

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

By

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B.Sc., Animal and Poultry Production (2005)

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LIST OF ABBREVIATIONS

EPL	: Essential Phospholipids.
°C	: Degree Celsius (Centigrade).
CP	: Crude protein.
d	: Day
E.F.A	: Essential fatty acids.
G.L.C	: Gas Liquid chromatography.
g	: Gram.
H.P.L.C	: High performance Liquids .
Kcal	: Kilo- Calory.
Kg	: Kilo gram.
ME	: Metabolizable energy.
mg	: Milligram
ml	: Milliliter
mm	: Millimeter
p.p.m	: Part per million.
r.p.m	: Revolutions per minute.
NRC	: National Research Council.
am	: After morning.
Vit	: Vitamins.
Wks	: weeks
min	: minute.
Av.	: Available.
Mix	: Mixture.
mg	: Milligram
IU	: International Unite
ICU	: International Chicken Unite.
n.mol	: Nano mol.
ng	: Nanogram
pg	: Pico- gram
A.O.A.C.	: Association of Official Agriculture Chemists.
U.S.A	: United States of America .
cm.	: Cintimeter.
Cont	: Continues.
hr	: Hours.

1- 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 (nonesterified) 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 a 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 trails 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 components of layer diet (**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**) Hypocholesterolemic drugs may be classified according to their mode of action.

Essential phospholipids (EPL) as hypocholesterolemic drug, 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**). Essential phospholipids (EPL) is highly purified phosphatidyl choline fraction isolated from soybeans, the substance is particularly rich in polyunsaturated fatty acid with linoleic acid accounting for approximately 70% (**Lekim and Betzin., 1974**). 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.

2- REVIEW OF LITERATURE

2.1 Effect of unsaturated fatty acids and hypocholesterolemic drugs on performance of laying hens.

2.1.1 Live body weights and body weight gain:

El-Sheikh (2005) indicated that no significant differences in live body weight when Gimmizah or Bandarah laying hens at 40 weeks of age were fed diets with 300 and 1500 mg EPL/kg diet compared with the control group. Similar result was found by **Shafey (1998)** who indicated that body weight gain 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 live body weight due to hypocholesterolemic agent (11.7 gm of cholestipol and 35 mg lovastatin/hen/day) in the laying hen diets. **Waldroup, et al. (1986)** reported that the addition of probucol as hypocholesterolemic agent up to 1% in laying hen diets did not show any influence on body weight and body weight gain. **Rosebrough et al. (1981)** indicated that no effect on body weight was observed when turkey hens were fed diets contained 6, 18, 30 and 42% of metabolizable energy (ME) as soybean oil. Moreover, **Weiss and Fisher (1957)** found that no relationship between adult body weight and cholesterol level in the laying hens.

From these results, it can be concluded that, using some hypocholesterolemic drugs had no significant effect on body weight in laying hens during the experimental period. This may indicate that the palatability of the diet was not changed by the addition of Essential phospholipids.

On the other hand, **Hanafy (2006)** showed that body weight was significantly ($P \leq 0.01$) increased when 44 wks old Gimmizah laying hens were injected subcutaneously twice a week by 150 or 300 mg EPL /kg body weight compared with the control group. **EL-Bagir et al. (2006)** found that body weight was significantly increased when feeding diets with 10 or 20 gm whole black cumin seed (*Nigella sativa*) /kg diet in laying hens. **Vasko et al. (2005)** showed that addition of omega-3 polyunsaturated fatty acids (PUFA) from flax and fish oil significantly increased body weight compared with the control group. While, **Shang et al. (2004)** found that body weight gain 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 (CLA) .

2.1.2 Feed consumption and feed conversion ratio:

Hanafy (2006) reported that feed intake was not affected by injection of 150 or 300 mg EPL/Kg body weight of Gimmizah laying hens compared with the control group. This supports the finding of **El-Sheikh (2005)** who showed that no significant effect on feed consumption when used essential phospholipids at 300 or 1500 mg/kg diet. **Shafey et al. (2003)** showed that feed consumption was not significantly affected by feeding grain (wheat vs. sorghum) and oils (0 and 20 gm olive oil, 20 gm safflower oil and 10 gm olive oil plus 10 gm safflower oil)/kg diet over a 12 weeks. **Szymenzyk and Pisulweski (2003)** indicated that dietary linoleic acid had no significant effect on

feed consumption. **Danicke et al. (2000)** found that feed intake was not influenced by dietary soya oil (0, 3, 5, 7, 10.5 and 14%) and dietary protein level (13.2 and 16.3%) in laying hens during 22 - 45 weeks of age. Also, **Shafey (1998)** showed that feed consumption was not affected by dietary retinol (0, 6 mg/kg) and sunflower (0, 20 gm/kg) supplementation of laying hens. **An et al. (1997)** indicated that feed consumption was not significantly affected when dietary crude and purified safflower phospholipids in laying hen diets. While, **Celebi and Utlu (2006)** showed that addition of 4% flaxseed oil to the laying hens diets improved, feed intake and feed efficiency compared with the control group.

On the other hand, **Shang et al. (2004)** reported that feed consumption was decreased linearly ($P \leq 0.01$) due to feeding laying hens corn-soybean meal diets containing 0, 1, 2, 3, 4, 5 or 6% conjugated Linoleic acid. Also, **Meluzi et al. (2003)** showed that feed consumption of laying hens was significantly lower in all groups fed conjugated linoleic acid compared with the control group. **Sijben et al. (2002)** observed that feed consumption was decreased when used three dietary concentrations of linoleic acid with vitamin E in laying hens.

Bolukbas and Erhan (2005) reported that feed conversion and egg production were negatively influenced by dietary conjugated linoleic acid. **Kim et al. (2004)** showed that no significant effect on feed consumption and feed conversion due to addition of 0.03 or 0.06% lovastatin and simvastation pravastatin as hypocholesterolemic drugs in ISA brown hen diets during 40 – 44 weeks of age. Also, **Schafer et al. (2001)** found that the effect of dietary conjugated linoleic acid on feed conversion of laying hens was not significantly. **Waldroup et al. (1986)** showed there was no significant impairment in feed utilization when probucol was added laying hen diets. Also, **Daghir et al. (1960)** reported that no significant ($P \leq 0.05$) differences for groups fed diet contained 700mg choline per pound of diet.

On the other hand, **Bolukasi and Erhan (2007)** indicated that feed conversion was decreased due to addition of linoleic acid (CLA) to lohaman hen diets. Also **Meluzi et al. (2003)** observed that conjugated linoleic acid (CLA) supplementation in laying hen diets significantly decreased feed conversion in all groups compared with the control group. **Danicke et al. (2000)** found that feed conversion reached a minimum due to addition of soya oil from 3.5 to 10.5% to laying hen diets.

2.1.3 Egg production, egg weight and egg mass:

Hanafy (2006) indicated that injection of EPL at 150 and 300 mg/kg body weight of Gimmizah laying hens had no significant effect on egg number and egg production percentage. **Aydin et al. (2006)** showed that addition of 0.25 and 0.5% conjugated linoleic acid in Japanese quail laying hen diets did not influence egg weight and percentage egg production. **Al-Sulton (2005)** found that fish oil addition of concentration of 1.5 and 3% in basal diet to laying hens for one month caused no significant effect on egg production. **Bolukbas and Erhan (2005)** observed that the dietary conjugated linoleic acid (CLA), sunflower oil and soybean oil fed a negative influence on egg production in laying hens. **Cachaldora et al. (2005)** reported that laying hens diet supplemented with conjugated linoleic acid, fish oil and high - oleic sunflower oil did not affect egg production traits. **Parido et al. (2005)** indicated that

egg weight was not influenced due to addition of soybean soap stock in the laying hen diets. **Meluzi et al. (2003)** showed that dietary conjugated linoleic acid of laying hens caused no significant effect on egg weight. **Shafey et al. (2003)** indicated that egg weight of laying hens over a 12 weeks period was not significantly affected due to addition of grain (wheat vs. sorghum) and oil supplement /kg diet (0 and 20gm olive oil, 20gm safflower oil and 10gm olive oil plus 10gm safflower oil). **Schafer et al. (2001)** indicated that no significant effect on egg weight due to conjugated linoleic acid supplementation in the laying hen diets. Also, **Zhao and Scheidele (1999)** stated that dietary linoleic acid had no significant effect on egg production. Similarly, **An et al. (1997)** indicated that no significant effect on egg weight due to addition of safflower phospholipids to the laying hen diet. **Ferrier et al. (1995)** indicated that egg weight was not significantly affected by the concentration of flaxseed oil in the laying hen diets. **Waldroup et al. (1986)** reported that addition of ProbucoL as hypocholesterolemic agent to of laying hens diets up to 1%, egg weight was not impairment.

On the other hand, **Bolukbasi and Erhan (2007)** indicated that egg production was decreased due to addition of linoleic acid, olive oil and corn oil to laying hen diet . **EL-Bagir et al. (2006)** observed that diets with 10 or 30 gm whole seed black cumin (*Nigella sativa*)/kg diet, significantly reduced egg production. **EL-Sheikh (2005)** who observed that addition of 300 or 1500 mg EPL/kg diet to laying hens significantly ($P \leq 0.01$) decreased egg mass and percentage egg production, while had no significant effect on egg weight compared with the control group. **Kim et al. (2004)** indicated that addition of 0.03 or 0.06% of lovastatin, simvastatin and pravastatin as hypocholesterolemic drugs in laying hen diets (ISA brown) during 40 to 44 weeks of age, significantly decreased egg weight especially with high level (0.06%), the reduction approximately 10% in egg weight, while egg Production was not significantly changed by supplementation at either doses. **Shang et al. (2003)** reported that percentage egg production and egg weight were decreased linearly ($P \leq 0.01$) due to corn – soybean meal diets containing 0, 1, 2, 3, 4, 5 or 6% conjugated linoleic acid. **Elkin et al. (1999)** indicated that egg production decreased by 19% and 3% hens due to feeding 0.06% of atorvastatin and simvastatin, respectively. **Shafey (1998)** found that addition of retinol (0 and 6 mg/kg diet) to the laying hen diets, reduced egg weight of pullets (because the reduction in egg weight may be caused by the inhibitory effect of retinol on the synthesis of arachidonic acid from linoleic acid in the liver of laying hens). while, sunflower oil supplementation increased the egg weight of pullets. On the other hand **Bakir et al. (1988)** showed that the high dose of Clofibrate as hypocholesterolemic drug reduced egg production. **Marion and Edwerds (1964)** tested the effect of addition of 5% of coconut oil, corn oil or fish oil to layer diets, they concluded that egg production, egg size and hatchability of eggs appeared to be positively associated with the linoleic acid content of the diet.

While, **Attia et al. (2008)** reported that soy lecithin at 3 and 6% in laying hens diets significantly increased egg weight and egg mass. **Hanafy (2006)** showed that egg weight was significantly increased ($P \leq 0.01$) due to injection of 300mg EPL/kg body weight. **Vasko et al. (2005)** indicated that addition of omega-3 PUFA from flax and fish oil in laying hen diets significantly increased egg weight compared with the control group. **Crobes et al. (2001)** reported that egg production and egg weight were not significantly different when used two strains (ISA Brawn and single Comb white

leghorn) at 28 weeks of age which fed four sources of fat; tallow oil, olive oil, soya oil and linseed oil.

Moreover, they observed that egg weight was greater for hens fed soy oil than other groups. **Danicke et al. (2000)** showed that egg weight was significantly improved by Soya oil. **Shafey (1998)** found that egg production was significantly ($P \leq 0.05$) higher due to retinal addition (0, 6 mg /kg) and sunflower oil (0, 20 gm/kg) to the diets of laying hens. **An et al. (1997)** found that egg mass and egg production were significantly increased due to dietary crude and purified safflower phospholipids. Also, **Scragg et al. (1987)** indicated that egg weight was increased due to linoleic acid concentrations supplementation at up to 2.33% in the diet, **Bragg et al. (1973)** reported that egg weight improved by adding soybean and sunflower oils at 1% level to the diet. **Balnave (1970) and Guenter et al. (1971)** showed that the egg weight improved by the addition of linoleic acid to linoleic – deficient diets. **Kondra et al. (1968)** found that addition soybean oil to laying hen diet increased egg weight and yolk weight.

