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# The influence of long term feeding flaxseeds on fatty acid profile of egg yolk, production parameters and plasma lipids profile of layers

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## Abstract

The influence of feeding flaxseeds, on fatty acids profile of egg yolk, egg production, egg external and internal quality and plasma lipids profile was studied in an experiment in which a group of hisex laying hens were fed diet containing 10% whole flaxseeds, for eight weeks, and compared with birds fed corn based control diet. Fatty acids profile of egg yolk was determined by the end of the trial, egg production was monitored daily, and egg external and internal quality was also determined by the end of the experiment. Plasma lipids profile was monitored weekly. As compared to the control group, flaxseeds fed group deposited significantly ($P<0.01$) high levels of omega-3 fatty acids into their eggs, also significant ($P<0.05$) high level of polyunsaturated fatty acids, as well as unsaturated fatty acids, while there was no significant different levels of saturated and monounsaturated fatty acids between the control and the treated group. At the first month there was no significant difference in egg production between the control and the treated group, while the production in the second month was significantly ($P<0.05$) high in the treated group compared with the control group. Feeding flaxseeds for eight weeks; resulted in no significant difference in egg weight, egg size and albumin weight compared with control group, while shell thickness and yolk thickness were significantly ($P<0.05$) reduced in the treated group. Plasma cholesterol, total lipids, triglycerides and LDL; were significantly reduced in the treated group, while HDL-cholesterol was significantly elevated.

**Keywords:** Flaxseeds, Fatty Acids, Plasma Lipids, Layers

## Introduction

Flaxseeds have been known as a rich source of linlenoic acid (α LNA, $C_{18:3\square3}$), the parent fatty acid of longer chain omega-3 fatty acids. α LNA, from oil seeds can be converted to longer chain omega-3 fatty acid, such as Eicosapentanaeoic FA (EPA $C_{20:5\square3}$), Docosapentaenoic FA (DPA $C_{22:5\square3}$) and Docosahexa-naeoic FA (DHA $C_{22:6\square3}$), ( Cherian and SIM 1991). When eggs are to be enriched with LNA, flaxseeds, and flaxseeds oil could be considered (Gonzlez and Leeson 2001). Flaxseeds may lower cholesterol levels; especially in women (Pan et al., 2009). A variety of researches showed that egg yolk lipids compo sition is influenced by dietary fat (Cherian et al., 1991).

Increasing the ratio of polyunsaturated fatty acids (PUFA) to saturated fatty acids of the diet reduced the plasma concentration of cholesterol (Brison, 1996). The fatty acids composition of egg yolk can be altered by dietary modification (Cruickshank, 1934).

According to epidemiological studies, there is a direct relationship between intake of saturated fatty acids and incidence of cardiovascular diseases. There is an indication that increasing the ratio of poly unsaturated fatty acids to saturated fatty acids of the diet reduces the plasma concentration of cholesterol (Grobas et al., 2001). Numerous studies provide evidence for an essential role for the polyunsaturated fatty acids in the mammalian central nervous system. Recently, (n-3) PUFA deficiency has been linked to a number of biological dysfunction in humans. The dietary (n-3) PUFA supplementation or deficiency affects melatonin release (Zaouali-Ajina et al., 1999).

A benefit of omega-3 fatty acids is helping the brain to repair damage by promoting neural growth. In a six month study involving people with schizophrenia and Huntington's disease who were treated with Eicosasapentaenoic acid or a placebo, placebo group had clearly lost cerebral tissue, while the patients given the supplements had a significant increase of grey and white matter (Puri, 2006).

## Materials and Methods

Thirty laying hens (hisex) breed, 20 weeks old, purchased from animal production research center (kuku), were used in this study. The birds were divided into two groups (each of 15) and were housed in cages (2, 1.5,1 meters). The treated diet was prepared by inclusion of 10% flaxseeds). The diets were formulated to meet the requirements of egg production according to the directions of the national research council (1994).

The flax seeds were brought from a spice man, and subjected to proximate analysis to determine its content of protein, fat, fiber, N.F.E and energy. The treated and control diets were both subjected to proximate analysis, the protocol of analysis followed was that described by (AOCA, 2000).

Table (1), and (2), show the nutritional composition of the control and the treated groups diets, respectively. Thirty eggs of each group; were collected randomly throughout the eighth week for egg yolk lipids profile determination. Eggs were broken, the yolk was separated, and each two yolk were pooled together and placed into a glass container and stored at -20°c until analysis. Twenty eggs of each group were collected randomly throughout the last two days of the experiment, for determination of egg external and internal quality. Three (ml) of blood were collected from seven birds of each group weekly in EDTA coated vials, the samples were centrifuged at 3000rpm, and plasma was transferred into plane vials. Plasma samples were stored at -20°c until analysis.

