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Effect of Flaxseed Diet on Egg Quality of Laying Hens (*Gallus gallus domesticus*)

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Abstract: ***Egg is one of the most complete food from a nutritional point of view .It is necessary to produce healthier eggs. The aim of the current study was to study the effects of flaxseed diet on egg quality and production of omega-3 enriched egg. This experiment started when the hens were 24 wk age and lasted for 32 wks age. All the hens are divided randomly into 3 treatment group and each treatment group received 0.5%,10% and last one is control which received no flaxseed diet .All the hens were provided with water and food ad libitum. During the experimental period egg production, egg quality and feed conversion were recorded at 4 weeks interval. It is found that after adding flaxseed in the diet increased the omega-3 fatty acid content in egg as compared to the control egg .however, also flaxseed diet increased linolenic fatty acid and significantly decreased the palmitic acid. It can be concluded that flaxseed diet did not negatively affects the egg production and egg quality criteria; also it can result in producing omega-3enriched egg. So it is good to produce egg with beneficial amount of fatty acid after adding flaxseed in the diet of laying hens.***

Keyword: flaxseed, laying hens, fatty acid, egg quality, egg production

1. Introduction

Egg in one of the most complete food from a nutritional point of view, but now-a-days consumers abstain from egg consumption due to high cholesterol content of eggs which tends to risk factors for coronary heart disease (Blanch and Grashorn, 1995; Bhatnagar and Durrington, 2003; Erkkila *et al.*, 2003; Meyer*etal.*, 2003) in those, who have high blood cholesterol levels (Zeilder,1998). In past suggestion egg cholesterol caused atherosclerosis which in turn results in health complications such as paralyses and heart attack in debatable at the present (Hansen and Thorling, 1994; Marshall *et al.*, 1994; Cherian and Sim, 1996;Farell, 1997). Cholesterol and fatty acids contents of yolks vary depending on dietary control, age and egg production rate (Beyer and Jensen, 1989; Hargis and Van, 1993; Ahn *et al.*, 1995; Meluzzi *et al.*,1995; Vanelswyk *et al.*,1997; Scharf and Elmadfa, 1998).

Flaxseed is one of the most concentrated sources of polyunsaturated fatty acids available in natural feed stuffs for poultry (Caston and Leeson, 1990; Jiang *et al.*, 1991), because it contains high amount of Linolenic acid. Also flaxssed in used in the production of Omega-3 enriched eggs (Hayat *et al.*, 2009; Afaf *et al.*, 2011). The increase in PUFA cause decrease in saturated fatty acid resulting in a healthier fat profile to meet to consumer's desire. Nowadays flaxseeds are emerging as a "Super Food" as more scientific research points to their health benefits. Flaxseeds contain a group of nutrient called lignans, which have powerful antioxidant and estrogen properties may help in preventing breast cancer. Flaxseed can improve digestive health, lowering B.P. and also control the body weight. Flaxseed help in producing Omega-3 enriched egg which help in reducing inflammation (Belluzzi *et al.*, 2000; Hoa *et al.*,2010) reducing Asthma symptoms (Broughton *et al.*, 1997).

Some reports showed a decrease in egg production in response to 15% flaxseed (Aymond and Elswky, 1995; Najib and A1yousef,2011) whereas, other reports showed an increase in egg production when hens fed 5 & 10 % flaxseed (Scheideler and Froning, 1996). Some reports indicated that flaxseed reduced yolk and egg weight (Scheideler and Froning, 1996; Bean and Leson, 2003), where others showed increased feed intake (Novak and Scheideler, 2001). Due to incompatible reports on the role of flaxseed in laying diets, the question that needs to be asked is whether flaxseed has beneficial effect when added to hen diets. Therefore, the purpose of this study was to examine the effects of flaxseed in diets of laying hens on performance, egg quality criteria, fatty acid composition of egg.