The relationship was evidenced between yolk cholesterol content and egg production. **Washburn and Marks (1977); Kicka et al. (1979) and El-Dakroury et al. (1984)** reported that negative correlations between egg yolk cholesterol and egg production. While, **Bartov et al. (1971) and Bakir et al. (1986)** indicated that inverse relationship was observed between egg yolk cholesterol and egg production. Whereas, **Lorenz et al. (1959)** showed that no significant correlation between egg production and cholesterol level in yolk.

2.1.4 Mortality rate:

Hanafy (2006) and El-Sheikh (2005) indicated that there was no mortality observed throughout the experimental period due to 300 and 1500 mg ELP/kg diet or injection of 150 and 300 mg ELP/kg body weight of local laying hens. **Vanschoubrock et al. (1971)** reported that no effect on mortality could be demonstrated due to 4.5% soybean oil addition to broiler chicks diet

2.1.5 Egg quality:

Attia et al. (2008) reported that soy lecithin at 3 and 6% in laying hens diets significantly increased Haugh unit score. **Hanafy (2006)** observed that injection 150 or 300 mg EPL/kg body weight of Gimmizah hen had no significant effect on egg quality except albumen weight percentage and yolk index at 40 and 48 weeks of age respectively. Although EPL significantly increased ($P \leq 0.05$) albumen weight percentage but 300 mg EPL/kg body weight significantly reduced ($P \leq 0.05$) yolk index. While, **EL-Sheikh (2005)** indicated that no significant differences in yolk index, yolk percentage, Haugh unit score and shell thickness when the laying hens fed diets containing 300 or 1500 mg EPL/kg diet during the experimental Period except yolk percentage which significantly ($P \leq 0.01$) decreased after 10 weeks of treatment.

Attia et al. (2008) reported that soy lecithin supplementation at 3 and 6% significantly increased yolk percentage, while the highest level significantly decreased shell quality. **Parido et al. (2005)** observed that shell thickness, shape index and Haugh unit score were not influenced by soybean soap stock in laying hen diets.

While, **Shang et al. (2004)** indicated that absolute weight of yolk, albumen and egg shell were decreased linearly ($P \leq 0.01$) due to feeding corn-soy bean meal diets containing 0, 1, 2, 3, 4, 5 or 6% conjugated linoleic acid for 36 days, but relatively weights of albumen was increased and egg yolk was decreased in Brown Dwarf laying hens at 40 weeks of age. **Crobes et al. (2001)** showed that no significant effect on egg yolk weight, albumen weight and shell thickness, while Haugh unit score was lowered due to tallow oil, olive oil, soya oil and linseed oil. **Danicke et al. (2000)** found that shell percentage decreased due to soya oil addition (0, 3.5, 10.5 and 14%) to laying hens aged 22 - 45 weeks. **Zhoa and Scheidele (1999)** found that eggs from dietary linoleic acid had significantly higher albumen percentage than eggs from control diets. **Whitehead et al. (1993)** observed that egg albumen was increased when used dietary fatty acid by stimulating the synthesis of oviduct proteins; consequently, egg weight increased. Whereas, **Jiang et al. (1992)** reported that Hough unit of eggs from hens fed high oleic sunflower seed was higher ($P \leq 0.05$) than Haugh unit of eggs from hens fed high linoleic acid sunflower seed. **March (1989)** who indicated that increasing dietary linoleic acid level resulted in greater yolk size of the egg yolk.

Moreover, various reports have been published on the effect of other hypocholesterolemic drugs on egg quality, **Waldroup et al. (1986)** reported that addition of probucol to the laying hen diets significantly ($P \leq 0.05$) influenced Haugh unit score, while no effect was noticed on the shell strength and albumen quality. Whereas, **Daghir et al. (1960)** found that no effect was noticed on Hough unit scores due to increasing choline level from 400 to 700 mg/ pound in layer diets.

2.2 Effect of unsaturated fatty acids and hypocholesterolemic drugs on fertility and hatchability of laying hens.

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 grow and viability (**Boel, 1955**).

Aydin et al. (2006) indicated that addition of 0.5% conjugated linoleic acid (CLA) to the Japanese quail laying hens caused a significant decrease in hatchability percentage of fertile eggs, while no significant effect was observed on fertility percentage compared to the control group. **Aydin (2006)** found that dietary oils rich in unsaturated fatty acids were reduced embryo mortality in fertile eggs. **Hanafy (2006)** observed that injection of EPL did not affect fertility and weight of hatched chicks, but significantly ($P \leq 0.05$) reduced hatchability percentage by 12.4 and 12.9% due to 150 and 300 mg EPL/Kg body weight of Gimmizah laying hens at 48 weeks of age respectively. Also, **El-Sheikh (2005)** found that addition of 1500 mg EPL/Kg diet in laying hen diets significantly ($P \leq 0.01$) decreased hatchability percentage about 19.9% compared to the control group, the decrease in hatchability of fertile eggs of Essential phospholipids group may be due to lower content of egg yolk cholesterol and total lipids compared with the control group; therefore, there was a negative relationship was observed between hypocholesterolemic drug (EPL) and hatchability percentage. Also, **Cunningham et al. (1974)** found a significant positive correlation between egg yolk cholesterol level and hatching of fertile eggs, indicating that hens with high egg yolk cholesterol may have some what higher hatchability percentage. **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.

The efficiency of essential fatty acid was a major depressive factor for fertility and hatchability, Menge (1967) found a high incidence of early or late embryonic mortality and nearly zero hatchability in eggs resulted from essential fatty acid – deficiency in hen diet.

2.3 Effect of unsaturated fatty acids and hypocholesterolemic drugs on some slaughter characteristics of laying hens.

2.3.1 Internal organ weights:

Hanafy (2006) indicated that injection of 150 and 300 mg. EPL /Kg body weight had no effect on relative weights of liver, ovary, oviduct and oviduct length after 12 week of treatment, while abdominal fat percentage was significantly ($P \leq 0.01$) decreased and bile content of gall bladder was significantly increased in Gimmizaoh laying hens at 48 weeks of age. These observations are in accordance with those of El-Sheikh (2005) showed that addition of 150 and 1500 mg EPL/Kg diet of Gimmizah and Bandarah hens had no significant effects on relative weights of liver, ovary and oviduct and oviduct length. Although this hypocholesterolemic drug significantly decreased abdominal fat percentage by 12.9 and 22.9%; respectively, while the bile content of gall bladder was significantly increased after 10 weeks of treatment.

On the other hand, Sim and Bragg (1978) showed that incorporation of hydrogenated coconut oil (8%) in laying hen diets, significantly increased liver weight compared with safflower oil at the same level. Whereas, Maurice and Hensen (1978) indicated that corn accelerated and wheat depressed lipid accumulation in the hen liver, this effect was attributed to the higher content of linoleic acid in corn compared to wheat, the weight of the liver increased relatively to body weight.

2.3.2 Bile excretion:

Hanafy (2006) indicated that injection of 150 and 300 mg EPL/Kg body weight of Gimmizah laying hens significantly increased bile volume of gall bladder after 12 weeks of treatment. Also, El-Sheikh (2005) observed that bile volume of gall bladder significantly increased when laying hens fed diets supplemented with 300 and 1500 mg EPL/Kg diet after 10 weeks of treatment. Balasubramaniam *et al.* (1985) suggested that a diet rich in omega-3 fatty acid reduced plasma cholesterol in rats by increasing the transfer of cholesterol into bile. Also, 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. Kubota *et al.* (1981) reported that females Golden hamsters fed 5 gm/dl essential phospholipids or 2.9% plant sterols for 30 day's showed a high level of cholesterol (Lithogenic) in bile and formed gallstones in the gall bladder, Analysis of the bile lipids proved that EPL and plant sterols very slightly and significantly lowered

the lithogenic index of bile and prevented gallstone formation. EPL increased not only biliary phospholipids but also cholesterol and total bile acid concentrations.

Moreover, **Sim *et al.* (1980)** indicated that addition of soya sterols to either safflower oil or hydrogenated coconut oil in the laying hen diets increased feces bile acid excretion. **Sim and Bragg (1977)** 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. **Lindsey *et al.* (1969)** found that feeding plant sito sterol to cockerels, increased total bile acid excretion in feces.

2.4 Effect of unsaturated fatty acid and hypocholesterolcim agents on lipids content of blood, liver and egg yolk.

2.4.1 Blood cholesterol, total lipids, triglyceride, glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), high density lipoprotein (HDL) and low density lipoprotein (LDL).

Lipid metabolism is complex in laying hens because of the requirement of the egg yolk formation and due to the possible regulation by estrogen (**Polin and Wolford, 1977**).

On the other hand, **Andrews *et al.* (1965)** found that the hens had a fast turnover rate of cholesterol compared to mammals and this may explained by the large quantities of cholesterol excreted. **Celebi and Utlu (2006)** reported that addition of 4% flaxseed oil to ISA brown hen diets reduced serum triglyceride and total cholesterol compared with the control group. **El-Bagir *et al.* (2006)** observed that serum cholesterol and triglyceride significantly decreased due to feeding diets with 10 or 30 gm whole seed black cumin (*Nigella Sativa*)/kg of laying hens. **Hanafy (2006)** indicated that the injection of 300 mg EPL/kg body weight a significantly ($P \leq 0.01$) decreased serum total lipids at 40, 44 and 48 weeks of age by 26.4; 21.8 and 18.8%; serum cholesterol by 31.7, 32.6 and 33.9% and serum triglyceride by 24.6, 25.5 and 29.5% respectively compared with the control group. **El-Shiekh (2005)** found that addition of 300 or 1500 mg EPL/kg diet, significantly ($P \leq 0.01$) decreased in serum cholesterol by 7.7 and 18.0 %; total lipids by 9.8 and 18.2% and triglyceride by 11.7 and 18.6% respectively after 10 weeks of treatments. **Vasko *et al.* (2005)** indicated that addition of omega -3 polyunsaturated fatty acid (PUFA) from flax and fish oil to the laying hen diets significantly decreased serum total lipids. **Kim *et al.* (2004)** showed that feeding hypocholesteremic drug (0.06% lovastatin) plasma total cholesterol was significantly reduced by 28%, also (0.03 and 0.06 % simvastatine) reduced plasma cholesterol by 36 and 53 (mg/dl), while (0.03% lovastatine) induced a greater than 50% reduction in plasma triglyceride compared with the control group. **An *et al.* (1997)** who reported that used dietary safflower phospholipids (crude safflower phospholipids and purified safflower phospholipids) were significantly decreased

serum cholesterol concentration, while triglyceride was not affected by dietary treatments in white leghorn laying hens.

Some studies have shown that dietary fish oil which is rich source of omega-3 fatty acids, have a significant hypotriacylglycerolemic and hypocholesterolemic effect, **Kobatake *et al.* (1984)** suggested that these two effects might be caused by different components of fish oil, eicosapentaenoic acid acting (EPA) on plasma triacylglycerols and docosahexaenoic acid acting (DHA) on plasma cholesterol. Also, **Sallmann and Schole (1977)** indicated that feeding 10% soya oil decreased serum cholesterol by 20% compared with control group. **Marion *et al.* (1961)** found that the unsaturated fats lowered plasma cholesterol in laying hens. While, **Shafey *et al.* (2003)** indicated that no significant effect on plasma total lipid and cholesterol of laying hens due to type of grain (wheat vs. sorghum) and oil supplementation at (0 and 20 gm olive oil, 20 gm safflower oil and 10 gm olive oil plus 10 gm safflower oil). Similarly, **Shafey (1998)** found that plasma total lipids; cholesterol; HDL and triglyceride were not significantly affected by retinal (6 mg/kg) and sunflower oil (20 mg/kg) in the laying hen diets.

