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EFFECT OF GARLIC OIL SUPPLEMENTATION ON EGG YOLK LIPID PROFILE AND PERFORMANCE OF JABALPUR COLOUR BIRDS

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ABSTRACT

The present study was aimed to assess the effect of garlic (*Allium sativum*) oil on egg-yolk lipid profile and the performance of adult layer birds. Twenty four 40-weeks-old Jabalpur colour birds were fed on 4 dietary treatments (diet supplemented with 0, 250, 500 and 750 mg garlic oil kg^{-1}) for 56 days. Birds in each group were caged individually and egg production and weight recorded daily whereas body weight and feed consumption were taken on 0, 14, 28, 42 and 56^{th} day of feeding. The variation in egg-yolk total lipids, cholesterol, triglycerides, egg production and body weight between intervals within treatment were highly significant ($p<0.01$). Maximum egg production was recorded in birds fed with garlic oil @ 750 mg kg^{-1} feed whereas maximum body weight gain was observed in birds fed with garlic oil @ 250 mg kg^{-1} feed. The study revealed that supplementation of garlic oil @ 750 mg kg^{-1} feed is most effective in reducing egg-yolk lipid profile in Jabalpur colour birds.

Keywords: Cholesterol, egg yolk, garlic oil, Jabalpur colour birds, total lipid, triglycerides

INTRODUCTION

Egg is a rich source of all the essential amino acids, minerals and vitamins. Further, it contains about 200-250 mg cholesterol (Griffin, 1992) which is considered as a major source of dietary cholesterol. The fatty acid composition of egg lipids in laying hens may predictably be influenced by fatty acid composition of diet (Milinsk *et al.,* 2003). Liver of layer birds produce most of the lipids found in egg-yolk. Since lipids are transported to ovary by serum lipoproteins (Elkin, 1997), therefore a decrease in serum lipid concentration may lead to decrease in egg-yolk lipids. Production of low cholesterol eggs not only is expected not only to increase the economy of poultry industry but may also enhance the consumption of such eggs by the health conscious consumers.

Garlic (*Allium sativum)* belongs to the family *Alliaceae* and has therapeutic properties due to the presence of organosulphur compounds such as allicin, ajoene, S-allylcysteine, diallyl disulphide, S-methylcysteine sulphoxide and S-allylcysteine sulphoxide (Chi *et al*., 1982). Allicin is active compound responsible for all benefits of garlic (Lawson, 1998). Garlic reduces the hepatic activities of lipogenic and cholesterogenic enzymes such as malic enzyme, fatty acid synthase, glucose-6 phosphate dehydrogenase and 3-hydroxy-3-methyl-glutaryl-CoA (HMG-CoA) reductase (Qureshi *et al*., 1983; Youn

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et al., 1996). In view of above, the present study was undertaken to study the effect of garlic oil supplementation on egg production, body weight and egg-yolk lipid profile of Jabalpur colour birds.

MATERIALS AND METHODS

The study was conducted on 24 healthy Jabalpur colour birds (pure line developed by the *inter-se* mating of 3rd generation among the selected stock of Krishna J. Commercial Broiler/Breeder and one colour line from Poultry Breeding Farm, Adhartal, Jabalpur) of 40 weeks age. Birds were procured from All India Coordinated Research Project (AICRP) on Poultry Breeding, Adhartal, Jabalpur, MP, India. They were kept separately in individual cages and maintained under similar hygienic conditions at Poultry Farm Adhartal. The birds were randomly divided into 4 groups having 6 birds each. These groups were fed with diets supplemented with garlic oil @ 0, 250, 500 and 750 mg kg^{-1}. The basal diet consisted of 2700 Kcal ME kg^{-1} and 17% protein. Six eggs were collected from each group on 0th, 14th, 28th, 42th and 56th day of feeding. Egg-yolk total lipids were extracted as per Folch *et al.* (1957) and estimated as per Frings *et al.* (1972). The egg yolk cholesterol and triglycerides were estimated by standard diagnostic kits (Erba). All the birds were weighed individually using a hanging double dial balance for observing change in body weights on 0th, 14th, 28th, 42th and 56th day of feeding. The egg production, egg weight and feed consumption were recorded at 2 week's interval in different treatment groups of birds. The data obtained was analyzed using hierarchical analysis of variance (Steel and Torrie, 1992).

