Effect of Dietary Fish Meal on Production Performance and Cholesterol Content of Laying Hens

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Abstract: The effect of dietary fish meal (FM) on production and egg yolk cholesterol of commercial Hyline White Leghorn hens (24-week old) was studied for four weeks. Eighty birds were given a corn-wheat-soyabean meal diet that contained either 0% (control diet, C) or 3% fish meal (DM basis). Hens were randomly divided into two experimental treatments with four replicates (10 hens per replicate). Egg weight, daily egg production (g/hen/day), daily feed consumption and feed conversion ratio were recorded. At the end of each week, 12 eggs from each group were randomly collected and egg yolk cholesterol, egg volume, shell thickness and Haugh unit (HU) were measured. There was no significant (p<0.05) effect of feeding 3% FM on egg yolk cholesterol concentration (mg/100 g yolk or mg/yolk) compared with the control diet, but 3% FM, tended to decrease egg yolk cholesterol concentration (1930.93 vs 2021.48 mg/100 g yolk). Hens fed on 3% FM had higher (p<0.05) egg production, egg weight, egg volume, shell thickness, HU and better feed conversion ratio. It was concluded that under the condition of the study, feeding 3% fish meal improved egg production traits but was not able to reduce cholesterol concentration of the egg yolk although tended to reduce cholesterol concentration.

Key words: Egg, fish meal, cholesterol, laying hens

INTRODUCTION

Health recommendations encourage a reduction in the consumption of total lipids, cholesterol and saturated fatty acids and to increase the proportion of mono-unsaturated and polyunsaturated fatty acids (PUFAs) in their diets (Walsh et al., 1975). Dietary mono-unsaturated fatty acids were very effective in lowering blood cholesterol concentration and may be important in preventing coronary heart disease (Grundy, 1986; Ramaswamy et al., 2001). Cholesterol metabolism in the laying hen has been reviewed by McDonald and Shafey (1989). Dietary and genetic factors can affect egg cholesterol deposition (Sutton et al., 1984; Hargis, 1988). Different feed such as flax seed, safflower oil, fish and vegetable oil have been added to chicken feeds to increase the n-3 fatty acid content in the egg yolk (Jiang et al., 1991; Kim et al., 1997; Chae et al., 1998). Fish lipids are highly digestible by all species of animals and are excellent sources of the essential PUFAs in both omega-3 and omega-6 families of fatty acids. The predominant omega-3 fatty acids in fish meal and fish oil are linolenic acid, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA)(Kitessa et al., 2001). Fish meal and oil contain more omega-3 than omega-6 fatty acids. In contrast, most plant lipids contain higher concentrations of omega-6 fatty acids. Scheideler and Froning (1996) observed higher omega-3 content of eggs with feeding fish oil or flax oil to hens.

The beneficial effects of omega-3 fatty acids, such as their anti-thrombotic and anti-inflammatory properties have been established by clinical and epidemiological studies (Herod and Kinsella, 1986; Baguma-Nibashika et al., 1999; Constant, 2003). Also, fish oil may inhibit the desaturation of n-6 fatty acids with subsequent lowering of plasma lipids (McDonald and Shafey, 1989). In addition, oxidation of cholesterol to bile acids (Barbara et al., 1977) changing lipids metabolism to phospholipids formation (Wong et al., 1985) or decreasing the activity of esterifying enzymes (Rustan, 1988) may result in hypocholesterolemic effect of fish oil. The amino acid profile of fish meal is what makes this feed ingredient so attractive as a protein supplement. Overall protein digestibility values for fish meal are consistently above 95%.

This study was designed to investigate the effects of feeding fish meal to laying hens on production performance and cholesterol concentration of egg yolk.

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MATERIALS AND METHODS

The study was performed using eighty Hyline White Leghorn layers (24-week old). This experiment was carried out from August to September 2006, at Basat Education and Research Center, Shiraz, Iran.

