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Effect of feeding powdered *Nigella sativa* L. seeds on poultry egg production and their suitability for human consumption

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ABSTRACT

The effect of Kalongi (*Nigella sativa,* L.) seeds was studied on the performance of layers and cholesterol contents of their egg-yolks. A total of 96 White-Leghorn birds of 40 weeks of age and at the egg-laying stage were randomly divided into 12 experimental units, eight birds in each unit. These units were randomly allotted to four treatments in such a way that each treatment received 3 experimental units. Four test rations were prepared by supplementing a commercial layer-ration with powdered Kalongi seeds at the rates of 0.0, 0.5, 1.0 and 1.5%. Effects of feeding these rations on feed intake, egg production, egg mass, egg shell thickness, Haugh unit, yolk index, blood spots, meat spots and total cholesterol in eggs were determined after a period of 12 weeks. Blood samples of the two birds selected at random from each replicate were taken at 0, 6 and 12 weeks. The serum obtained from these samples was analyzed for total cholesterol, low-density lipoproteins, high-density lipoproteins and triglycerides. Data on feed intake, feed refused and egg production were used to calculate the feed conversion ratio. Results showed that *Nigella sativa* seeds significantly ($P<0.05$) increased egg production, egg mass, egg-shell thickness and Haugh unit. However, there was no significant ($P>0.05$) change in yolk index, blood and meat spots. The *Nigella sativa* seeds also significantly ($P<0.05$) reduced yolk cholesterol contents. The serum triglycerides, low-density lipoprotein, cholesterol and total cholesterol levels were also reduced, while serum high-density lipoprotein cholesterol level was increased by supplementing the commercial layer-ration with *Nigella sativa* seeds.

Key words: *Nigella sativa*, Kalongi, White-Leghorn, yolk cholesterol, serum lipids, egg

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Introduction

The poultry industry has been considered as the second largest industry in Pakistan. This sector has not only provided best quality, low cholesterol meat but also highly nutritious eggs to consumers. Poultry meat is lower in cholesterol than red meat but poultry eggs have a high concentration of cholesterol, i.e. 213 mg per egg (ANONYMOUS, 1989). Normally, a person is able to consume about 300 mg. of dietary cholesterol per day to avoid the risks associated with coronary heart disease (ANONYMOUS, 1986). This has necessitated a drastic reduction or even elimination of egg intake in the human diet in order to stay below the recommended level. The high cholesterol level in eggs has been a possible contributory factor to the decrease their consumption.

There is a well-known religious instruction which goes as follows: "There exists in the black seed (Kalongi) health and a cure for all diseases, except death" (BUKHARI, 1985). The black seed (*Nigella sativa*), also called Kalongi, has been used in pickles and for the treatment of stomach diseases since ancient times. It has also been traditionally used as a stimulant, diuretic, carminative, stomachic, emmenagogue, galactagogue, and in the treatment of mild fever and scorpion stings (KHAN and CHOUDHURI, 1998).

Kalongi seeds have been reported to possess a favourable effect on serum lipid profile by decreasing its total cholesterol, low density lipoprotein, triglycerides and by elevating the high density lipoprotein level (EL-DAKHAKHNY et al., 2000). Administration of seed oil has decreased serum cholesterol and total lipids in rats (BASHANDY, 1996). EL-AYEK et al. (1999) substituted the concentrate feed mixture with *Nigella sativa* meal in growing lambs and reported that the meal could provide 50% of proteins without producing adverse effects on their performance. They concluded that the meal could be used as a relatively good source of energy and protein supplement in diets of ruminants. SOLIMAN et al. (1999) studied the synergistic effect of feeding black seeds and garlic on broiler performance and immunity. Their results showed that using 0.3% black seeds in broiler diets improved the development of immunity. However, there was no significant effect on performance parameters due to the addition of black seed when compared to the control diet. In the present study the effects of feeding rations supplemented with powdered Kalongi seeds on poultry

egg production and their quality for human consumption were determined after a period of 12 weeks.

Materials and methods

This study was conducted at the Poultry Research Centre, University of Agriculture, Faisalabad. Ninety-six White-Leghorn layers aged 40 weeks and of approximately the same body mass were divided into 12 experimental units/replicates (8 birds per replicate). These units were randomly distributed among four treatments (3 replicates per treatment).

Feed was purchased from a commercial feed mill and was analyzed for its proximate analysis composition (A.O.A.C.: Official Methods of the Analysis. Association of Official Analytical Chemists. Washington D.C.20044. USA, 1990). Kalongi (*Nigella sativa* L.) seeds were purchased from the local herbal market and after grinding they were mixed in the commercial layer ration at rates of 0.0, 0.5, 1.0, and 1.5%. An adjustment period of two weeks was provided and the treatments were then given for a period of 12 weeks.