On the other hand, some studies indicated that dietary unsaturated fatty acids had a significant effect on lipoproteins. A major role of lipoprotein is in the transport of lipid from the site of synthesis or absorption to tissues for utilization. **Bolukbasi and Erhan (2007)** reported that addition of 3.32% olive oil in laying hen diets decreased serum total cholesterol, triglyceride and LDL, while serum HDL was increased. **Celebi and Utlu (2006)** indicated that addition of 4% flax oil in laying hen diet significantly increased serum HDL, while LDL and VLDL significantly decreased compared with the control group. **Hanafy (2006)** showed that injection of 150 or 300 mg EPL/kg body weight of Gimmizah laying hens significantly ($p \leq 0.01$) increased serum HDL, compared with the control group. **Al-Sulton (2005)** indicated that feeding fish oil at concentration of 1.5 and 3% in laying hen diets significantly reduced plasma total lipids, triglycerides, cholesterol, LDL and VLDL. **El-Sheikh (2005)** who found that 300 and 1500 mg EPL/kg diet for laying hens significantly increased serum HDL by 16.6 and 25.9% respectively as a percentage of the control group after 10 weeks of treatment. **Scott and Jensen (1993)** reported that addition of d-a-tocotrienol in the diets of chickens decreased serum total cholesterol and low density lipoprotein LDL.

Moreover, GOT and GPT as liver enzyme were n't significantly effected by EPL. **Hanafy (2006)** indicated that injection of 150 or 300 mg EPL /kg body weight significantly ($P \leq 0.01$) decreased serum GOT, while had no significant effect on serum GPT compared with the control group. While, **El-Sheikh (2005)** found that no significant differences were observed in serum GOT and GPT when laying hens fed diet supplementation with 300 or 1500 mg EPL/kg diet compared with the control group.

2.4.2 Liver cholesterol and total lipids

Hanafy (2006) indicated that administration of 300 mg EPL/ kg body weight of Gimmizah local hens for ten weeks, significantly decreased liver total lipids and cholesterol by 13.6 and 38.9% respectively compared with the control group. **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.01$) decreased liver cholesterol by 17.5 and 60.3% as a percentage of the control

group respectively. Thus, the reduction in liver cholesterol level was more pronounced than liver total lipids. While, **Rozewicka and Kadlubowska (1978)** reported that administration of 280 mg EPL with the high - fat diet for rats decreased neutral lipid content in hepatocytes. Also, **Kim et al. (2004)** indicated that liver weights were significantly decreased by 16.6 and 15.1% due to administration of 0.03% lovastatin and 0.03% pravastatin respectively, while liver cholesterol concentration was significantly decreased by 14.7 and 20.6% due to 0.03 and 0.06% pravastatin respectively compared to the control group. **ElKin et al. (1999)** reported that addition of lovastatin, lovastatin or simvastatin to laying hen diets for 5 weeks decreased liver cholesterol concentration. **Naber et al. (1982)** found that the probucol as hypocholesterolemic agent in layer diet reduced total liver lipogenesis *in vivo*

On the other hand, **An et al. (1997)** showed that addition of safflower phospholipids in the laying hen diets during 60 - 67 weeks of age significantly decreased liver cholesterol and triglyceride contents in all treated groups compared to the control group. **Balnave (1975)** indicated that liver weight and liver lipid concentration significantly reduced in experimental groups fed dietary linoleate compared with the control group. **Bragg et al. (1973)** observed that the liver weight and lipid content were decreased when linoleic acid was provided by soya or sunflower oil in the laying hen diets. **Yeh et al. (1970)** reported that corn oil rapidly decreased hepatic lipogenesis in the chickens. **Menge (1967)** showed that linoleic acid in the laying hen diets prevented fat accumulation in the liver. Also, **Morton and Horner(1961)** observed that linoleic acid in the diet prevented fat accumulation in the liver of rats.

2.4.3 Egg yolk cholesterol and total lipids.

studies on cholesterol metabolism in laying hens has been increased due to the fact that egg is one of the major components of the human diets. It is known that egg cholesterol contents can be altered by various dietary and drug treatments the laying hens. **Hanafy (2006)** indicated that injection of 300 mg EPL/kg body weight of Gimmizah laying hens for ten weeks, egg yolk total lipids and cholesterol were significantly decreased ($P \leq 0.01$) by 19.5 and 30.9% respectively. Also, **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.01$) reduced egg yolk cholesterol level by 18.4 and 34.8 % and total lipids by 5.3 and 14.9% respectively. Moreover, the reduction in cholesterol was more pronounced than total lipids. **Kim et al. (2004)** indicated that addition of 0.03 and 0.06% pravastatin as hypocholesterolemic drug in the laying hen diets reduced total egg yolk cholesterol content per yolk by 11.1 and 19.6% respectively compared with the control group. This drug has potential commercial applications for production of low cholesterol eggs without negative impact on egg production or hen physiology. **ElKin and Rogler (1989)** reported that the high dosage of lovastatin can decrease the cholesterol content of egg yolk by approximately 15%, the doses may need to be greater than those found to be effective for humans, because laying hens must synthesize much more cholesterol per kg of metabolic body weight for cholesterol deposition in the egg yolk, **Bakir et al. (1988)** reported that addition of hypocholesterolemic compound (Atromid - s) in the laying hen diets at (100 and 200 mg Atromid - s/ hen/ day) reduced egg yolk

cholesterol by 12 and 18% respectively compared to the control group. **Waldroup et al. (1986)** indicated that addition of probucol (4,4-isopropylidene dithio) - bis (2,6-di-*t*-butyl-phenol) as hypocholesterolemic agent to the diet of laying hens up to 1% significantly reduced egg yolk cholesterol content by 7% (mg /g yolk) without impairment of rate of egg production, egg weight, shell strength, albumen quality or other production related parameters. While, **Naber et al. (1982)** found that egg yolk cholesterol content is reduced by 5% with the 10% dietary level of probucol. **Edward et al. (1982)** reported that cholesterol content of egg yolk was reduced to 15 mg/g yolk by feeding probucol. **Helene et al. (1981)** reported that egg yolk cholesterol reduced after 2 weeks of feeding 5 ppm azacholesterol by 20% of the total sterol, but feeding 5 ppm of diazacholesterol for 2 weeks reduced egg yolk cholesterol to 45% of the total sterols, after 4 weeks egg yolk cholesterol was reduced to 36% of total sterols. **Clearenburg et al. (1971)** reported that cholesterol content of egg yolk may be affected by environmental factors and can be lowered by 35% by feeding a plant sterol sitosterol C₂₉H₅₀O.

Many studies were conducted to reduce egg yolk cholesterol content by using unsaturated fatty acid. **Qota (2007)** indicated that incorporation of 2.5 and 5% linseed oil into the hen diets for 11 wks; gradually, reduced ($P \leq 0.05$) lipids and cholesterol levels in serum, liver and egg yolk compared with the control group. **El-Bagir et al. (2006)** observed that the egg yolk total cholesterol was significantly reduced by 34 and 42% due to feeding diet containing 10 or 30 gm whole seed black cumin (*Nigella sativa*)/ kg of laying hens. **Vasko et al. (2005)** showed that egg yolk cholesterol significantly decreased in the groups fed flax and fish oil supplementation in the laying hen diets. **Hur-sunjin et al. (2003)** indicated that egg yolk cholesterol significantly decreased by 5% conjugated linoleic acid in the laying hen diets for 5 weeks feeding; **Carroll (1983)** showed that dietary plant proteins are hypocholesterolemic in contrast to animal proteins such as casein. **Guenter et al. (1971)** reported that increasing linoleic acid contents in the laying hens diet decreased lipid content in the egg yolk compared with those fed lower dietary levels of linoleic acid. While, **Shafey et al. (2003)** found that egg yolk cholesterol was not significantly affected by type of grain (wheat vs. sorghum) and oil (20 gm olive oil, 20 gm safflower oil and 10 gm olive oil plus 10 gm safflower oil) supplement/kg diet over a 12 week period of laying hens. **Shafey (1998)** found that egg yolk cholesterol was not affected by retinal (0 and 6 mg /kg) and sunflower oil (0 and 20 gm/kg) supplementation to the laying hens diets. **An et al. (1997)** observed that egg yolk cholesterol was not affected due to dietary safflower phospholipids (crude and purified safflower phospholipids) for laying hens.

Many studies showed that egg yolk cholesterol averaged 14.0 mg/g yolk for 7 inbred lines and 15 breed of chickens, these is an extensive literature over the last 50 years concerning the cholesterol content of chicken eggs. Almost all of the data are based upon calorimetric determinations and most give cholesterol values of 12 to 18 mg/g yolk. Whereas, **Kicka et al. (1979)** reported that mean yolk cholesterol values of 14.28, 13.65 and 13.40 mg cholesterol gm yolk in Fayoumi, White Ballades and White leghorn respectively. However, **El-Dakrouy et al. (1984)** found that egg yolk cholesterol ranged from 16.1 to 22.0 mg/g yolk with significant differences between four Egyptian Crossbred strains.

3- MATERIALS AND METHODS

This field study was carried out at a private poultry farm, while the hematological and biochemical of blood analysis were determined in the Animal and Poultry production Department, Faculty of Agriculture (Damanhour), Alexandria University, Egypt. The experiment was conducted during the period from July 2007 to September 2007 to investigate the effect of Essential phospholipids (EPL), as a hypocholesterolemic drug, on some productive and physiological traits of laying hens.

3.1 Experimental procedures:

A total of sixty four laying hens of Bandara local 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 diet supplemented with 300, 400 and 500 mg EPL/ kg diet respectively.

All hens were housed individually in layer cages in one open system house for drug application. Essential phospholipids supplementation was continued for 10 weeks from 30 to 40 weeks of age. Feed and water were provided *ad-libitum* and the birds were exposed to 14 hours light daily throughout the experimental period. The experimental diet was formulated based on **NRC (1994)**, as shown in Table (1). Composition of concentrate used in experimental diet are shown in Table (2). The chemical analysis and composition are illustrated in Table (3). While, fatty acids analysis in the experimental diet and Essential phospholipids are shown in Tables (4 and 5).

At 30, 32, 36 and 40 weeks of age, all birds were weighted and blood samples were withdrawn from the brachial vein from five birds in each group at 9:00 am before access to feed and water. Blood samples were centrifuged at 3000 r.p.m for 20 minutes to separate serum samples which were stored at -18 oC until assay. Also five eggs were randomly taken from each group at the same time of blood sampling for egg quality measurements and determination of total lipids and total cholesterol in yolk extract.

At 36 weeks of age, fertility and hatchability percentages were calculated for three weeks consequently. At the end of experimental period, five hens from each group were sacrificed to calculate relative weight of some internal organs, whereas, the liver samples were taken and stored at - 18 oC for determination of total lipids and cholesterol in liver extracts.

Table (1) Composition 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

(a) As described in table (2).

(b) Each kg. contains: manganese 40mg, zinc 45gm., copper 3 gm., iodine .03gm., selenium 0.1 gm., iron 30g m., wheat bran to 1000gm.

(c) Each kg. contains: vit.A 20.000IU, vit. D3 2000ICU, vit.E 400 mg., niacin 20gm , vit. B2 4.5gm., vit.B6 3.0 gm., vit B12 13.0mg., choline chloride 100gm., and vit. K 2.0gm.