Diets (Table 1) were formulated to meet the nutrient requirements of laying hens (NRC, 1994). Dietary treatments consisted of either 0% Fish Meal (FM) (control diet, C) or 3% FM. Hens were kept in wire cages, given feed and water for ad libitum intake and subjected to a photoperiod of 14 h light and 10 h dark day. The house was maintained at a temperature of 25±2°C and at 45 to 65% relative humidity. Birds were divided randomly into two groups of 10 birds with four replicates. Diets were fed for 4 weeks. A 3-week acclimation period was performed prior to the onset of the experiment. Egg production and feed consumption were recorded daily and egg weight was determined by collecting the eggs of each cage weekly. Daily feed consumption and feed conversion ratio were calculated. During 4 weeks of experiment, 12 eggs were randomly collected from each group, broken and weighed and the yolk separated and weighed yolk were homogenized before analysis at the end of each week. Cholesterol was determined by the method of Zak (1977).

Also, shell thickness, egg volume and Haugh unit (HU) were determined. Data were analysed according to procedures of SAS (1996). Differences between treatments were tested using student’s t-test.

RESULTS AND DISCUSSION

The effects of feeding fish meal had no effect (p>0.05) on cholesterol concentrations of egg yolk expressed as mg/100 yolk or mg/yolk, but tended to decrease cholesterol content as compared with the control diet (Table 2). This is in agreement with Daghir et al. (1960), Weiss et al. (1967) and Bartow et al. (1971) who found that supplementation of 120, 160 or 200 g/kg of soyabean oil to diet of laying hens did not affect yolk cholesterol. Wang (1996) reported lower egg yolk cholesterol content with feeding 8% safflower to laying hen. Higher egg yolk cholesterol was reported with adding fish oil as compared with adding poultry fat, tallow, corn oil or soya oil to hens diets (Melluzzi et al., 1996). Watkins and Elkin (1992) reported that, olive oil, soya oil and tallow did not affect the egg yolk cholesterol content of laying hens. Variations in yolk weight did not affect cholesterol concentrations between diets (Sheridan et al., 1982). Sheridan et al. (1982) reported differences in yolk cholesterol concentrations between strains. Jiang and Sim (1994) reported lower liver and plasma cholesterol concentrations in rats fed diets containing dried egg yolk enriched with n-3 PUFAs than that in rats fed control diets. Barbara et al. (1977) attributed the hypocholesterolemic effect of fish oil to the oxidation of cholesterol to bile acids. The 3% fish meal used in this study might not be enough to reduce cholesterol concentration of egg yolk. Another factor for differences in the results of cholesterol content in other studies, might be due to the strain differences (Sheridan et al., 1982). The magnitude decreased of egg cholesterol with feeding FM was expected as its concentration in 3% FM diet was lower than control diet (Table 1). Fish meal had significant (p<0.05) effect on production traits of laying hens (Table 2). Feeding of vegetable oils have shown to increase egg number (El-Kateha, 1990; Mareh and MacMillan, 1990) and improved feed conversion (Sell et al., 1976; Al-Sultan, 2005). In other study, feeding 4, 8 and 12% menhaden meal to laying hens, increased (linearly,
(p<0.05) egg production expressed as both hen-day or hen-housed and improved feed conversion but Haugh units and egg weight were not affected (p>0.05) by dietary treatments (Nash et al., 1996). In contrast, Farrel (2002) did not find any significant increase in egg weight by feeding canola oil to laying hen. Egg shell thickness was higher (p<0.05) for 3% FM diet. This property simplifies the handling and distributing of these eggs. Fish meal of high quality provides a balanced amount of all essential amino acids, fat-soluble vitamins, steroid hormones, phospholipids and fatty acids (e.g., DHA and EPA) for optimum development, growth, and a variety of physiological processes (Clandinin and Van Aerde, 1990; Baguma et al., 1999). Any complete diet must contain some protein, but the nutritional value of the protein relates directly to its amino acid composition and digestibility, which is the case in the present study for 3% FM diet as compared with the control diet. Based on the results of this experiment, supplementing laying hen diet with 3% fish meal can improve production.

REFERENCES