Eggs were collected and weighed daily. Data on feed intake and refuse were collected weekly. Live body mass of birds were taken bi-weekly. Egg production, feed conversion ratio, egg shell thickness, Haugh Unit, yolk index, blood spots, meat spots and egg-yolk total cholesterol levels were determined bi-weekly.

Blood samples of two birds selected at random from each replicate were taken at 0, 6 and 12 weeks. Serum was analyzed for total cholesterol, low-density lipoprotein, high-density lipoprotein and triglyceride content. Finally, the economics of each treatment was also calculated. Data thus obtained were analyzed by using analysis of variance technique under completely randomized design with factorial arrangement of time and treatments. The significance of differences between the treatments was calculated by the Least Significance Difference Test (STEEL and TORRIE, 1986).

Results and discussion

Egg production. It was observed that supplementation of the layer-ration with *N. sativa* (Kalongi) seeds significantly increased egg production, as egg production of the control group was 4.10 v 5.39 eggs /bird/week for

the group treated with 1.5% Kalongi seeds. Production might have been enhanced by the presence of some active principles(s) and a number of valuable nutrients contained in the seeds which improve the health status as well as reproductive performance of birds and could have thus increased egg production. These results are in close agreement with those of EL-SHEIKH et al. (1998), who have also recommended the use of Kalongi seeds in layer-rations due to having obtained similar results. Similarly, better egg production was obtained by using Kalongi seeds in layer-ration by EL-GHAMRY et al. (1997).

Egg mass. Our data have also showed that supplementation of layer-ration with Kalongi seeds increased egg mass from 229.9 to 303.6 g/bird/week. This might be due to the availability of a large number of specific nutrients from the seeds that have resulted in better reproductive performance and egg production. Similar results have been obtained by EL-GHAMRY et al. (1997) and EL-SHEIKH et al. (1998) with the supplementation of these seeds to layer birds.

Mortality. The results obtained further showed that mortality rate decreased from 16.67 to 4.17% by supplementation of layer-ration with Kalongi seeds. These seeds have also been reported to improve immunity due to the presence of pharmacologically active constituents, e.g. thymoquinone, dithymoquinone, thymohydroquinone, thymol, nigellicine, nigellimine and nigellidine (OSMAN and EL-BARODY, 1999). Similar results were obtained by ABDUR-REHMAN and ABU-BAKAR (1997), who studied the effect of Kalongi seed meal on turkey poults. They observed that Nigella has a potential as an alternative to antibiotics and vaccination to improve immunity and to reduce mortality in poultry birds. Similar results were obtained by EL-GHAMRY et al. (1997), EL-SHEIKH et al. (1998), OSMAN and EL-BARODY (1999) and SOLIMAN et al. (1999).

Feed conversion ratio. The results of the present study also showed that inclusion of Kalongi seeds in layer- ration improved FCR/dozen eggs from 1.97 to 1.50 and FCR/kg egg mass from 2.90 to 2.22. Similar results have also been obtained by EL-GHAMRY et al. (1997) and EL-SHEIKH et al. (1998) in layers; OSMAN and EL-BARODY (1999) and SOLIMAN et al. (1999) in broilers; MANDOUR and RADY (1997) in ducklings and ABDUR-REHMAN and ABU-BAKAR (1997) in turkey pullets.

Body mass. The results of the present study also indicated that Nigella supplementation in layer-ration decreased body mass significantly. Since increase in body mass of layers is negatively correlated with egg production, reduction of body mass in layers by supplementation is considered a favourable factor in increasing egg production. Our findings are again similar to EL-SHEIKH et al. (1998), who have also recommended the use of *N. sativa* seeds in layer-ration.

Physical properties of eggs. The effects of rations supplemented with varying concentrations of Kalongi seeds on physical properties of eggs are given in Table 1.