Table (2) Formula and composition of concentrate used in the experimental diets

Ingredients	Layer concentrate 48%
Meat meal 60% CP	70.0
Fish meal 64% CP	3.0
Dried Corn	10.0
Alfalfa meal	10.0
Minerals and vitamins mixture	1.2
Calcium diphosphate	3.0
Salt (NaCl)	2.0
DL – Methionine	0.80
Total (Kg)	100
Composition :	
Crude protein	48.8
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
ME.K cal / kg	2100

Table (3) Calculated and analyzed composition of experimental diet

Ingredients	Ratio
Calculated :	
Crude protein %	16.7
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

Table (4) 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	4.21
4	Myristic 14 : 0	16.51
5	Myristolic 14 : 1	19.35
6	Palmitic 16 : 0	17.92
7	Palmitoliec 16 : 1	1.38
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 (5) 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

* (EPL) derived from soybean, (lipostabil booklet by Rhone- Poulenc Rorer, Nattermann, International GMBH .Germany) **lekim and Betzin (1974) .**

3.2 Measurements and studied traits:

3.2.1 Live body weight

Live weight of birds was individually recorded to the nearest gram in early morning before receiving any feed or water.

3.2.2 Feed consumption

Feed consumption (g) was recorded daily for each group in treatments. Each hen was provided with adequate amount of weighed feed and thereafter, feed residue was collected and weighed every day to calculate the amount of feed consumed for each bird per day for each group (g/bird/d).

3.2.3 Feed conversion ratio

Feed conversion ratio was calculated as the amount of feed consumed (g) required to produce a unit (g) of egg mass

$$\text{Feed conversion} = \text{g feed} / \text{g egg} .$$

Feed conversion ratio was recorded daily throughout the whole experimental period.

3.2.4 Mortality rate

Mortality rate was calculated as a number of dead birds in relation to the number of living birds for each group in treatments during the whole experimental period.

3.3 Egg production traits

3.3.1 Egg production (%)

Eggs were collected and recorded daily. The percentage of egg production for each group was calculated as follows:

$$\text{Egg production percentage} = \frac{\text{Number of eggs produced}}{\text{Number of live hens}} \times 100$$

3.3.2 Average egg weight (g)

Eggs were individually weighted daily for each group of treatments and the average was calculated.

3.3.3 Egg mass:

Egg mass was calculated daily using the following equation:

Egg mass (g/hen/day) = Average egg weight (g) x egg number every day per hen.

3.4 Egg quality traits:

3.4.1 External egg quality:

3.4.1.1 Egg shape index:

Egg shape index was calculated according to **Carter (1968)** as the percentage of the maximum width to the maximum length. A caliper used to measure the width and the length with a vernier Scale to the nearest 0.1 mm.

Egg shape index = (width / length) × 100

3.4.1.2 Shell percent:

Each shell was washed carefully to remove all traces of albumen, then the washed shells were dried in a still - air oven at 95 ° C for five hours, the period after which the shell weight was found to be constant, and the dry weight was recorded to the nearest 0.1 gram. Egg shell percent was calculated using the following equation:

Shell percent = (shell weight (g) / egg weight (g)) ×100

3.4.1.3 Shell thickness:

Shell thickness was measured without membrane on the dry shell using micrometer to the nearest 0.01 mm. The shell thickness was the average of 3 measurements near the equator.

3.4.2 Internal egg quality:

Eggs were weighted and then broken on a flat glass plate to estimate the yolk and the shell weights. While, the albumen weight was calculated by subtracting the yolk weight plus shell weight from the egg weight. Yolk, albumen and shell weight were calculated as percentage of egg weight.

3.4.2.1 Yolk index:

The height and diameter of yolk were measured by using tripod micrometer and Caliper with a vernier Scale to the nearest 0.1mm.

The index was estimated by dividing the height of yolk on its diameter and multiplying by 100 as reported by **Funk (1948)**.

3.4.2.2 Haugh Unit score:

Haugh units was calculated according to the method of **Haugh (1937)** on the basis of the individual egg weight and the albumen height. The albumen height was measured using tripod micrometer, the average of two readings on each egg was taken to the nearest 0.01mm. using the following formula:-

$$\text{Haugh unit} = 100 \log (\text{H} - 1.7 \text{W}^{0.37} + 7.6)$$

Where: **H** = Albumen height

W = Egg weight

3.5 Chemical analysis:

3.5.1 Analysis of the experimental diet :

3.5.1.2 Determination of moisture, crude protein, ether extract and ash:

Three replicates of air dried samples of diet were weighted carefully, and then introduced into the oven. The samples were dried on 105 °C for at last three hours. They were considered dry after three constant consecutive weights. Moisture content was obtained as the difference between weight of air dried samples and weight after dryness. The analysis of crude protein and ether extract were carried out according to **A. O. A. C. (1970)**. Nitrogen content of diet was determined by a Microkjeldahl method according to **Allen (1942)**. Ash content was determined in diet according to the method of **A. O. A. C. (1975)**.

3.5.1.3 Determination of fatty acids:

The lipid samples were extracted by Chloroform : Methanol (2:1) according to **Folch et al. (1957)**. Fatty acids composition of the experimental diet were determined using HPLC system (**KNAUER HPLC 64, Germany**). The determination was performed at Animal Production Research Institute, Ministry of Agriculture, Giza, Cairo. The system used is summarized as follow:

Wave length	210 n.m
Flow rate	1.0 ml/min.
Run time	21.00 min : sec
Injection value	20.0 UI
Solvent A	90 : 10 (Methanol 90% + 10% buffer Na H 2 Po4. PH)
Column	Ultra carp ODS 20
I.D	(15 x 3.6)

3.5.2 Determination of lipids in serum, liver and egg yolk:

Lipids were extracted from liver and egg yolk samples by chloroform: methanol (2:1) according to **Washburn and Nix (1974)**. Total lipids (**Thannhauser, 1958**), total cholesterol (**Tietz, 1970**), triglyceride (**Royer and Koh 1969**) High

density lipoprotein (HDL) (**Warnick *et al.*, 1983**) and Low density Lipoprotein (LDL) (**Assmann *et al.*, 1984**).

3.5.3 Determination of enzymes related to liver function:

Glutamic Oxaloacetic Transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) were determined according to **Reitman and Frankel (1957)** in serum by Spectrophotometric method using available commercial kits. (SCLAVOINS., 5 Masard count., Wayne NS 07470, USA)

3.6 Fertility and hatchability:

At 36 weeks of age all hens in each group were artificially inseminated twice a week with 0.05 ml/ hen undiluted pooled semen for three weeks consequently. Semen was collected from 20 males of the same strain fed the experimental diets without drugs. Every week, 50 eggs from each group were chosen randomly and incubated according to the normal procedure. Eggs were candled at day 18 and those appeared infertile were removed and hatched chicks were counted and weighed. Fertility and hatchability percentages were calculated as follows:

$$\text{Fertility percentage} = \frac{\text{Total number of fertile eggs}}{\text{Total number of incubated eggs}} \times 100$$

$$\text{Hatchability percentage of fertile eggs} = \frac{\text{Total number of hatched chicks}}{\text{Total number of fertile eggs set}} \times 100$$

3.7 Slaughter characteristics:

At the end of the experimental period (40 weeks of age), five hens from each group were sacrificed after overnight fasting to calculate relative weights of carcass, empty gizzard, heart, liver, abdominal fat, ovary and oviduct. Also oviduct length (cm) was recorded and bile volume of gall bladder (ml) was measured by tuberculin syringe. Liver samples were taken and refrigerated at -20°C for analysis.

3.8 Comb index :

The comb index of each bird was calculated at slaughter test according to **Jones and Lamoreaux (1943)**:

$$\text{Comb index} = 1/2 \text{ Height (mm)} \times \text{length (mm)}$$

Comb height and length were measured by a straight ruler, scored at 1 mm interval. Height was taken as the distance from the highest point on the second blade

from the rear to the base of the skull. Length was taken across the entire width of the comb from the attachment of the front blade to the base of the skull, to the rear most curve of the rear blade (**Eitan *et al.*, 1998**).

3.9 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**).

4- RESULTS AND DISCUSSION

4-1 Effect of essential phospholipids on body weight (kg):

Results of body weights of Bandarah hens fed different levels of essential phospholipids at 30, 32, 36 and 40 weeks of age are given in Table (6). The mean body weight of hens fed control, 300, 400, and 500 mg EPL were found to be 1.615, 1.602, 1.614 and 1.594 kg at 32 weeks of age, respectively. The differences among these groups were insignificant. At 36 and 40 weeks of age, a similar trend was observed for mean body weight of different experimental groups. These results indicated that essential phospholipids had no significant effect on mean body weights of Bandarah hens during laying period (from 30 to 40 weeks of age), this may be indicated that the palatability of the diet was not changed by the addition of essential phospholipids.

These results are in agreement with **Rosebrough *et al.* (1981)** who found that no effect on body weight was observed when turkey hens were fed diets containing 6, 18, 30 and 42 % of metabolizable energy (ME) as soybean oil. **Shafey (1998)** indicated that body weight gain was not significantly affected by 6 gm retinol or 20 gm sunflower oil supplementation in the laying hen diets. **Waldroup *et al.* (1986)** reported that addition of probucol as hypocholesterolemic drug upto 1% in laying hen diets did not show any influence on body weight and body weight gain. **Luhman *et al.* (1990)** showed that no significant influence on body weight due to another hypocholesterolemic drugs (11.7 gm of cholestipol and 35 mg lovastatin / hen / day) in laying hen diets. **El-Sheikh (2005)** 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.

From these results it can be concluded that different level of essential phospholipids (EPL) at (300, 400 and 500 mg/kg diet) had no significant effect on body weight of Bandarah hens during 30 to 40 weeks laying period

Table (6): Effect of different levels of essential phospholipids in layer diets on body weights (kg/ hen) at different period 30, 32, 36 and weeks of age ($\bar{X} \pm S.E.$)

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

4.2 Effect of essential phospholipids on egg weight (gm) and egg production percentage at different experimental periods.

Results of egg weight (gm). and egg production percentage for groups fed essential phospholipids are given in Table (7). The egg weight for groups fed control, 300, 400 and 500 mg EPL/kg diet were found to be 45.84, 45.58, 45.38 and 45.25 gm respectively, Also egg production percentage for groups fed control, 300, 400 and 500 mg EPL/kg diet were found to be 54.88, 54.33, 53.83 and 53.19% respectively at the period from 30-32 weeks of age, These results indicate that differences among groups, were insignificant. At the following periods 32-36 and 36-40 weeks of age) a similar trend was observed for mean egg weight and egg production percentage. Generally, it can be concluded that essential phospholipids had no significant effect on mean egg weight and egg production percentage of Bandarrah hens during 30-40 wks of age. These results are in agreement with **Waldroup *et al.* (1986)** who 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. **Ferrier *et al.* (1995)** indicated that egg weight was not significantly affected by the concentration of flax seed oil 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. **Zhao and Scheidele (1999)** stated that dietary linoleic acid had no significant effect on egg production **Schafer *et al.* (2001) and Meluzi *et al.* (2003)** indicated that no significant effect on egg weight when conjugated linoleic acid supplementation in the laying hen diets. **Al-Sultan (2005)** found also that feeding fish oil at concentration of 1.5 and 3% in the basal diet to laying hens for one month did not significantly affect egg production. **Bolukbasi and Erhan (2005)** observed that sunflower oil and soybean oil negatively influence egg production in laying hens. **Cachaldara *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. **Parido *et al.* (2005)** indicated that egg weight was not influenced due to addition of soybean soap stock in the laying hen diets. **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. **Hanafy (2006)** reported that injection of essential phospholipids at 150 or 300 mg/kg body weight of Gimmizah laying hens had no significant effect on egg number and egg production percentage. While, **El- Shiekh (2005)** showed that addition of 300 or 1500 mg EPL/kg diet in laying hen diets significantly ($P \leq 0.01$) decreased egg production percentage but without significant effect on egg weight compared with the control group. **Attia *et al.* (2008)** reported that addition of soy lecithin at 3% significantly increased egg production, egg weight and egg mass.

Table (7): Effect of essential phospholipids in layer diets on egg weight (gm) and egg production percentage (%) at different periods of production ($\bar{X} \pm S.E.$).