Lipids were extracted in chloroform-methanol (2:1 v/v) according to the method of (Folch and Sloane-Stanely, 1975). Methyl esters of the lipid extract were prepared according to (Wang et al., 2000). The analysis was performed using (2010, Shimadzu, Japan) gas chromatograph, fitted with Flame ionization detector (FID). Separation of fatty acids was achieved using DB-WAX column, serial number (us 6551263 H), of 0.25um film thickness, 30 meter length and 0.25 mm inner diameter.

Fatty acids methyl esters were identified by comparison of retention times with standards, and expressed as percentage of methyl esters. The plasma lipids profile were determined using commercial kits by Unicam 8625 Spectrophotometer following the instructions of the manufacture. Egg and albumin weight were determined using digital scale model. The shell thickness was measured using a modified starrett model 1010M thickness gauge, according to the method described by Anderson and Heckey (1970). For yolk height measurement, a needle provided with a movable loop was dipped in the center of the yolk, the lower end of the loop was adjusted and the dipped portion of the needle was measured in centimeters on a scale.

## Results

Table (3) and figure (1), show the accumulative effect of feeding 10% flaxseeds on egg yolk fatty acid profile. Flaxseeds fed group showed no significant difference in saturated and mono unsaturated fatty acids compared to the control group (A). Birds fed 10% flaxseeds showed significant (p‹ 0.01) high egg yolk levels of poly unsaturated fatty acids, compared to the control group (A). Group (B), deposited a significant (p‹ 0.01) high level of omega-3 fatty acids into their egg compared to the control group. Group (B), deposited a significant (p‹ 0.01) high Linolenic acid (ALA) and linoleic acidinto their egg yolk, compared to the control group (A).

There were no significant different levels of oleic acid between the control group and flaxseeds fed group. The control group (A), showed a significant (P<0.01) less levels of stearic acid, compared to the treated group (table 5), where there was no significant difference in palmitic acid levels between the two groups. Table (4), shows the accumulative effect of feeding 10% flaxseeds on plasma lipids profile. The control group (A), showed significant (P<0.01) high plasma triglycerides,

**Table 1: The diet ingredients and nutritional composition of the control group**

| Ingredients % | | Composition | |
|---|---|---|---|
| Corn | 62% | ME Kcal/kg | 2729 |
| Groundnut Cake | 19% | C.P% | 17.25 |
| Wheat hull | 3.9% | E.E% | 3 |
| L.Concentrate | 5% | C.F% | 4.2 |
| Calcium | 10% | Calculated analysis % | |
| Carbonate | 0.25 | Ca | 4 |
| Salt | % | Methionine+cystine | 0.72 |
| Methionine | 0.34 | Available phosphorous | 0.52 |
| Lysine | % | | |
| Mycofix | 0.1% | | |
| Premix | 0.1% | | |
| | 0.1% | | |

**Table 2: The diet ingredients and nutritional composition of the treated group**

| Ingredients % | | Composition | |
|---|---|---|---|
| Corn | 59.5% | ME Kcal/kg | 2816 |
| Wheat hull | 4.3% | C.P % | 18 |
| Groundnut Cake | 10.3% | E.E % | 4 |
| L.concentrate | 5% | C.F % | 4.1 |
| Calcium Carbonate | 10% | Calculated analysis % | |
| Salt | 0.25% | Ca | 4 |
| Methionine | 0.34% | Methionine | 0.71 |
| Lysine | 0.15% | +cystine | |
| Mycofix | 0.1% | Available | |
| Premix | 0.1% | phosphorous | 0.62 |
| Flaxseeds | 10% | | |

**Table 3: The accumulative effect of feeding 10% flaxseeds on egg yolk fatty acids profile**

| Group | DHA % | DPA % | EPA % | Arachidonic % | Linolenic % | Linoleic % | Oleic % | Stearic % | Palmitic % |
|---|---|---|---|---|---|---|---|---|---|
| Control | 0.00 ± 0.0326[a] | 0.00 ± 0.0241[a] | 0.00 ± 0.0716[a] | 0.00 ± 0.1587[a] | 0.00 ± 0.8327[b] | 0.00 ± 1.2633[b] | 35.110 ± 8.2511[b] | 1.0222 ± 1.3269[b] | 21. 771 ± 4.9994[b] |
| Flaxseeds 10% | 0.00 ± 0.0326[a] | 0.00 ± 0.0241[a] | 0.00 ± 0.0716[a] | 0.00 ± 0.1587[a] | 3.4106 ± 0.8327[a] | 13.253 ± 1.2633[a] | 45.213 ± 8.2511[ab] | 7.9878 ± 1.3269[a] | 30.128 ± 4.9994[ab] |

Means in the same columns followed by the same letters are not significantly different at (P<0.05).