Table 1. Effects of rations containing varying concentrations of Kalongi seeds on physical properties of eggs (means ± SD)

Treatments (rations)	Egg weight (g)	Egg shell thickness (mm)	Albumin quality (Haugh units)	Egg yolk index
T_1 (0.0% Kalongi seeds)	54.92 ± 3.39 [b]	0.32 ± 0.01 [b]	0.740 ± 0.010 [b]	0.42 ± 0.01 [b]
T_2 (0.5% Kalongi seeds)	57.09 ± 2.52 [a]	0.34 ± 0.02 [a]	0.747 ± 0.010 [a]	0.43 ± 0.01 [a]
T_3 (1.0% Kalongi seeds)	57.00 ± 1.28 [a]	0.33 ± 0.01 [a]	0.745 ± 0.114 [ab]	0.43 ± 0.01 [a]
T_4 (1.5% Kalongi seeds)	58.46 ± 2.68 [a]	0.34 ± 0.01 [a]	0.750 ± 0.014 [a]	0.43 ± 0.01 [a]
Overall mean	56.86 ± 2.83	0.33 ± 0.02	0.745 ± 0.002	0.42 ± 0.01

Values with different superscripts in a column differ significantly ($P<0.05$)

Egg mass. This study showed that supplementation of layer-ration with Kalongi seeds improved egg mass significantly ($P<0.05$). The eggs produced by T1 (0 % seed) weighed 54.92 g while those produced by T_4 (1.5% seed) weighed 58.46 g. EL-SHEIKH et al. (1998) have also recommended use of Nigella seeds in layer-rations, but EL-GHAMRY et al. (1997) found a non-significant change in egg mass by feeding the seed meal and rice polishings.

Egg shell thickness. It was found that egg shell thickness was significantly increased by supplementation of the seeds in layer-ration.

This may be due to the presence of the ample amount of calcium contained in them. These findings are in line with the study by EL-SHEIKH et al. (1998), who found a non-significant change in egg-shell thickness, but have recommended its use in layer-ration.

Albumin quality. The results of the present study showed that inclusion of Kalongi seeds in feed improved albumin quality. Similar results were found by EL-SHEIKH et al. (1998), who studied the effect of Kalongi seeds on layer performance and egg quality characteristics, although EL-GHAMRY et al. (1997) observed no significant effect of feeding Kalongi seeds meal and rice polishings on egg quality.

Yolk index. The results also showed that Kalongi seed supplementation did not increase the yolk index significantly (P>0.05). Similar results were obtained by EL-SHEIKH et al. (1998) and EL-GHAMRY (1997).

Chemical constituents. The effects of rations supplemented with varying concentrations of Kalongi seeds on chemical constituents properties are given in Table 2.

Table 2. Effects of rations containing varying concentrations of Kalongi seeds on chemical constituents (means SD)

Treatments (rations)	Egg yolk cholesterol (mg/dl)	Serum triglycerides (mg/dl)	Serum total cholesterol (mg/dl)	Serum HDL cholesterol (mg/dl)	Serum LDL cholesterol (mg/dl)
T_1 (0.0% Kalongi seeds)	227.62 ± 15.29 [a]	941.4 ± 60.2 [a]	306.1 ± 64.6 [a]	22.11 ± 3.18 [c]	161.89 ± 10.45 [a]
T_2 (0.5% Kalongi seeds)	205.92 ± 15.41 [b]	923.6 ± 16.1 [ab]	296.6 ± 19.9 [a]	29.33 ± 5.94 [b]	139.40 ± 16.88 [b]
T_3 (1.0% Kalongi seeds)	203.42 ± 11.78 [b]	915.7 ± 13.5 [ab]	283.1 ± 21.6 [a]	24.67 ± 5.07 [c]	134.67 ± 13.40 [b]
T_4 (1.5% Kalongi seeds)	199.72 ± 18.55 [b]	896.9 ± 33.7 [b]	231.0 ± 54.9 [b]	33.77 ± 7.15 [a]	71.22 ± 54.69 [c]
Overall mean	209.17 ± 18.67	919.4 ± 38.1	279.4 ± 51.8	27.47 ± 6.96	126.81 ± 44.53

Values with different superscripts in a column differ significantly (P<0.05)

Egg-yolk cholesterol. Results of the present study showed that egg-yolk cholesterol was decreased significantly (P<0.05) by supplementation of Kalongi seeds in layer-ration. Supplementation of 1.5% Kalongi seeds

in layer- rations resulted in 199.72 mg/egg-yolk cholesterol compared to 227.63 mg/egg from birds fed control ration. Liver is the organ that regulates the deposition of lipids and phospholipids in egg-yolk (BELL and FREEMAN, 1971). Since liver and serum cholesterol are decreased by supplementation of Kalongi seeds, deposition of cholesterol in egg-yolk may also be decreased. Thus, the decrease in egg-yolk cholesterol by supplementation of Kalongi seeds may be due to a lesser deposition of cholesterol by liver in egg-yolk during yolk synthesis. However, further investigation may serve to clarify the underlying mechanism.

Serum triglycerides. Results showed that Kalongi seed supplementation in layer-rations reduced their serum triglyceride level from 941.4 to 896.9 mg/dl ($P<0.05$).