Age weeks	Treatments (mg EPL/kg diet)	Egg weight (gm)	Egg production (%)
29-30	Control	45.89 ± 0.49 ^a	53.33 ± 3.56 ^a
	300	45.56 ± 0.33 ^a	53.83 ± 2.91 ^a
	400	45.65 ± 0.29 ^a	52.88 ± 1.74 ^a
	500	45.93 ± 0.51 ^a	53.43 ± 3.85 ^a
30-32	Control	45.84 ± 0.34 ^a	54.88 ± 3.69 ^a
	300	45.58 ± 0.45 ^a	54.33 ± 2.91 ^a
	400	45.38 ± 0.69 ^a	53.83 ± 1.74 ^a
	500	45.25 ± 0.22 ^a	53.19 ± 2.46 ^a
32-36	Control	47.88 ± 0.38 ^a	58.65 ± 0.95 ^a
	300	47.48 ± 0.41 ^a	58.10 ± 2.80 ^a
	400	47.45 ± 0.40 ^a	57.79 ± 1.91 ^a
	500	47.28 ± 0.57 ^a	57.14 ± 1.98 ^a
36-40	Control	50.88 ± 0.37 ^a	67.62 ± 0.95 ^a
	300	50.40 ± 0.17 ^a	66.67 ± 0.11 ^a
	400	50.22 ± 0.31 ^a	66.16 ± 1.90 ^a
	500	50.18 ± 0.21 ^a	65.72 ± 1.74 ^a

4.3 Effect of essential phospholipids on feed consumption (gm/hen/day); egg mass (gm/hen/day); feed conversion (kg diet /kg egg) and mortality rate at different experimental periods.

4.3.1 Feed consumption:

Means daily feed consumption for hens fed different levels of essential phospholipids are presented in Table (8). Feed consumption at the periods from 29-30 weeks of age for groups fed control, 300, 400 and 500 mg EPL/kg diet was found to be 113.1, 113.4, 111.7 and 110.4 gm, respectively. Analysis of variance indicated that the differences among groups were insignificant. On the other hand, Essential phospholipids decreased feed consumption of hens from 30 to 40 wks of age. Statistical analysis indicated that the reduction of feed consumption of groups fed 300 and 400 mg EPL were insignificant compared with the control group. While feed consumption values for the group that fed 500 mg EPL/kg diet was significantly ($P \leq 0.05$) lower than the other groups. These results are in agreement with **Sijben *et al.* (2002)** who indicated that feed consumption was decreased when used three dietary concentrations of linoleic acid with vitamin E in laying hen diets. **Meluzi *et al.* (2003)** showed that feed consumption of laying hens was significantly lower in all groups fed conjugated linoleic acid compared with the control group. **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 .

On the other hand, **Danicke *et al.* (2000)** found that feed intake was not influenced by dietary soya oil (0, 3, 5, 7, 10.5 and 14%) and dietary protein level (13.2 and 16.3%) in laying hens aged 22-45 weeks. Also, **Szymezyk and Pisulewski (2003)** indicated that dietary linoleic acid had no significant effect on feed consumption. Moreover, **El-Sheikh (2005)** that no significant effect on feed consumption due to feeding laying hens 300 or 1500 mg essential phospholipids /kg diet. Also, **Hanafy (2006)** who observed that feed consumption was not affected by injection of 150 or 300 mg essential phospholipids/kg body weight of Gimmizah laying hens compared with the control group.

4.3.2 Egg mass:

Results of mean egg mass (gm/hen/day) for hens fed different levels of essential phospholipids are presented in Table (8). During the experimental period, The mean egg mass during different experimental periods were not affected by essential phospholipids in the laying hen diets. Statistical analysis showed that differences among groups were insignificant. These results are in agreement with **Cachaldara *et al.* (2005)** who reported that laying hen diets supplemented with conjugated linoleic acid, fish oil and high-oleic sunflower oil did not affect egg production characteristics. While, **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet to Gimmizah laying hens significantly ($P \leq 0.01$) decreased daily egg mass compared with the control group. On the other hand, **Attia *et al.*, (2008)** reported that soy lecithin at 3 and 6 % in laying hen diets significantly increased egg weight and egg mass.

4.3.3 Feed conversion:

Results of mean feed conversion (kg diet/kg eggs) for hens fed different levels of essential phospholipids are presented in table (8). Feed conversion was partly improved by addition of essential phospholipids in the diets of laying hens compared with the control group throughout the experimental period; while, statistical analysis indicated that essential phospholipids had no significant effect on feed conversion.

These results are in agreement with those reported by **Waldroup *et al.* (1986)** showed that there were no significant impairment in feed utilization when probucol was added to the diet of laying hens. **Schafer *et al.* (2001)** found that the effect of dietary conjugated linoleic acid had not significantly on feed conversion of laying hens. **Kim *et al.* (2004)** showed that no significant effect on feed conversion were observed when addition of 0.03 or 0.06% lovastatin, simvastatine and pravastatin as a hypocholesterolemic drugs in ISA brown hen diets during 40 - 44 weeks of age. **Bolukbas and Erhan (2005)** reported that feed conversion was negative influenced from dietary conjugated linoleic acid. Results in this study are not in agreement with **Meluzi *et al.* (2003)** and **Bolukasi and Erhan (2007)** indicated that feed conversion was decreased when the laying hen diets supplemented with conjugated linoleic acid (CLA). **Attia *et al.* (2008)** reported that soy lecithin at 3 and 6 % significantly improved feed conversion ratio of laying hens.

4.3.4 Mortality rates:

Essential phospholipids as a hypocholesterolemic drug at different levels in the laying hen diet had no effect on mortality rates during the experimental period from 30 to 40 weeks of age. These results are in agreement with **El-Sheikh (2005)** who indicated that there was no effect on viability and mortality rates when used 300 and 1500 EPL/kg diet. Also, **Hanafy (2006)** who found that injection of 150 or 300 mg essential phospholipids /kg body weight of Gimmizah hens, had no effect on mortality observed during the experimental period; moreover, **Vanschoubrock *et al.* (1971)** reported that no effect on mortality could be demonstrated when diets of broiler chicks were supplemented with 4.5% soybean oil.

4.4 Effect of essential phospholipids on egg quality.

4.4.1 Relative weights of albumen, yolk; shell and shell thickness (mm)

Results of albumen (%), yolk (%), shell (%) and shell thickness (mm) of Bandarah hens fed different levels of essential phospholipids are given in Table (9). At 32 weeks of age (after 2 weeks of treatment), the albumin percentage for groups fed control, 300, 400 and 500 mg EPL/kg diet were found to be 57.39, 85.56, 57.75 and 58.34% respectively; yolk percentage were 30.64, 30.25, 30.33 and 29.95% respectively; shell percentage were 11.98, 11.19, 11.92 and 11.68% respectively and shell thickness were 0.394, 0.398, 0.400 and 0.402 mm respectively. The statistical analysis showed that the differences among treatment groups were insignificant in these traits. At 36 and 40 weeks of age (after 6 and 10 weeks of treatment) similar trend were observed for mean albumin (%), yolk (%), shell (%) and shell thickness (mm). These results indicated that the essential phospholipids had no significant effect on relatively weight of albumin, yolk and shell and shell thickness of Bandarah hens during laying period (from 30 to 40 weeks of age). However, **Attia *et al.* (2008)** reported that soy lecithin supplementation at 3 and 6 % significantly increased yolk percentage, while the highest level significantly decreased shell quality.

These results are in agreement with **Waldroup *et al.* (1986)** who found that no significant effect on shell strength and albumin quality due to probucal addition as a hypocholesterolemic agent in the laying hen diets; **Crobes *et al.* (2001)** showed that no significant effect on egg yolk weight, albumin weight and shell thickness of two strain of laying hens (ISA Brown and SCWL) at 28 weeks of age due to feeding four sources of fat: tallow oil, olive oil, soy oil and linseed oil. **El-Shiekh (2005)** indicated that no significant differences were observed in yolk percentage and shell thickness due to feeding diets containing 300 or 1500 mg EPL/kg diet to laying hens. **Hanafy (2006)** who observed that injection 150 or 300 mg EPL/kg body weight Gimmizah hens had no significant effects on yolk and relatively weight of shell and shell thickness (mm) during the whole experimental period (from 40 to 48 weeks of age) .

4.4.2 Egg shape index, yolk index and Haugh unit score:

Results of egg shape index, yolk index and haugh units score of Bandrah hens fed different levels of essential phospholipids are given in Table (10). At 32 weeks of age (after 2 weeks of treatment) averages of egg shape index for groups fed control, 300, 400 and 500 mg EPL/ kg diet were found to be 75.8, 74.6, 75.6 and 74.8% respectively; yolk index were 44.8, 43.2, 44.00 and 44.20% respectively and Haugh unit score were 85.80, 84.96, 85.33 and 85.27% respectively. The statistical analysis showed that the differences among treatment groups were insignificant in these traits. At 36 and 40 weeks of age (after 6 and 10 weeks of treatment) similar trends were observed for egg shape index, yolk index and Hough units, except for yolk index at 40 weeks of age (after 10 weeks of treatment) which significantly ($P \leq 0.05$) increased compared with the control group. Generally, it can be conclude that essential phospholipids had no significant effect on mean egg shape index, yolk index and Haugh unit of Bandarrah hens during the whole experimental period, 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 in agreement with those reported by **Jiang *et al.* (1992)** who found that Haugh units score of egg from hens fed oleic acid sunflower seed was higher ($P \leq 0.05$) than those of eggs from hens fed on high linoleic acid sunflower seed. **El-Sheikh (2005)** found that no significant differences in yolk index and Haugh unit score due to EPL level at 300 or 1500 mg EPL/kg diet Gimmizah hen diets during the experimental period (from 40 to 50 weeks of age). **Hanafy (2006)** found that injection 150 or 300 mg EPL/kg body weight of Gimmizah hens had no significant effect on egg shape index and haugh unit percentages compared with the control group during the whole experimental period. While, **March, (1989)** indicated that increase dietary linoleic acid levels resulted in greater egg yolk size. Also, **Attia *et al.* (2008)** reported that soy lecithin at 3and 6% in laying hens diets significantly increased Haugh unit score

