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Effect of Dietary Fish Oil on Production Traits and Lipid Composition of Laying Hens

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Abstract: Feeding of fish oil at a concentration of 1.5 and 3% in a basal diet to laying hens for one month produced no significant effect on production traits except in the egg number and food conversion parameters. Fish oil had significantly reduced plasma total lipids, triglycerides, cholesterol and low and very low density lipoproteins. It's suggested that fish oil may divert lipids metabolism to phospholipids formation, a mechanism explaining elevation in phospholipids observed in this study.

Key words: Layers, fish oil, lipids, egg production

Introduction

Fish oils are known to contain the polyunsaturated fatty acids eicosapentaenoic acids (EPA; C20:5n-3 and docsahexaenoic (DHA; C22: 6n-3) , known as omega-3 fatty acids (Dyerberg and Jorgensen, 1982). These acids inhibit the synthesis of arachidonic acid (AA, C20: 4n-6) and compete with it for incorporation into the C-2 position of phospholipids (Dyerberg *et al*., 1986) thus limiting the availability of eicosanoids such as prostaglandins, leukotriens and thromboxenes (Baguma *et al*.,1999). Therefore omega-3 fatty acids are expected to produce anti-inflammatory, antihypertension, vasodilatory and anti-atherothrombatic effects. Furthermore, fish oil may inhibit the desaturation of n-6 fatty acids with subsequent lowering of plasma lipids (Haung *et al*., 1992). This study was conducted to investigate the effect of feeding fish oil on performance and plasma lipids concentration of laying hens.

Materials and Methods

Birds and treatments: The study was performed using 75, 24-week old Single Comb White Leg horn layers of hybrid strain. All chickens were obtained from a poultry breeding farm. Chickens were placed individually in cages where lighting was maintained 14h/24h and were allowed a 7-day acclimation period to prior study. The house was maintained at a temperature of 25± 2°C and at 45 to 65% relative humidity. Water was supplied at libitum and feed was offered to chickens at a rate of 50g/hen/day for one month. The basal diet (Table 1) has been formulated to meet; the nutrient requirements of laying hen (NRC, 1994). Birds at the age of 25 weeks were divided randomly into 3 groups of 25 birds each and fed fresh diet prepared daily. Birds in group A were fed the basal diet which contained 3% cotton seed oil. Birds in group B were fed the basal diet which contained 1.5% cotton seed oil and 1.5% fish oil (Active EPA-30, fish cod liver, Sigma ,UK). Birds in group C were fed the basal diet which contained 3% fish oil. Birds were observed closely for their performance.

Collection of the blood samples: Blood was collected from the wing vein using chilled syringes containing heparin. Blood was then centrifuged at 1000g for 10 minutes, plasma separated and stored at -30°C until analysis.

Biochemical analysis: Plasma a total lipids, phospholipids , triglyceride and total cholesterol were detected by Ames diagnostic Kits according to the manufacture recommendations (Bayer Diagnostics Bashing stocke, UK) . High density lipoprotein (HDL) cholesterol was detected after precipitation of HDL by heparin and manganese (Warnik and Alber, 1978). Low density (LDL) and very low density lipoprotein (VLDL) , cholesterol level were calculated according to method of Bauer (1982).

Statistical analysis: Statistical significance was assessed by Student's t-test procedure (Steel and Torrie, 1960).

Results and Discussion

The effects of feeding of increasing level of fish oil caused no effect on production traits of laying hens (Table 2) except in egg number and food conversion parameters ($P<0.05$) . Feeding of vegetable oils have also shown to increase egg number (March and MacMillan, 1990; El-Katcha, 1990) and improve feed conversion for egg production (Sell *et al*., 1976).

The effects of fish oil on plasma lipids are shown in Table 3. Fish oil has significantly ($P< 0.05$) reduced total lipids, triglycerides, cholesterol, LDL and VLDL levels while phospholipids and HDL levels were significantly ($P< 0.05$) increased. Similar changes in lipids and lipoproteins as a results of feeding omega-3

Table 1: Percentage Composition of basal diet used for laying Hens

Ingredients		Composition	
White corn	64.0	Metabolizable energy (kcal/kg)	2800
Soybean meal	20.0	Moisture	98
Fish meal	5.0	Crude protein	18.3
Bone meal	1.40	Ether extract	3.50
Cotton seed oil	3.0	Crude fibre	3.50
Cod liver oil	-	Nitrogen free extract	59.70
Lime stone	0.48	Ash	5.04
Common salt	0.50	Calcium	1.00
Vitamin and Trace mineral (premix)	0.25	Available phosphorus	0.49
		Methonine +Cysteine	0.36

Table 2 : Effect of Feeding Fish oil for one month on performance of laying hens

Parameter	Group A	Group B	Group C
Initial Weight (g)	1680±30[a]	1682±32[a]	1685±36[a]
Final body Weight (g)	1687±32[a]	1688±33[a]	1689±32[a]
Egg Weight (g)	53.3±0.8[a]	54.6±0.7[a]	55.1±0.8[a]
Number of eggs /one month	24.4±0.04[a]	28±0.04[ab]	29.1±0.05[ab]
Shell Thickness (mm)	0.032±0.001[a]	0.031±0.001[a]	0.032±0.001[a]
Food Conversion (kg/kg)	2.61±0.03[a]	2.40±0.03[ab]	2.92±0.03[ab]

Values with different superscripts differ significantly ($p<0.05$)

Table 3: Effect of Feeding Fish oil on plasma concentration of lipids in laying hens

Parameter (mg/dL) (fed basal diet control) (n=25)	Group A (fed 1.5% fish oil) (n=25)	Group B (fed 3% fish oil) (n=25)	Group C
Total lipids	555.81±1.836[a]	507.78±1.176[b]	522.31±2.429[c]
Phospholipids	143.67±1.536[a]	170.97±1.394[b]	182.71±1.632[c]
Triglycerides	170.22±2.044	137.37±1.658[b]	100.24±1.464[c]
Cholesterol	244.60±1.439[a]	194.35±1.161[b]	194.48±1.536[b]
HDL	73.42±0.846[a]	99.04±0.909[b]	137.41±0.814[c]
LDL	136.30±0.710[a]	68.18±0.678[b]	37.03±2.181[c]
VLDL	34.89±0.561[a]	27.13±0.403[b]	19.13±0.688[c]

* Values with different superscripts differ significantly ($p<0.05$)

compounds such as linolenic acids were reported elsewhere (Nestel *et al*., 1984; Ferrandez *et al*., 1992; Farrell, 1996; Lee *et al*., 1988). A number of theories have been suggested to explain the mechanism whereby fish oil caused reduction in cholesterol, triglycerides and lipoproteins. These included reduction of hepatic synthesis and secretion of triglycerides by decreasing activity of synthetic enzymes (Rustan *et al*., 1988), increased proximal beta oxidation (Yamazki *et al*., 1987) , increasing in the expression of hepatic receptor for LDL (Shephered *et al*., 1980) and increasing LDL apo-B fraction catabolic rate (Fernandez, 1992). Furthermore, the hypocholestrolemic effect of fish oil may be attributed to the oxidation of cholesterol to bile acids (Barbara *et al*., 1977) , decreasing activity of esterifying enzymes (Rustan, 1988) or diverting lipids metabolism to phospholipids formation (Wong *et al*., 1985; Wong and March, 1988) a mechanism explaining the elevation in phospholipids levels observed in this study.

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