**Table 4: The accumulative effect of feeding 10% flaxseeds on plasma lipids profile**

| Group | Total lipids | cholesterol | triglycerides | LDL-cholesterol | HDL-cholesterol |
|---|---|---|---|---|---|
| Control (A) | 592.7[a]±8.347 | 124.28[a]±1.662 | 334.9[a]±2.9174 | 49.143[a]±1.2816 | 9.13[a]1.2579 |
| Flaxseeds10% (B) | 578.85[a]±8.347 | 110.95[b]±1.662 | 280.5[b]±2.9174 | 43.992[b]±1.2816 | 16.822[b]±1.2579 |

Means in the same columns followed by the same letters are not significantly different at (P<0.05)

**Table 5: The accumulative effect of feeding 10% flaxseeds on egg external and internal quality**

| Group | Egg weight(g) | Egg size($cm^{3)}$ | Shell thickness(mm) | yolk weight(g) | yolk height(mm) |
|---|---|---|---|---|---|
| Control (A) | 52.986± 1.3122[a] | 47.00± 2.5422[a] | 0.1030± 6.389[a] | 13.592± 0.4107[a] | 1.635± 0.054[a] |
| Flaxseeds 10% (B) | 53.685 ± 1.3122[a] | 47.8± 2.5422[a] | 0.0900± 6.389[b] | 13.335± 0.4107[a] | 1.4500± 0.054[b] |

Means in the same columns followed by the same letters are not significantly different at (P< 0.05).

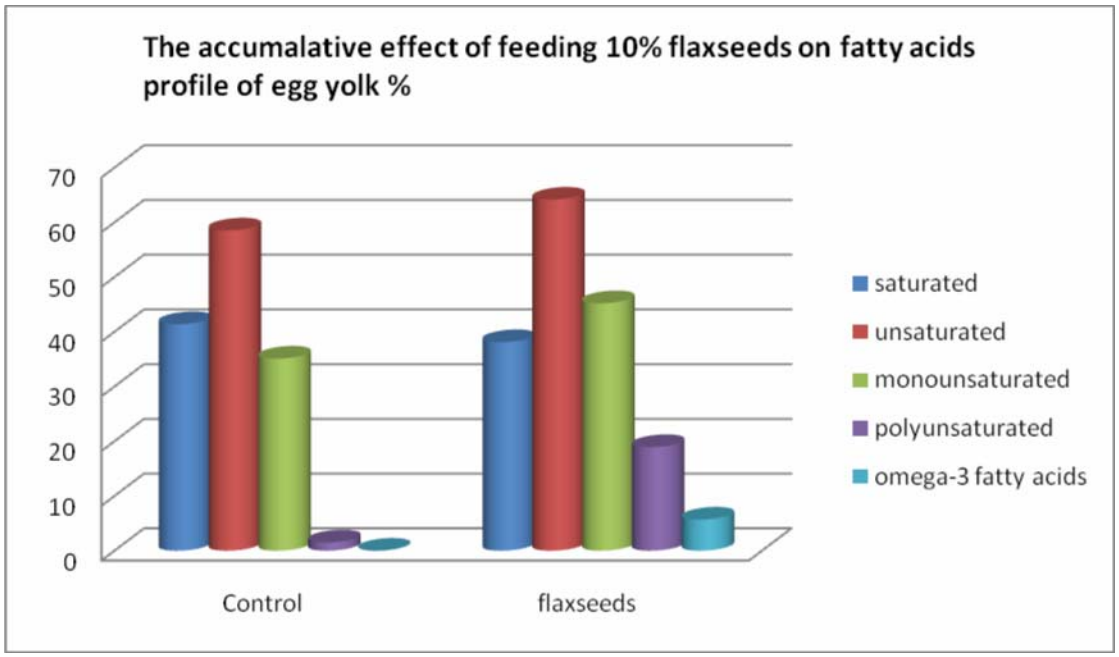


**Fig. 1: Birds fed 10% flaxseeds showed significant (P<0.01) high egg yolk levels of poly unsaturated fatty acids, compared to the control group (A).**