4.5 Effect of essential phospholipids on serum total lipids (mg/dl)

4.5.1 Serum total lipids (mg/dl), cholesterol (mg/dl) and triglycerides (mg/dl):

Results of serum total lipids, cholesterol and triglycerides of Bandarah hens fed different levels of essential phospholipids at 30, 32, 36 and 40 weeks of age are given in Table (11). Differences in Serum total lipids, cholesterol and triglycerides of different groups at 30 weeks of age (zero time) were insignificant. At 32 weeks of age (after 2 weeks of treatment) the mean serum total lipids for groups fed control, 300, 400 and 500 mg EPL/ kg diets were found to be 1323.36, 1295.70, 1261.24 and 1229.82 (mg/dl) respectively; serum cholesterol were found to be 216.38, 205.34, 194.84 and 179.90 (mg/dl) respectively, and serum triglyceride were found to be 125.84, 121.44, 118.84 and 113.84 (mg/dl) respectively. Statistical analysis showed that the groups fed 400 and 500 mg EPL/kg diet had significantly ($P \leq 0.05$) lower serum total lipids, cholesterol and triglyceride than the control group. At 36 weeks of age (after 6 weeks of treatment) the mean serum total lipids of hens fed control, 300, 400 and 500 mg EPL/kg diets were found to be 1327.72, 1282.64, 1231.34 and 1199.58 (mg/dl), respectively. serum cholesterol were found to be 222.24, 187.48, 166.52 and 151.58 (mg/dl), respectively and serum triglycerides were found to be 126.82, 119.45, 116.02 and 107.80 (mg/dl) respectively. The statistical analysis showed that essential phospholipids at 300, 400 and 500 mg/kg diet significantly ($P \leq 0.05$) decreased total lipids, cholesterol and triglyceride compared with the control group. At 40 weeks of age (after 10 weeks of treatment) the mean serum total lipids, cholesterol and triglyceride of different groups showed the same trend as cited above. Moreover, at the end of treatments (after 10 weeks of treatment) it can be observed that the groups fed essential phospholipids at 300, 400 and 500 (mg/kg diet) had significantly ($P \leq 0.05$) lower serum total lipids by 4.5, 9.6 and 13.5% respectively then the control group, serum cholesterol by 26.56, 35.04 and 42.52 % respectively compared with the control group and serum triglyceride by 7.68, 11.21 and 17.83% respectively compared with the control group. Generally, it can be concluded the groups fed essential phospholipids significantly ($P \leq 0.05$) reduced serum total lipids, cholesterol and triglyceride after 10 weeks of treatment compared with the control group. These results are in agreement with **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. **An et al. (1977)** reported that dietary safflower phospholipids (crude and purified safflower phospholipids) significantly decreased serum cholesterol concentration in laying hens. **Kim et al. (2004)** found that feeding hypocholesterolemic drugs (0.06% lovastatin), similarly plasma total cholesterol significantly reduced by 28%, 0.03 and 0.06% simvastatin reduced plasma cholesterol by 36 and 53 (mg/dl), while (0.03% lovastatin) induced a greater than 50% reduction in plasma triglyceride compared with the control group. **El-Sheikh (2005)** indicated that laying hens fed 300 or 1500 mg EPL/kg diet were significantly ($P \leq 0.01$) 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. **Al-Sultan (2005)** showed that feeding 1.5 and 3% fish oil in laying hen diets for one month significantly reduced plasma total lipids, cholesterol and triglyceride compared with the control group. **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. **Celebi and Utlü (2006)** reported that addition of 4% flax seed oil in ISA Brown hen diets reduced serum total lipids and triglycerides compared with the control group. **El-Bagir et al. (2006)** observed that serum cholesterol and triglycerides were significantly decreased by feeding 10 or 30 gm whole seed black cumin (*Nigella Sativa*)/kg diets of laying hens. **Hanafy (2006)** found that injection of 300 mg EPL/kg body weight of Gimmizh laying hens at 40, 44 and 48 weeks of age significantly ($p \leq 0.01$) decreased serum total lipids by 18.8, 21.8, and 26.4%, serum cholesterol by 31.7, 32.6 and 33.9% and serum triglycerides by 24.6, 25.5 and 29.5%, respectively compared with the control group.

4.5.2 Serum high density lipoprotein (HDL) and low density lipoprotein (LDL):

Results of high density lipoprotein (HDL) and low density lipoprotein (LDL) of Bandarah hens fed different levels of essential phospholipids at 30, 32, 36 and 40 weeks of age are given in Table (11). Differences in Serum HDL and LDL of different groups at 30 weeks of age (zero time) were insignificant. At 32 weeks of age (after 2 weeks of treatment). The mean serum HDL for groups fed control, 300, 400 and 500 mg EPL/kg diets were found to be 24.12, 24.44, 28.86 and 25.00 (mg /dl), and serum LDL were found to be 172.84, 169.96, 168.62 and 166.94 (mg/dl), respectively compared with the control group. Statistical analysis indicated that differences among treatments were insignificant in serum HDL and LDL. At 36 weeks of age (after 6 weeks of treatment) the mean serum HDL of hens fed control, 300, 400 and 500 mg EPL/kg diet were 24.22, 25.84, 25.66 and 26.32 mg/dl respectively and serum LDL were found to be 174.60, 169.12, 165.66 and 159.84 (mg/dl) respectively. Although the statistical analysis showed that the differences between the groups were insignificant for serum HDL, it can be noticed the serum HDL for the groups fed EPL were higher than the control group. While, serum LDL of different groups fed essential phospholipids significantly ($P \leq 0.05$) decreased compared with the control group at 40 weeks of age (after 10 weeks of treatment) Serum HDL of hens fed control, 300, 400 and 500 mg EPL/kg diet were 24.30, 25.78, 26.20 and 26.82 (mg/dl) and serum LDL were 175.20, 164.44, 160.16 and 153.10 (mg/dl), respectively. The statistical analysis showed that serum HDL were significantly ($P \leq 0.05$) increased in treated groups, While. Serum LDL were significantly ($P \leq 0.05$) decreased in treated groups compared with the control groups. Moreover, at the end of treatments (after 10 weeks of treatment) it can be observed that groups fed essential phospholipids 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. Generally, it can be concluded that groups fed essential phospholipids significantly ($P \leq 0.05$) increased serum HDL while serum LDL significant ($p \leq 0.05$) decreased compared with the control group.

The present results are in agreement with those by **Scott Beyer et al. (1993)** who reported that addition of d-a-tocotrienol to chicken diets decreased serum total

cholesterol and low density lipoprotein. **El-Sheikh (2005)** who indicated that the addition of 300 and 1500 mg/ kg diet of laying hens significantly ($P \leq 0.01$) increased serum HDL by 16.6 and 25.9% respectively as a percentage of the control group after 10 weeks of treatment. **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. Also, **Hanafy (2006)** indicated that injection of 150 or 300 mg EPI /kg body weight significantly ($P \leq 0.01$) increased serum HDL compared with the control group. **Balukasi and Erhan (2007)** 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.

4.5.3 Glutamic oxaloacetic transaminase (GOT) and Glutamic pyruvic transaminase (GPT)

Results of serum GOT and GPT of Bandarah hens fed different levels of essential phospholipids at 30, 32, 36 and 40 weeks of age are given in Table (12). The differences in serum GOT and GPT at 30 weeks of age (zero time) of hens for different groups were insignificant. At 32 weeks of age (after 2 weeks of treatment), the mean serum GOT for the groups fed control, 300, 400 and 500 mg EPL/kg diet were found to be 73.78, 74.08, 74.04 and 74.32 (I.u/l) and serum GPT were found to be 4.66, 4.26, 4.72 and 4.66 (I.u/l), respectively. Statistical analysis showed that differences in serum GOT and GPT between the treatment groups were insignificant. At 36 and 40 weeks of age (after 6 and 10 weeks of treatment) the mean serum GOT and GPT of different groups showed the similar trend as cited above. These results indicated that the serum GOT and GPT of Bandarah hens did not significantly affected by essential phospholipids compared with the control group.

These results are in agreement with those by **El-Sheikh (2005)** who showed that insignificant differences in serum GOT and GPT when laying hens fed 300 or 1500 mg EPL/kg. diet compared with the control group. While, **Hanafy (2006)** indicated that injection of 150 or 300 mg EPL/kg body weight significantly ($p \leq 0.01$) decreased serum GOT but had no significant effect on serum GPT throughout the experimental period compared with the control group.

4.6 Effect of essential phospholipids in layer diets on egg yolk total lipids (mg/gm) and cholesterol (mg/gm).

Results of egg yolk total lipids and cholesterol of Bandarah hens fed different levels of essential phospholipids at 30, 32, 36 and 40 weeks of age are given in Table (13). Differences in egg yolk total lipids and cholesterol contents at 30 weeks of age (zero time) of hens for different experimental groups were insignificant. At 32 weeks of age (after 2 weeks of treatment), the egg yolk total lipids for the groups fed control, 300, 400 and 500 mg EPL/kg diet were 253.34, 250.88, 240.10 and 239.32 (mg/gm yolk), respectively and egg yolk cholesterol were found to be 13.78, 12.54, 12.26 and 11.94 (mg/gm yolk), respectively. Statistical analysis showed that the hens fed 400 or 500 mg EPL/kg diet had significantly ($P \leq 0.05$) lower egg yolk total lipid contents than the control group. While, egg yolk cholesterol contents of hens fed different levels of essential phospholipids significantly ($P \leq 0.01$) decreased compared with the control group. At 36 weeks of age (after 6 weeks of treatment) egg yolk total lipids for groups fed control, 300, 400 and 500 mg EPL/kg diet were 254.78, 241.36, 237.30 and 188.74 (mg/gm yolk), respectively, and egg yolk cholesterol as 13.76, 10.96, 10.66 and 9.84 (mg/gm yolk), respectively. Statistical analysis indicated that the all levels of essential phospholipids decreased significantly ($p \leq 0.05$) egg yolk total lipids and cholesterol contents compared with the control group. At 40 weeks of age (after 10 weeks of treatment) the mean egg yolk total lipids and cholesterol contents of different treatment groups showed the same trend as cited above.

It can be noticed from Table (13) that hens fed 300, 400 and 500 mg EP/kg diet caused a decrease in egg yolk total lipids by 7.52, 11.58 and 29.53% respectively and egg yolk cholesterol contents by 29.71, 32.43 and 37.86%, respectively compared with the control group. These results are in agreement with the finding of **Clearenburg et al. (1971)** who 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 sitosterol $C_{29}H_{50}O$. **Helene et al. (1981)** indicated that egg yolk cholesterol reduced after 2 weeks of feeding 5 ppm of azacholesterol by 20% of the total sterol and feeding 5 ppm of diacholesterol 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. **Edward et al. (1982)** found that the mean cholesterol content of egg yolk was reduced to 15 mg/gm yolk by feeding probucol. Also, **Walderoup et al. (1986)** showed that addition of probucol (4,4-isopropylidinedithio)-bis(2,6-di-*t*-butylphenol) 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. **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. **Elkin and Rogler (1989)** reported that high dosage of lovastatin can decrease the cholesterol content in egg yolk by approximately 15%, the doses may need 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 for egg yolk cholesterol. **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 per yolk by 11.1 and 19.6%, respectively compared with the control group. This drug has potential commercial applications for production of

low cholesterol eggs without negative impact on egg production or hen physiology. **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.01$) reduced egg yolk cholesterol level by 18.4 and 34.8% and total lipids by 5.3 and 14.9%, respectively. Moreover the reduction in cholesterol was more pronounced than total lipids. **Hanafy (2006)** who found that the injection of 300 mg EPL/kg body weight of Gimmizah laying hens for ten weeks significantly reduced ($P \leq 0.01$), egg yolk total lipids and cholesterol by 19.5 and 30.9%, respectively.

Many studies were conducted to reduce egg yolk cholesterol content by using other unsaturated fatty acids. **Guenther 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. **Carroll (1983)** showed that general dietary plant proteins are hypocholesterolemic in contrast to animal proteins such as casein. **Vasko et al. (2005)** indicated that cholesterol in the egg yolk significantly decreased in the groups fed flax and fish oil supplemented diets. **El-Bagir et al. (2006)** observed that egg yolk total cholesterol was significantly reduced by 34 and 42% due to 10 or 30 gm whole seed black cumin (*Nigella stiva*)/kg diet for laying hens. **Qota (2007)** who found that addition of 2.5 and 5% linseed oil into the hen diets for 11 wks gradually reduced ($P \leq 0.05$) lipids and cholesterol levels in serum, liver and egg yolk.

The average of egg yolk cholesterol in this study are in agreement with results obtained by **Kicka et al. (1979)** who indicated that mean yolk cholesterol values were found to be 14.40, 13.65 and 14.28 mg cholesterol per gram yolk in Fayoumy, White Ballades and White Leghorns respectively. Studies showed that egg yolk cholesterol averaged 14.0 mg/gm yolk for 7 inbred lines and 15 breeds of chickens, There is an extensive literature over the last 50 years concerning the cholesterol content of chicken eggs, almost all of the data are based upon calorimetric determinations and most give cholesterol values of 12 to 18 mg/gm yolk.

4.7 Effect of essential phospholipids in layer diets on fertility(%), hatchability (%) and chicks weight(g).

Results of fertility, hatchability percentage and chicks weight (gm) of Bandarah hens fed different levels of essential phospholipids are presented in Table (14). Fertility percentage at 36 weeks of age (after 6 weeks of treatment) for groups fed different levels of essential phospholipids at (0, 300, 400 and 500 mg/kg diet) was 92.20, 93.33, 91.1 and 92.20 %, respectively. The statistical analysis indicate that differences in fertility percentage between treatment groups were insignificant. These results indicated that essential phospholipids in laying hen diets didn't affect fertility percentage compared with the control group.