2. Materials and Methods

The hens that are used in the experiment were Vanaraj chicken (*Gallus gallus domesticus*), 24 weeks of age and were allotted in the experimental house under proper light and temperature. Treatment started when hens were 24 weeks of age and lasted for 32 weeks age. At 24 weeks age hens were divided in to three treatment groups and are housed in individual cages. Each treatment group received 0.5%, 10% flaxseed diet and last one is control which received no flaxseed diet. Nutrient content of the diets was determined by proximate analysis. The ingredients and chemical composition of diet of 3treatment groups are shown in table-1.

Table 1: The data of ingredients and chemical analysis

Ingredients	0% flaxseed	5% flaxseed	10% flaxseed
Corn(g)	42	42	42
Soyabean (g)	40	40	40
Wheat bran(g)	15	15	15
Flaxseed (g)	3	3.5	4
Chemical analysis%	0% flaxseed	5% flaxseed	10% flaxseed
Moisture	7.0005	7.3255	7.6505
Crude protein	17	17.90	18
Crude fat	3.65	5.38	5.86
Calcium	3.00	3.04	3.36
Crude fibre	4.00	4.04	4.80
Total phosphorus	0.76	0.73	0.75
Metabolisable energy	2815	2834	2844

Al the hens were provided with water and food *ad libitum* and also hygienic condition. Egg production, broken-cracked eggs were recorded daily. During the experimental period egg weights (in g) were recorded daily. At 4 weeks intervals average egg weight were calculated for each treatment group. Feed intake was recorded per week. Average egg mass and feed conversions (g feed/g egg) per each treatment group were calculated as below:

Egg mass (gm/hen) = hen-day egg production (%) * egg weight(gm)/100

Feed conversion (gm feed/gm egg)= daily feed intake (gm/hen)/ daily egg mass(g/hen)

Egg quality

To determine the egg quality, 5 eggs from each treatment group in every 4 week were randomly collected. Hence, 50 eggs from all treatment groups were collected to evaluate the quality of the egg. Egg quality parameters like egg shell thickness, egg shell strength, yolk color, Haugh unit (HU) and albumen height, length and width were examined. Egg shell thickness was measured by using a micrometer screw gauge (i.e, the top, middle and bottom). Average of the thickness measurements from each egg was used to determine the egg shell thickness. The shell was weighted in order to evaluate the proportion of the shell. The measurements of albumen height were done on thick albumen. The height of yolk and albumin was determined by using tripod micrometer. Haugh unit was calculated according to the given formula:-

Haugh unit=100 log [albumin height (mm)+7.57-1.7 egg weight 0.37(g)]

At the end of the experiment, the total of 5 eggs from each groups randomly selected for the analysis of fatty acid composition of egg by gas chromatography method.

3. Result and Discussion

In this experiment, the effects of adding flaxseed (0, 5, 10 & 15%) in the diet of laying hens on various production performance, fatty acid composition were studied (Table 2 and 3).

Table 2: Productive parameters of laying hens fed with flaxseed diet

1ST Period				
Item	Control	5%	10%	Mean ±SD
Egg mass/g	14.73	20.82	24.59	20.04 ±2.87
Egg weight/g	41.25	45.35	45.92	44.17 ±1.47
Egg production%	35.71	45.91	53.57	45.06 ±5.17
Feed intakeg/h/d	105.92	106.9	108.16	106.99 ±0.64
Feed conversion	7.19	5.13	4.39	5.57 ±0.83
2ND Period				
ITEM	Control	5%	10%	Mean ±SD
Egg mass/g	15.23	21.13	24.98	20.44 ±2.83
Egg weight/g	41.68	45.15	46.01	44.28 ±1.32
Egg production%	36.55	46.82	54.31	45.89 ±5.14
Feed intakeg/h/d	108.18	105.4	109.9	107.82 ±1.31
Feed conversion	7.1	4.98	4.39	5.49 ±0.82
Whole Period				
Item	Control	5%	10%	Mean ±SD
Egg mass/g	14.98	20.97	24.78	20.24 ±2.85
Egg weight/g	41.46	45.25	45.96	44.22 ±1.39
Egg production%	36.13	46.36	53.94	45.47 ±5.16
Feed intakeg/h/d	107.05	106.15	109.03	107.41 ±0.85
Feed conversion	7.14	5.05	4.39	5.52 ±0.82