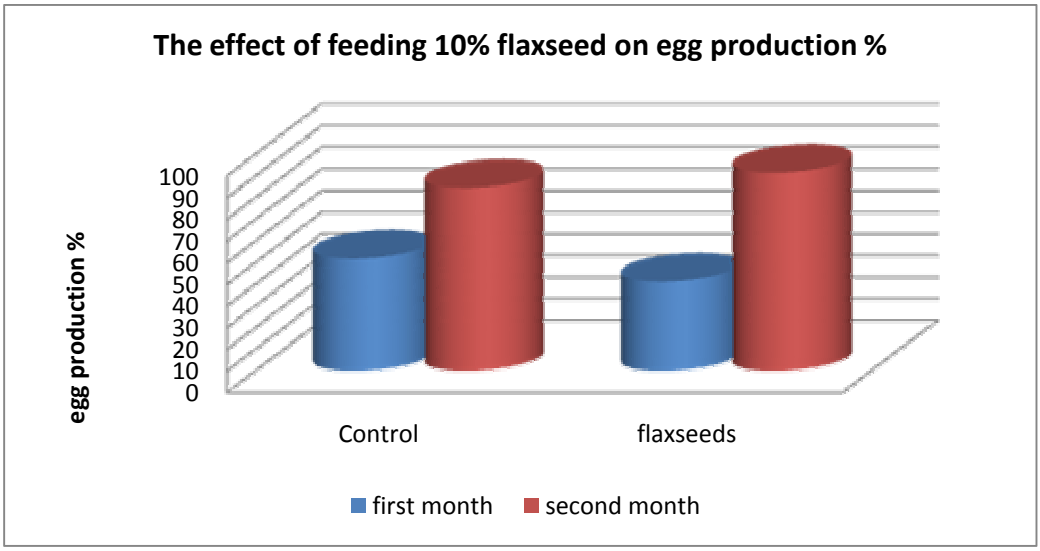


**Fig. 2: shows the accumulative effect of feeding 10% flaxseeds on egg production**

cholesterol, and LDL-cholesterol; concentration compared to the treated group (B). While the flaxseeds fed group showed significant (p› 0.01) high levels of HDL-cholesterol compared to the control group. There was no significant difference in the number of produced egg between the control group and flaxseeds fed group, (figure 2). Table (5), shows the accumulative effect of feeding 10% flaxseeds on egg external and internal quality. Feeding flaxseeds for eight weeks; resulted in no significant difference in egg weight, egg size and yolk weight. The control group (A) showed significant (P<0.01) high yolk and shell thickness compared to treated group (B).

## Discussion

The effect of feeding 10% flaxseeds on plasma lipids profile in this study showed a significant reduction in total lipids, cholesterol, triglycerides and LDL-cholesterol concentrations in plasma compared with the control group, while the concentration of HDL-cholesterol was significantly elevated, these findings agree with what was reported by (Simopoulos, 1991), who studied the effect of dietary omega-3 fatty acids on factors and mechanisms involved in the development of inflammation, atherosclerosis and immune diseases. He reported a reduction in LDL-cholesterol, triglycerides and an increase in HDL-cholesterol levels. The same results were found when hyperlipidemic patients fed diets supplemented by flaxseeds, the patients showed significant reduction in total cholesterol, LDL-cholesterol and triglycerides (Mandasecu et al., 2005).

In the present study, the significant high levels of polyunsaturated and omega-3 fatty acids in flaxseeds treated group compared to the control group agrees with findings of (Balevi and Coskun, 2000), who reported that feeding 2.5%flaxseeds oil to the laying hens resulted in significant higer levels of polyunsaturated fatty acids and omega-3 fatty acids compared to the group which fed 2.5% corn oil.

On the other hand, a study conducted by (Grobas et al., 2001) indicated that strain of hen influences the fatty acids profile of the egg yolk, though the effect was quantitatively small but significant for most saturated and monounsaturated fatty acids. The findings of the current study, disclosed no significant difference in deposition of SFA and MUFA, between flaxseeds treated group and the control group, however, this result disagrees with numerous previous studies. Strain of hen influence most of the productive traits studied, including egg weight, egg mass output and feed efficiency (Grobas et al., 2001).

The present study, showed a significant increase in egg production in response to consuming 10% flaxseeds compared to the control group, the same results were reported by (Scheideler and Forning, 1996). The same authors reported decreased eggshell thickness in birds fed flaxseed for eight month, these results agree with the findings of the present study. Flaxseeds in this study; has no effect on egg and yolk weight, this result was also reported by (Aymond and Elswyk, 1995).

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