These findings are in agreement with those reported by TAYYAB et al. (1995) and CHAUDARY et al. (1996), who concluded that supplementation of Kalongi seeds in diets of rats decreased their serum triglyceride level significantly. Similar results were obtained by BADARI et al. (2000) while studying the effect of thymoquinone on serum triglycerides in rats.

Serum total cholesterol. The present study revealed that supplementation of powdered Kalongi seeds in layer-rations decreased serum total cholesterol level. Feeding with a diet containing 1.5% Kalongi seeds resulted in the lowest ($P<0.05$) serum total cholesterol level. The presence of a high percentage of monounsaturated fatty acids (MUFA) in Kalongi seeds may have favourable effect, either alone or in combination with other factors, on synthesis of cholesterol in liver (EL-DAKHAKHNY et al., 2000). The decrease in serum total cholesterol by supplementation of Kalongi seeds showed the cholerectic activity of these seeds, as reported by EL-DAKHAKHNY et al. (2000). The cholerectic function may be caused either by reducing the synthesis of cholesterol by hepatocytes or by decreasing its fractional reabsorption from the small intestine and thus lowering the serum cholesterol level (BRUNTON, 1999).

Our findings are in agreement with those reported by TAYYAB et al. (1995) and CHAUDARY et al. (1996). These workers showed that Kalongi seed supplementation in diets of rats reduced serum total cholesterol level. Similar results were obtained by HUSSAIN and HASSAN (1996) while studying the effect of the seeds on rats. Similar results were obtained by BADARI et

al. (2000) with thymoquinone on the serum total cholesterol in rats.

Serum HDL-cholesterol. In the present study, supplementation of Kolangi seeds increased serum HDL-c significantly ($P<0.05$) from 22.11mg/dl in control to 33.77 mg/dl in T_4. Our results are in agreement with CHAUDARY et al. (1996), who observed that Kalongi seed supplementation to rats increased their HDL-c level.

Serum LDL-cholesterol. Supplementation of Kalongi seeds decreased serum LDL-c significantly ($P<0.05$). The control group showed 161.89 mg/dl LDL-c as compared to 71.22 mg/dl which resulted by inclusion of 1.5% Kalongi seeds in layer-ration. The decrease in serum LDL-c by supplementation of Kalongi seeds showed cholerectic activity of *Nigella sativa*, as reported by EL-DAKHAKHNY et al. (2000), LDL-c level may be decreased by increasing the production of LDL-c receptors (CHAUDARY et al., 1996).

Our results are in agreement with CHAUDARY et al. (1996) and TAYYAB et al. (1995), who observed that Kalongi seed supplementation to rats decreased their LDL-c level.

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SAŽETAK

Istražen je učinak hranidbe sjemenkama uzgojene crnjike *Nigella sativa* L. na proizvodnju jaja i sadržaj kolesterola u žumanjku. Istraživanje je provedeno na 96 nesilica bijele leghorn pasmine u dobi 40 tjedana podijeljenih u 12 skupina po 8 jedinki. Nesilice su ovisno o skupini bile hranjene hranom koja je sadržavala 0,0%, 0,5%, 1,0% i 1,5% usitnjenih sjemenki. U razdoblju od 12 tjedana praćene su sljedeće odrednice: količina i konverzija uzete hrane, proizvodnja jaja, težina jajeta, debljina ljuske jajeta, Haughova jedinica, indeks žumanjka, krvne mrlje, mesne mrlje i ukupni kolesterol u jajetu. Praćene su i serumske vrijednosti u dvije nesilice iz svake skupine i to: ukupni kolesterol, lipoproteini niske gustoće, lipoproteini visoke gustoće i trigliceridi. Iz dobivenih vrijednosti se može zaključiti da je hranidba usitnjenim sjemenkama crnjike značajno utjecala na povećanje ($P<0,05$) nesivosti, težinu jajeta, debljinu ljuske jajeta te vrijednosti Haughove jedinice. U nesilica nisu potvrđene značajnije razlike ($P>0,05$) u odnosu na indeks žumanjka te prisutnost krvnih i mesnih mrlja. U jaja nesilica hranjenih usitnjenim sjemenkama crnjike zabilježena je značajno manja količina ($P<0,05$) kolesterola. Ustanovljene su i niže razine serumskih triglicerida, lipoproteina niske gustoće i ukupnog kolesterola, dok je razina loipoproteina visoke gustoće bila povišena dodavanjem komercijalne hrane sa sjemenkama crnjike.

Ključne riječi: *Nigella sativa*, Kalongi, bijeli leghorn, kolesterol u žumanjku, serumski lipidi, jaje