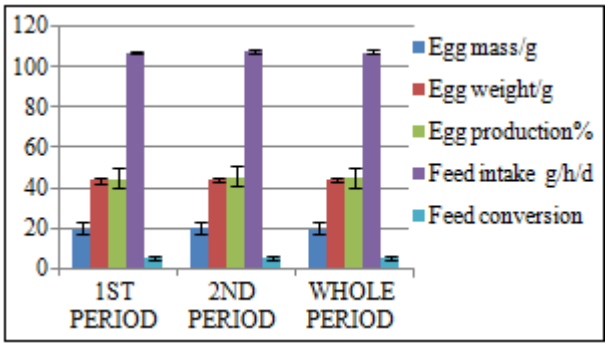

Figure 1: Graph showing Productive parameters (Mean±SD) of laying hens fed with flaxseed diet

Feeding flaxseed diet had no much significant effects on egg production during 1st and 2nd period. The production of control in both 1st and 2nd period decreased as comparison to flaxseed-fed hens. The production rate flaxseed-fed hens increased in two periods. Also feeding 10% flaxseed in the diet of laying hens supports good egg production. Our results similar with the result of (Yannakopoulos *et.al.*,1999; Bean and Leeson, 2003 and Yannakopoulos *et.al.*,2005) who found that adding flaxseed in the diet of laying hens did not significantly affect egg. (Novak and Scheideler, 2001) also found that there is no significant effect of flaxseed on egg production. However,(Scheideler and Froning, 1996;and Scheideler *et.al.*,1998) found that feeding flaxseed to laying hens improved egg production.

Furthermore, Novak and Scheideler (2001) found that adding flaxseed diet in laying hens significantly increased egg weight. During 1st and 2nd period flaxseed diet had no much effect on egg weight. Feeding 10% and 5% flaxseed in the diet of laying hens supports increase in egg weight as comparison to control egg. There is no significant difference of egg weight between treatments groups at all tested periods. These results agree with the findings of Bean and Leeson (2003) and Nain *et.al.*, (2012). The present results were not agree with Caston *et.al.*, (1994) and Schieldeler and Froning (1996), who found the decrease in egg weight with increase in flaxseed diet.

Egg mass was high in flaxseed diet fed hens and increased with increasing the flaxseed level ($P<0.05$) in table-2. Egg mass of control is lower than that of the flaxseed diet of 5% and 10% in both periods. According to Novak and Scheideler (2001), that there is no difference between 2 phases with significant diet effect, when flaxseed diet supports in increasing the egg mass compared to controls.

There is not much significant increase of feed intake of hens fed with flaxseed diet as compared to controls. There is significant differences among treatment groups were estimated, the relationship among treatment groups and 2 periods was not compatible.

It is very important to notice that the use of flaxseed diet had no harmful effects on production parameter during experiment. In general, the addition of flaxseed diets to the laying hen did not cause any negative effect on some egg quality criteria, such as shell quality, Haugh unit, egg weight as reported by Hazim *et.al.*, (2010).

Table 3: [abc]Means within the same row with different letters are significantly different ($p<0.05$)

Fatty Acid	Control	5%	10%	Mean±SE
C14:0	0.30[c]	0.60[a]	0.40[b]	0.43 ±0.08
C16:0	26.74[a]	28.89[b]	23.19[c]	25.27 ±1.07
C17:0	0.22[a]	0.10[b]	0.12[b]	0.14 ±0.03
C18:0	14.68[a]	11.89[b]	11.09[bc]	12.55 ±1.08
C20:0	0.18[bc]	0.24[a]	0.19[b]	0.2 ±0.01
Total saturated fatty acid	40.13[a]	38.71[b]	34.99[c]	37.94 ±1.53
C16:1	2.7	2.6	2.51	2.6 ±0.05
C18:1	34.08[a]	34.24[a]	33.12[b]	33.81 ±0.34
C20:1	0.15	0.18	0.2	0.17 ±0.01
C18:2	13.35	13.38	13.33	13.35 ±0.01
C18:3	0.16[c]	0.23[b]	0.29[a]	0.22 ±0.03
Total unsaturated fatty acid	50.28[ab]	50.63[a]	49.45[c]	50.12 ±0.34