RESULTS AND DISCUSSION

The variations in egg-yolk total lipids, triglycerides and cholesterol at various time intervals within treatments were highly significant ($p<0.01$) whereas those between treatments within group were significant ($p<0.05$), except for egg-yolk triglycerides. The reduction in egg yolk total lipids was 22.96% in birds fed with 250 mg garlic oil kg^{-1} diet on 56th day of experiment whereas it was 31.15 and 42.12% in birds fed with 500 and 750 mg garlic oil kg^{-1} diet, respectively (Table 1). No significant change was observed in control. Similar pattern of reduction in egg-yolk total lipids has been reported by Hebbar (2010) on dietary supplementations consisting of five plants, *A. sativum, Cuminum cyminum, Terminalia arjuna, cinnamon* and *Tinospora cordifolia* in the ratio of 3:2:2:2:1 @ 4500 mg kg^{-1} feed in adult layer birds.

Table 1: Effect of garlic oil supplementation in diet on egg-yolk total lipids (mg g^{-1}) of Jabalpur colour birds (mean ± SE; n = 6)

Garlic oil	Feeding period (days)					
(mg kg^{-1} feed)	0	14	28	42	56	Mean
0	314.29 ±5.47	314.89 ±1.02	311.63 ±2.30	313.76 ±1.97	313.49 ±3.29	313.61 ±2.81
250	315.11^{a} ±2.23	308.83^{a} ±2.61	295.64^{b} ±3.66	274.07^{c} ±3.41	242.76^{d} ±1.35	287.28 ±2.65
500	317.05^{a} ±3.38	306.77^{b} ±1.94	285.06^{c} ±3.96	261.94^{d} ±2.14	218.28^{e} ±2.08	277.82 ±2.70
750	312.82^{a} ±1.79	299.19^{b} ±2.91	265.55^{c} ±3.05	232.16^{d} ±1.84	181.06^{e} ±4.85	258.15 ±2.88
Mean	314.81 ±3.22	307.42 ±2.12	289.47 ±3.24	270.48 ±2.34	238.89 ±2.89	284.21 ±2.76

Mean values with different superscripts in a row vary significantly ($p< 0.01$)

The egg-yolk cholesterol was reduced by 22.75, 29.60 and 35.61% in birds fed with 250, 500 and 750 mg garlic oil kg^{-1} diet, respectively, on 56th day of experiment (Table 2). Chowdhury *et al.* (2002) observed 5-24% reduction in yolk cholesterol of laying hens when fed on diets supplemented with garlic paste. Khan *et al*. (2008) observed a significant reduction in egg yolk cholesterol concentration with increasing level of oven-dried garlic powder from 0 to 8% in native desi-layers for 6 weeks.

Table 2: Effect of garlic oil supplementation in diet on egg yolk cholesterol (mg g^{-1}) of Jabalpur colour birds (mean ± SE; n = 6)

Garlic oil	Feeding period (days)					
(mg kg^{-1} feed)	0	14	28	42	56	Mean
0	17.47 ± 0.19	17.98 ± 0.39	17.72 ± 0.23	17.68 ± 0.29	17.95 ± 0.20	17.76 ± 0.26
250	17.40^{a} ± 0.14	16.32^{b} ± 0.17	15.61^{b} ± 0.13	14.71^{c} ± 0.21	13.44^{d} ± 0.13	15.49 ± 0.15
500	17.33^{a} ± 0.19	16.93^{a} ± 0.24	15.36^{b} ± 0.21	14.33^{c} ± 0.19	12.20^{d} ± 0.32	15.23 ± 0.23
750	17.41^{a} ± 0.15	16.86^{a} ± 0.12	15.22^{b} ± 0.18	13.96^{c} ± 0.28	11.21^{d} ± 0.09	14.93 ± 0.16
Mean	17.40 ± 0.16	17.02 ± 0.23	15.97 ± 0.18	15.17 ± 0.24	13.70 ± 0.17	15.85 ± 0.19

Mean values with different superscripts in a row vary significantly ($p<0.01$)

Like egg-yolk total lipids and cholesterol, triglyceride values were reduced in birds fed with all the preparations in all the treatments in a dose-dependent manner (Table 3). The reduction was 16.76, 17.94 and 22.13% in birds fed with 250, 500 and 750 mg garlic oil kg^{-1} diet, respectively, on 56^{th} day of experiment. Hebbar (2010) reported 19.19% reduction in egg yolk triglyceride values on supplementing the diet by a polyherbal preparation.