Hatchability percentage of fertility eggs for groups fed control, 300, 400 and 500 mg EPL/kg diet was 86.87, 81.07, 74.5 and 69.83%, respectively. Statistical analysis showed that essential phospholipids significantly ($P \leq 0.05$) decreased hatchability percentage of fertile eggs compared with the control group.

From these results it can be observed that the addition of essential phospholipids at 300, 400 and 500 mg/kg diet in Bandarah hen diets decreased hatchability of fertile eggs by 6.68, 14.24 and 19.62%, respectively compared with the control group. The decreasing hatchability of fertile eggs of the groups fed essential phospholipids may be due to lower egg cholesterol compared with the control group. These results are in agreement with those of **Menge (1976)** who found that a high incidence of early or late embryonic mortality and nearly zero hatchability in eggs resulted from essential fatty acid-deficiency in hen diets. **Cunningham et al. (1974)** found that a significant positive correlation between egg yolk cholesterol level and hatching of fertile eggs, indicating that hens with high egg yolk cholesterol may have some what higher hatchability percentage. **El-Sheikh (2005)** found that addition of 1500 mg EPL/kg diet significantly ($P \leq 0.01$) decreased in hatchability percentage by 19.99% compared with the control group, The reduction of hatchability of fertile eggs of group fed essential phospholipids as a hypocholesterolemic drug may be due to lower content of egg yolk cholesterol and total lipids compared with the control group. therefore, there was a positive relationship between EPL and hatchability percentage. **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. Along the same line, **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.

From results in Table (14) it can observed that the mean body weight of day - old chicks produced from hens fed the un supplemented control, 300, 400 and 500 mg EPL/kg diet were 33.47, 34.45, 34.33 and 34.61 gm, respectively. The statistical analysis showed that no significant effect of essential phospholipids on chicks weight compared with the control group. These results are in agreement with **Hanafy (2006)** who reported that injection of EPL didn't impair fertility and weight of hatched chicks of Gimmizah laying hens.

4.8 Effect of essential phospholipids in layer diets on liver total lipids (mg/gm liver) and liver cholesterol (mg/gm liver).

Results of liver total lipids and cholesterol levels of Bandarah hens fed different levels of essential phospholipids are presented in Table (15). Liver total lipids for group fed control, 300, 400 and 500 mg EPL/kg diet were 5.62, 4.18, 3.54 and 2.64 mg/gm liver respectively, and liver cholesterol values were 254.00, 242.94, 217.88 and 195.90 mg/gm liver, respectively. Statistical analysis showed that hens fed 300, 400 and 500 mg EPL/kg diet had significantly ($P \leq 0.05$) lower liver total lipids and cholesterol contents at 40 weeks of age (after ten weeks of treatment) compared with the control group. From Table (15) it can be observed 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 indicate that essential phospholipids supplementation in Bandarah hen diets significantly ($P \leq 0.05$) reduced liver total lipids and liver cholesterol contents compared with the control group at the end of experimental period (after 10 weeks of treatment). These results are in agreement with **Rozewicka and Kadlubowska (1978)** who reported that administration of 280 mg essential phospholipids with the high - fat diet of rats caused a decrease in the neutral lipid content in hepatocytes. **Naber *et al.* (1982)** found that the probucol as hypocholesterolemic agent in layer diets reduced total liver lipogenesis in vivo. **Elkine *et al.* (1999)** indicated that addition of lorcovastatine, lovastatine or simvastatine to the diets of laying hens for 5 weeks decreased liver cholesterol concentration. **Kim *et al.* (2004)** showed that liver cholesterol concentration significantly decreased by 14.7 and 20.6% when hens fed diet with 0.03 and 0.06% pravastatin respectively compared with the control group. Also, **El-Sheikh (2005)** found that addition of 300 or 1500 mg EPL/kg diet significantly ($P \leq 0.01$) decreased liver cholesterol by 17.5 and 60.3 % as percentage of the control group, respectively. Thus, the reduction in liver cholesterol level was more pronounced than liver total lipids. **Hanafy (2006)** found that after 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.

Various reports have been published on the effect of unsaturated fatty acids on liver total lipids and cholesterol contents, **Morton and Horner (1961)** observed that linoleic acid in the diet prevented fat accumulation in the liver of rat. Also, **Menge (1967)** showed that linoleic acid in the laying hen diets prevented fat accumulation in the liver. Moreover, **Yeh *et al.* (1970)** found that the corn oil rapidly decreases hepatic lipogenesis in the chicken. **Bragg *et al.* (1973)** indicated that the liver weight and lipid content were decreased when linoleic acid was provided by soya or sunflower oil in the laying hen diets. **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 triglyceride contents in all treated groups as compared with the control group.

4.9 Effect of essential phospholipids on liver weight (%), ovary weight (%), oviduct weight (%), oviduct length (cm), abdominal fat weight (%), bile volume of gall bladder (ml) and comb index (%)

4.9.1 Liver weight percentage

Results of relatively weight of liver for groups fed different levels of essential phospholipids are presented in Table (16). Relatively weight of liver for groups fed control, 300, 400 and 500 (mg/kg diet) were 2.80, 2.63, 2.43 and 2.19% respectively. Statistical analysis showed that the groups fed 400 and 500 mg had significantly ($P \leq 0.05$) lower relatively weight of liver compared with the control group. These results are in agreement with **Balnave (1975)** who found that liver weight and liver lipid concentration were significantly reduced in groups fed dietary linoleate compared with the control group. **Bragg et al. (1973)** observed that the liver weight and lipid content were decreased due to linoleic acid supplementation by soya or sunflower oil in the laying hen diets. On the other hand, **Maurice and Hensen (1978)** indicated that corn accelerated, while wheat depressed lipid accumulation in the hen liver. This effect was attributed to the higher content of linoleic acid in corn compared to wheat. While, **El-Sheikh (2005)** who indicated that addition of 150 and 1500 mg EPL/kg diet to laying hen diets had no significant effect on relative weight of liver after 10 weeks treatment compared with the control group. Also **Hanafy (2006)** who reported that injection of 150 and 300 mg EPL/kg body weight had no effect on relative weight of liver after 12 weeks of treatment.

4.9.2 Relative weights of ovary and oviduct and oviduct length (cm).

Results of relative weights of ovary and oviduct and oviduct length for groups fed different levels of essential phospholipids are give in Table (16). Relative weight of ovary for groups fed control, 300, 400 and 500 EPL/kg diet were 2.80, 2.63, 2.43 and 2.19%, respectively. Statistical analysis indicated that differences in relative weight ovary among the different treatment groups were insignificant. While the relative weight of oviduct for groups fed control, 300, 400 and 500 mg EPL/kg diet were 2.55, 2.53 and 2.29%, respectively. Statistical analysis showed that the treatment groups fed 400 and 500 mg EPL had significantly ($P \leq 0.05$) lower relative weight of oviduct compared with the control group. The decreased in relatively weight of oviduct due to essential phospholipids may show that a decrease in the fat accumulation in the oviduct. Oviduct length for groups fed control, 300, 400 and 500 mg EPL/kg diet were found to be 59.43, 60.30, 60.10 and 59.95 cm, respectively.

Thus essential phospholipids in laying hen diets had no significant effect on oviduct length. These results are in agreement with **El-Sheikh (2005)** who found that addition of 150 and 1500 EPL/kg diet of laying hen diets had no significant effects on relative weights of ovary and oviduct length. Also, **Hanafy (2006)** found that injection of 1500 or 300 mg EPL/kg body weight did not significantly affect relative weight of ovary and oviduct length after 12 weeks of treatment. The present study indicated that relatively weight of oviduct significantly decreased in group fed 400 and 500 mg EPL compared with the control group. Whereas **El-Sheikh (2005)** and **Hanafy (2006)** indicated that no significant effect on the relative weight of oviduct due to addition of essential phospholipids in the hen diets or injection of laying hens during the whole experimental period.

4.9.3 Abdominal fat (%), bile volume of gall bladder (ml) and comb index (%)

Results of abdominal fat, bile volume of gall bladder and comb index for groups fed different levels of essential phospholipids are given in Table (16). Abdominal fat percentage for groups fed control, 300, 400 and 500 mg EPL/kg diet was found to be 3.22, 2.94, 2.33 and 1.79%, respectively. Statistical analysis indicated that the groups fed 300,400 and 500 mg EPL/kg diet had significantly ($P\leq 0.05$) lower abdominal fat percentage by 8.71, 27.64 and 38.82%, respectively compared with the control group. While, bile volume of gall bladder for groups fed control, 300, 400 and 500 mg/kg diet was 0.93, 1.35, 1.75 and 1.90, respectively. Statistical analysis showed that the groups fed 300, 400 and 500 mg EPL/kg diet had significantly ($P\leq 0.05$) increased bile volume of gall bladder compared with the control group, showing an increase in bile salt secretion.

Average comb index were 1.88, 2.06, 2.09 and 1.95% for the groups fed control, 300, 400 and 500 EPL respectively (Table 16). Statistical analysis showed that the essential phospholipids seemed to had no significant effect on comb index.

These results are in agreement with **El-Sheikh (2005)** who 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 while bile volume of gall bladder was significantly increased after 10 weeks of treatment 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 while bile volume of gall bladder was significantly ($P\leq 0.05$) increased in Gimmizah laying hens after 12 weeks of treatment compared with the control group.

Table (16): Effect of essential phospholipids in layer diet on some slaughter characteristics of Bandarah hens at 40 weeks of age (after 10 weeks treatment) ($\bar{x} \pm S.E.$)

Age Week	Treatments (mg EPL/kg diet)	Liver weight (%)	Ovary weight (%)	Oviduct weight (%)	Oviduct length (cm)	Abdominal fat weight (%)	Gall bladder volume (ml)	Comb index (%)
40	Control	2.80 ± 0.13 ^a	0.34 ± 0.04 ^a	2.55 ± 0.05 ^a	59.43 ± 2.33 ^a	3.22 ± 0.03 ^a	0.93 ± 0.05 ^c	1.88 ± 0.38 ^a
	300	2.63 ± 0.05 ^{ab}	0.35 ± 0.01 ^a	2.53 ± 0.05 ^a	60.30 ± 1.37 ^a	2.94 ± 0.06 ^b	1.35 ± 0.06 ^b	2.06 ± 0.76 ^a
	400	2.43 ± 0.06 ^{bc}	0.34 ± 0.01 ^a	2.35 ± 0.05 ^b	60.10 ± 1.14 ^a	2.33 ± 0.10 ^c	1.75 ± 0.22 ^a	2.09 ± 0.72 ^a
	500	2.19 ± 0.08 ^c	0.35 ± 0.12 ^a	2.29 ± 0.04 ^b	59.95 ± 1.93 ^a	1.97 ± 0.08 ^d	1.90 ± 0.11 ^a	1.95 ± 0.21 ^a

a, b, c, d = Means having different letter exponent with in column with in trait are significant different ($p \leq 0.05$)

5- SUMMARY

This field study was carried out at a private poultry farm, while the hematological and biochemical of blood analysis were determined in the Animal and Poultry production Department, Faculty of Agriculture (Damanhour), Alexandria University, Egypt. In order to investigate the effect of essential phospholipids as a hypocholesterolemic drug on reducing cholesterol and lipid contents in the blood as well as in egg yolk and its 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. Birds were divided randomly into 4 experimental groups, 16 birds in each group. The first group (1) was used as a control and fed the experimental diet without drug supplementation, while groups (2, 3 and 4) were fed on the diet supplemented with 300, 400 and 500 mg essential phospholipids/kg diet, respectively. Blood and egg samples were obtained at 30, 32, 36 and 40 weeks of age. All birds in the four experimental groups were leg banded and weighted at the start of experiment. All experimental hens were raised in laying batteries till the end of the experimental period at 40 weeks of age. Feed and water were offered ad-libitum during the whole experimental period (ten weeks). Results obtained can be summarized as follows:-

A. Laying performance:-

- 1- There were no significant effect of essential phospholipids on live body weight during the whole experimental period.
- 2- Essential phospholipids in the laying hen diets decreased the daily feed consumption compared with the control group while the reduction was significant ($P \leq 0.05$) in group that fed on 500 mg EPL/kg diet compared with the other groups.
- 3- No significant effect on egg mass by addition of essential phospholipids in the laying hen diets.
- 4- Essential phospholipids supplementation in the laying hen diet improved feed conversion but this improve was not significant.
- 5- Supplementing laying hen diets with essential phospholipids showed no significant effect on egg weight and percentage egg production compared with the control group.
- 6- There were no significant effect of essential phospholipids on the relative weight of albumen; yolk and shell; shell thickness; egg shape index, yolk index and Haugh units score during the experimental period, except for yolk index at 40 weeks of age (after 10 weeks of age) which was significantly ($P \leq 0.05$) increased compared with the control group.