Fatty acid composition of egg showed in table-3. These data agree with classical expectations (Jiang *et.al.,* 1991) and the statement about the effectiveness of the diet composition on fatty acid composition of egg (Hargis, 1988; Farrell, 1997). All the hens fed with flaxseed diets significantly decreased Palmitic acid (16:0) as compared to the control. This reduction of Palmitic acid point out health advantage for these n-3 enriched egg (Ayerza and Coates, 2000).The significant reduce in Palmitic fatty acid content of hens fed on the n-3 fatty acid enriched diets compared to control could be assigned to the high dietary intake of PUFA (Sim and Qi, 1995).

Another major saturated fatty acid named as Stearic acid (18:0), which was lower for treatment groups (5% and 10%) than the controls. In egg lipids, Oleic acid (18:1) content constitutes 90% of mono-unsaturated fatty acid. The Oleic acid content of egg yolks found more in 5% treatment group than the control. It is reported that (Baucells *et.al,* 2000) the capacity of laying hens to change the mono-unsaturated fatty acid mainly Oleic acid in yolk is limited, so it can be noticed that the proven ability of laying hens is to keep the degree of mono-unsaturated in yolk within very small margins (Alcin *et.al,* 2007).

Linoleic acid (18:2) is known as the parent compound of the n-6 family. The flaxseed diets contained no significant difference in Linoleic acid between levels of 0, 5 and 10% flaxseed treatment group. 5% flaxseed level treatment group contains higher Linoleic acid than other treatment groups. Flaxseed is very unique as it is exceptionally high content of alpha-Linolenic acid (ALA), which is essential in human diet and it is the parent fatty acid of the n-3 family (Hazim *et.al.*, 2011). ALA is converted into two fatty acid chain i.e.; eicosapentaenoic acid (EPA) and decoshexaenoic acid (DHA). Flaxseed diet may result in an excess ALA which is the forerunner of DHA & EPA in human body. Adding flaxseed in the diet f laying hens increased level of omega-3 fatty acids in eggs (Ferrier *et.al.,* 1995; Cherian and Sim, 2001; Bean and Leeson, 2003 and Yannakopoulo *et.al.,* 2005).

Linolenic acid (18:3) content of treatment group egg fed with flaxseed diet higher than that of control. Increasing flaxseed diet increases the Linolenic acid content of egg. For this purpose the increase in total n-3 fatty acids in eggs obtained from hens fed with flaxseed diet may be assigned to the rise in ALA concentration in yolk lipids, where there is lower Linolenic acid content was found in control group hens. These results are agree with Jiang *et.al.,*1991; Cherian and Sim, 1991 and Beynen, 2004), who found a significant reduction in the fatty acid content in the eggs of laying hens whose flaxseed fed diet compared to controls. The advantages of adding flaxseed in the egg diet of laying hens on increasing levels ofomega-3 fatty acid in egg yolk. Lewis *et.al.* (2000) reported that consuming omega-3 enriched eggs have positive effect and there is no negative effect.

However, any interchange in the composition fatty acid of the egg (increase in n-3 fatty acids and decease in n-6 fatty acids) resulted in large depletion in the n-3 ratio. Whereas, total saturated fatty acid was decreased in all treatment group as comparison to control.

On the whole, an increased in Alpha linolenic fatty acid content of the diet increased the fatty acid of the egg yolk. ALA enriched flaxseed diets produced lower n-6:n-3 ratios as compared with the control diets.

4. Conclusion

In conclusion, this study indicated that the addition of flaxseed in the diet of laying hens improved some amount of production, quality of egg and fatty acid content of the egg yolk. In general, it increased unsaturated and omega-3 fatty acid which is beneficial for human health.

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