35 ± 0.01	2.53 ± 0.05 ^{a}	60.30 ± 1.37	2.94 ± 0.06 ^{b}	2.06 ± 0.76
400	2.43 ± 0.06 ^{bc}	0.34 ± 0.01	2.35 ± 0.05 ^{b}	60.10 ± 1.14	2.33 ± 0.10 ^{c}	2.09 ± 0.72
500	2.19 ± 0.08 ^{c}	0.35 ± 0.12	2.29 ± 0.04 ^{b}	59.95 ± 1.93	1.97 ± 0.08 ^{d}	1.95 ± 0.21

a, b, c, d = Means having different letters exponent within column within each trait are significantly different ($p \leq 0.05$).

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الملخص العربي

تأثير الدهون الفوسفوريه الأساسية على بعض الصفات الإنتاجية والفسيولوجية للدجاج البياض

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أجريت هذه الدراسة لبحث تأثير الدهون الفوسفوريه الأساسية (كعقار مخفض للكولستيرول) على محتوى الكولستيرول والدهون في الدم وصفار البيض و كذلك التأثير على بعض الصفات الإنتاجية والفسيولوجية للدجاج البياض. حيث أستخدم في هذه الدراسة ٦٤ دجاجة بندرة عمر ٣٠ أسبوع قسمت الطيور عشوائيا إلى أربعة مجموعات تجريبية بكل مجموعة ١٦ دجاجة. أستخدمت المجموعة الأولى للمقارنة وغذيت على العليقه التجريبية دون إضافة العقار بينما غذيت المجموعات الثانية والثالثة والرابعة على الغذاء التجريبى مضاف اليه المستويات ٣٠٠ ، ٤٠٠ ، ٥٠٠ ملجم دهون فوسفوريه لكل كجم غذاء على الترتيب لمدة ١٠ أسابيع. وتتلخص النتائج المتحصل عليها فيما يلى :

- لم يلاحظ خلال فترة التجربة أى تأثير معنوي للدهون الفوسفورية الأساسية على وزن الجسم و الكفاءة التحويلية و وزن البيضة و كتلة البيض والنسبة المئوية لإنتاج البيض بينما أدى أضافة المستوى العالى من الدهون الفوسفورية الأساسية (٥٠٠ ملجم)// كجم غذاء للدجاج البياض إلى انخفاض معنوى للغذاء المستهلك خلال الفترة من ٣٠ إلى ٤٠ أسبوع من العمر مقارنة بالمجموعات الأخرى.

- لم يوجد تأثيرات معنويةلأضافة الدهون الفوسفورية الأساسية فى علائق دجاج البندرة البياض على النسبة المئوية لوزن البياض والصفار والقشرة وكذلك سمك القشرة ومعامل شكل البيضة ومعامل الصفار ووحدة هيو خلال فترة التجربة باستثناء معامل الصفار عند عمر ٤٠ أسبوع (بعد ١٠ أسابيع من المعاملة) و الذى ارتفع معنويا مقارنة بمجموعة الكنترول.

- وجد أن أضافة الدهون الفوسفورية الأساسية فى غذاء دجاج البندرة البياض بالمستويات ٣٠٠، ٤٠٠ ، ٥٠٠ملجم / كجم غذاء أدى إلى انخفاض معنوي للدهون الكلية في سيرم الدم بحوالى ٤.٥ ، ٩.٦ ، ١٣.٥ % و كولستيرول السيرم بحوالى ٢٦.٥٦ ، ٣٥.٠٤ ، ٤٢.٥٢ % و الجليسريدات الثلاثية في سيرم الدم بحوالي ٧.٦٨ ، ١١.٢١ ، ١٧.٧٣ % و الليبوبرتينات المنخفضة الكثافة في السيرم بحوالى ٦.١٤، ٨.٥٨ ، ١٢.٦١ % بينما البروتينات العالية الكثافة في السيرم زادت بحوالى ٦.٠٩ ، ٧.٨٢ ، ١٠.٣٧ % على الترتيب مقارنة بمجموعة الكنترول. ولم يلاحظ اى تأثير معنوي على مستوى انزيمات الكبد GOT، GPT في السيرم خلال فترة التجربة.

- أدى إضافة الدهون الفسفورية بالمستويات ٣٠٠، ٤٠٠، ٥٠٠ ملجم / كجم غذاء في عذاء دجاج البندرة البياض إلى انخفاض معنوي لمحتوى صفار البيض من الدهون الكلية بحوالى ٧.٥٢ ، ١١.٥٨ ، ٢٩.٥٣ % و محتوى صفار البيض من الكولسترول بحوالى ٢٩.٧١ ، ٣٢.٤٣ ، ٣٧.٨٦ % على الترتيب مقارنة بمجموعة الكنترول.

- أدى إضافة الدهون الفوسفورية الأساسية فى علائق الدجاج البياض بالمستويات ٣٠٠، ٤٠٠ ،٥٠٠ ملجم / كجم غذاء إلى انخفاض معنوي لمحتوى الكبد من الدهون الكلية بحوالى ٢٥.٦٢ ، ٣٧.٠١ ، ٥٣.٠٢ % وكذلك محتوى الكبد من الكولسترول بحوالى ٤.٣٥، ١٤.٢٢ ، ٢٢.٨٧ % على الترتيب بينما أرتفع معنويا حجم الصفراء للحوصلة المرارية مقارنة بمجموعة الكنترول.

- لم يلاحظ أى تأثير معنوي على النسبة المئوية للخصوبة ووزن الكتاكيت الناتجة نتيجة لأضافة الدهون الفوسفورية الأساسية. بينما أدى أضافة الدهون الفوسفورية الأساسية بالمستويات٣٠٠، ٤٠٠، ٥٠٠ملجم / كجم غذاء إلى انخفاض معنوي للنسبة المئوية للفقس للبيض المخصب بمقدار ٦.٦٨ ، ١٢.٢٤ ، ١٩.٦٢ % على الترتيب مقارنة بمجموعة الكنترول .

- أدى أضافة الدهون الفوسفورية الأساسية فى علائق الدجاج البياض بالمستويات ٤٠٠، ٥٠٠ملجم / كجم غذاء إلى انخفاض معنوي فى الوزن النسبي للكبد وقناة المبيض بينما أدى أضافة الدهون الفوسفورية الأساسية بالمستويات ٣٠٠، ٤٠٠، ٥٠٠ ملجم / كجم غذاء إلى انخفاض معنوى للنسبة المئوية لدهن البطن بحوالى ٨.٧١ ، ٢٧.٦٤ ، ٣٨.٨٢ % على الترتيب مقارنة بمجموعة الكنترول. بينما لم يلاحظ أى تأثير معنوى للمستويات المختلفة من الدهون الفوسفورية الأساسية فى علائق الدجاج البياض على الوزن النسبى للمبيض و كذلك طول قناة المبيض و معامل العرف.