B. Blood, egg yolk and liver chemistry:-

- 1- Bandarah hens fed essential phospholipids at 300, 400 and 500 mg/kg diet significantly ($P \leq 0.05$) reduced 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.

- 2- Bandarah hens fed 300, 400 and 500 mg EPL/kg diet had significantly ($P \leq 0.05$) increased serum HDL by 6.09, 7.82 and 10.37%, and serum LDL significantly ($P \leq 0.05$) decreased by 6.14, 8.58 and 12.61% respectively. While, there was no significant effects on serum GOT and GPT compared with the control group.
- 3- Essential phospholipids in laying hen diets at 300, 400 and 500 mg/kg diet significantly decreased ($P \leq 0.05$) 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.
- 4- Fertility percentage and chicks weight of Bandara hens did not significantly affected by essential phospholipids, while addition of 300, 400 and 500 mg EPL/kg diet significantly ($P \leq 0.05$) reduced hatchability percentage of fertile eggs by 6.68, 14.24 and 19.62% respectively compared with the control group.
- 5- Supplementing the laying hen diets with 300, 400 and 500 mg EPL/kg diet decreased significantly ($P \leq 0.05$) liver total lipids content by 25.62, 37.01 and 53.02% and liver cholesterol content by 4.35, 4.22 and 22.87% respectively compared with the control group at the end of experimental period.
- 6- Essential phospholipids at 400 and 500mg/kg diet in laying hen diets significantly ($P \leq 0.05$) decreased the relative weight of liver and oviduct.
- 7- No significant effect was observed of different levels of essential phospholipids in laying hen diets on comb index while, bile volume of gall bladder was significantly ($P \leq 0.05$) increased compared with the control group. On the other hand, abdominal fat percentage of groups fed 300, 400 and 500 mg EPL/kg diet significantly ($P \leq 0.05$) decreased by 8.71, 27.64 and 38.82%, respectively compared with the control group.

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الملخص العربي

تأثير الدهون الفوسفورية الأساسية على بعض الصفات الإنتاجية والفسولوجية للدجاج البياض

تم إجراء التجربة الخاصة بتلك الدراسة بمزرعة خاصة للدواجن أما التحليلات المعملية فأجريت بكلية الزراعة جامعة الإسكندرية فرع دمنهور وكان الهدف هو دراسة تأثير الدهون الفوسفورية كمخفض للكولسترول على محتوى الكولسترول والدهون في الدم وصفار البيض الناتج ودراسة هذا التأثير على بعض الصفات الإنتاجية والفسولوجية للدجاج البياض . استخدم في هذه الدراسة ٦٤ دجاجة من سلالة البندرة عمر ٣٠ أسبوع وقسمت الطيور عشوائيا إلى أربعة مجموعات تجريبية بكل مجموعة ١٦ دجاجة وتم وزن الطيور وأخذت عينات الدم و البيض عند عمر ٣٠ أسبوع قبل إضافة العقار للمجموعات الأربعة واعتبرت هذه العينات هي صفر البداية وقد استخدمت المجموعة الأولى كمنترول وغذيت على العليقة التجريبية بدون إضافة العقار بينما غذيت المجموعات الثانية والثالثة والرابعة على الترتيب على ٣٠٠ - ٤٠٠ - ٥٠٠ ملجم دهون فوسفورية لكل كجم غذاء. أخذت عينات الدم والبيض عند اعمار ٣٢، ٣٦، ٤٠، ٤٠ أسبوع وزدت جميع الطيور في الأربعة مجموعات التجريبية ورقمت بالساق عند بداية التجربة وتم تثبيت الطيور التي تؤخذ منها عينات الدم والبيض حتى نهاية التجربة و سكنت المجموعات التجريبية ظلت في بطاريات الدجاج البياض حتى نهاية الفترة التجريبية عند عمر ٤٠ أسبوع وقدم الغذاء والماء حتى الشبع خلال كل الفترة التجريبية (١٠ أسابيع).

وتتلخص أهم النتائج المتحصل عليها من هذه الدراسة في الآتي :

أ- الصفات الإنتاجية

- ١- لوحظ عدم وجود تأثير معنوي للدهون الفوسفورية على وزن الجسم الحي خلال كل الفترة التجريبية
- ٢- وجد أن إضافة الدهون الفوسفورية في علائق الدجاج البياض أدى إلى انخفاض الغذاء المستهلك يوميا مقارنة بمجموعة الكنترول وكان هذا الانخفاض معنوي عند المستوى ٠,٠٥ في المجموعة التي غذيت على ٥٠٠ ملجم دهون فوسفورية مقارنة بباقي المعاملات .
- ٣- لا يوجد تأثير معنوي على كتلة البيض عند إضافة الدهون الفوسفورية في علائق الدجاج البياض
- ٤- وجد أن إضافة الدهون الفوسفورية لعليقة الدجاج البياض أدى إلى تحسن في الكفاءة التحويلية ولكن هذا التحسن غير معنوي .
- ٥- وجد أن إضافة الدهون الفوسفورية لعليقة الدجاج البياض لم يؤثر معنويا على وزن البيضة والنسبة المئوية لإنتاج البيض مقارنة بمجموعة الكنترول .
- ٦- لا يوجد تأثير معنوي للدهون الفوسفورية على الوزن النسبي للبياض والصفار والقشرة وكذلك سمك القشرة ومعامل شكل البيضة ومعامل الصفار ووحدة هيو Haugh خلال الفترة التجريبية باستثناء معامل الصفار عند عمر ٤٠ أسبوع (بعد ١٠ أسابيع من المعاملة) حيث ارتفع مقارنة بمجموعة الكنترول.

ب- التحليل الكيميائي للدم وصفار البيض والكبد :

- ١- وجد أن تغذية إناث دجاج البندرة على المستويات ٣٠٠ و ٤٠٠ و ٥٠٠ ملجم دهون فوسفورية لكل طائر في اليوم أدت إلى انخفاض معنوي للدهون الكلية في سيرم الدم بحوالي ٤,٥ - ٩,٦ - ١٣,٥ % على الترتيب . وانخفاض كوليسترول السيرم بحوالي ٢٦,٥٦ - ٣٥,٠٤ - ٤٢,٥٢ % على الترتيب وأيضا انخفاض الجليسيريدات الثلاثية في سيرم الدم بحوالي ٧,٦٨ - ١١,٢١ - ١٧,٧٣ % على الترتيب مقارنة بمجموعة الكنترول
- ٢- وجد أن تغذية إناث البندرة على ٣٠٠ - ٤٠٠ - ٥٠٠ ملجم دهون فوسفورية لكل طائر في اليوم أدت إلى زيادة معنوية للبيوبروتينات العالية الكثافة في السيرم بحوالي ٦,٠٩ - ٧,٨٢ - ١٠,٣٧ % على الترتيب بينما للبيوبروتينات المنخفضة الكثافة في السيرم انخفضت معنويا

- بحوالي ٦,١٤ - ٨,٥٨ - ١٢,٦١ % على الترتيب في حين لم يلاحظ أي تأثير معنوي على مستوى انزيم الـGOT، GPT في السيرم مقارنة بمجموعة الكنترول
- ٣- أدى إضافة الدهون الفسفورية في علائق الدجاج البيضاء بالمستويات ٣٠٠، ٤٠٠، ٥٠٠ ملجم / كجم غذاء إلى انخفاض معنوي لمحتوى صفار البيض من الدهون الكلية بمقدار ٧,٥٢ - ١١,٥٨ - ٢٩,٥٣ % على الترتيب وكذلك انخفاض معنوي لمحتوى صفار البيض من الكولسترول بمقدار ٢٩,٧١ - ٣٢,٤٣ - ٣٧,٨٦ % على الترتيب مقارنة بمجموعة الكنترول
- ٤- وجد أن النسبة المئوية للخصوبة ووزن الكتاكيت الناتجة لإناث البذرة لم تتأثر معنويًا بالدهون الفوسفورية بينما إضافة ٣٠٠ - ٤٠٠ - ٥٠٠ ملجم دهون فوسفورية لكل كجم غذاء أدى إلى انخفاض معنوي للنسبة المئوية للفقس للبيض المخصب بمقدار ٦,٦٨ - ١٢,٢٤ - ١٩,٦٢ % على الترتيب مقارنة بمجموعة الكنترول .
- ٥- أدى إضافة الدهون الفوسفورية لعلائق الدجاج البيضاء بالمستويات ٣٠٠ - ٤٠٠ - ٥٠٠ ملجم لكل كجم غذاء إلى انخفاض معنوي للدهون الكلية بالكبد بمقدار ٢٥,٦٢ - ٣٧,٠١ - ٥٣,٠٢ % على الترتيب وكذلك انخفاض محتوى الكبد من الكولسترول بمقدار ٤,٣٥ - ١٤,٢٢ - ٢٢,٨٧ % على الترتيب مقارنة بمجموعة الكنترول في نهاية الفترة التجريبية (بعد ١٠ أسابيع من المعاملة)
- ٦- أدى إضافة الدهون الفوسفورية بالمستويات ٤٠٠ - ٥٠٠ ملجم لكل كجم غذاء إلى انخفاض معنوي للوزن النسبي للكبد وقناة المبيض ويرجع ذلك إلى انخفاض الدهون المتراكمة في الكبد وقناة المبيض.
- للملاحظة أي تأثير معنوي للمستويات المختلفة من الدهون الفوسفورية على معامل ا لعرف بينما حجم الصفراء للحوصلة المرارية ارتفع معنويًا مقارنة بمجموعة الكنترول ومن جهة أخرى وجد أن النسبة المئوية لدهن البطن للمجموعات المغذاة على ٣٠٠ - ٤٠٠ - ٥٠٠ ملجم دهون فوسفورية لكل كجم غذاء انخفض معنويًا بمقدار ٨,٧١ - ٢٧,٦٤ - ٣٨,٨٢ % على الترتيب مقارنة بمجموعة الكنترول.

تأثير الدهون الفوسفورية الأساسية على بعض الصفات
الإنتاجية والفسولوجية للدجاج البياض

رسالة علمية

مقدمة إلى الدراسات العليا بكلية الزراعة بدمنهور- جامعة الاسكندرية
استيفاء للدراسات المقررة للحصول على درجة
الماجستير فى العلوم الزراعية

فى

إنتاج الدواجن

مقدمة من

نهال خيرى عبد الرحمن القاضي

٢٠٠٨

تأثير الدهون الفوسفورية الأساسية على بعض الصفات
الإنتاجية والفسولوجية للدجاج البياض

مقدمة من

نهال خيرى عبد الرحمن القاضي

للحصول على درجة الماجستير فى العلوم الزراعية

إنتاج دواجن

لجنة المناقشة و الحكم على الرسالة : موافقون

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الأستاذ الدكتور/ يوسف عبد الوهاب عطية

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الدكتور/ على محمد حسن الشيخ

باحث أول فسيولوجيا الدواجن - معهد بحوث الإنتاج الحيوانى

مركز البحوث الزراعية - وزارة الزراعة

التاريخ / / ٢٠٠٨

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