Table 3: Effect of garlic oil supplementation in diet on egg-yolk triglyceride (mg g^{-1}) in Jabalpur colour birds (mean ± SE; n=6)

Garlic oil	Feeding period (days)					
(mg kg^{-1} feed)	0	14	28	42	56	Mean
0	181.09^{b} ± 1.14	180.36^{b} ± 0.72	181.58^{b} ± 1.44	183.27^{a} ± 1.69	180.91^{b} ± 1.43	181.44±1.28
250	184.51^{a} ± 0.89	178.45^{b} ±1.57	168.98^{c} ± 1.64	158.84^{d} ± 1.77	153.59^{e} ±1.28	168.87±1.43
500	185.73^{a} ±0.64	180.77^{b} ± 1.74	171.39^{c} ± 1.75	162.15^{d} ± 0.62	152.40^{e} ± 0.96	170.48±1.14
750	186.80^{a} ± 0.61	176.46^{b} ± 1.21	165.56^{c} ± 0.75	155.46^{d} ± 1.31	145.46^{e} ± 0.88	165.94±0.95
Mean	184.53±0.82	179.01±1.31	171.87±1.39	164.93±1.34	158.09 ± 1.13	171.68±1.19

Mean values with different superscripts in a row vary significantly ($p<0.01$)

The variations in body weight and egg production between intervals within treatments were highly significant ($p<0.01$) whereas those between treatments within group were significant ($p<0.05$). In the present study, no significant change was observed in control group birds. The increase in body weight was 29.21, 16.01 and 16.82% in birds fed with 250, 500 and 750 mg garlic oil kg^{-1} diet, respectively, on 56^{th} day of experiment (Table 4). The increase in egg production was 17.14, 23.51 and 35.27% in birds fed with 250, 500 and 750 mg garlic oil kg^{-1}, respectively, between 43-56 day of experiment (Table 5). Results corroborate with the finding of Chowdhury *et al.* (2008) who found significant increase in body weight of male guinea pigs after 30 days supplementation of garlic in their diet. Khan *et al.* (2008) also reported that 0, 2, 6 and 8% oven-dried garlic powder for 6 weeks had better effects on layer performance.

Table 4: Effect of garlic oil supplementation in diet on body weight (g) of Jabalpur colour birds under various treatments and durations (mean ± SE; n = 6)

Garlic oil	Feeding period (days)					
(mg kg^{-1} feed)	0	14	28	42	56	Mean
0	2025.1 ± 44.2	1998.4 ± 44.9	2083.4 ± 30.7	2040.1 ± 38.3	2093.4 ± 33.8	2048.1 ± 38.4
250	1839.3^{e} ± 20.4	1988.3^{d} ± 31.2	2130.1^{c} ± 48.4	2268.9^{b} ± 28.5	2376.8^{a} ± 40.5	2120.7 ± 33.8
500	2155.1^{c} ± 16.9	2243.3^{c} ± 19.6	2351.2^{b} ± 13.0	2423.4^{ab} ± 15.0	2500.1^{a} ± 13.7	2334.6 ± 15.6
750	1991.7^{d} ± 25.1	2046.7^{d} ± 21.2	2136.7^{c} ± 12.3	2231.7^{b} ± 14.7	2326.8^{a} ± 14.3	2146.7 ± 17.5
Mean	2002.8 ± 26.2	2069.2 ± 29.2	2175.3 ± 26.1	2241.0 ± 24.1	2324.1 ± 25.6	2162.5 ± 26.3

Mean values with different superscripts in a row vary significantly ($p< 0.01$)

Table 5: Effect of garlic oil supplementation in diet on egg production (No.) of Jabalpur colour birds (mean ± SE; n=6)

Garlic oil (mg kg^{-1} feed)	Feeding period (days)				
	0-14	15-28	29-42	43-56	Mean
0	32.2 ± 0.60	34.5 ± 0.43	33.2 ± 0.57	34.2± 0.61	33.52±0.55
250	35.0^{c} ± 0.84	37.8^{b} ± 0.80	39.5^{ab} ± 0.99	41.0^{a} ± 0.85	38.32 ± 0.87
500	37.0^{c} ± 1.14	41.8^{b} ± 0.56	42.5^{b} ± 0.96	45.7^{a} ± 1.99	41.75 ± 1.16
750	36.0^{d} ± 1.98	43.8^{c} ± 0.94	46.2^{b} ± 1.19	48.7^{a} ± 2.57	43.67 ± 1.67
Mean	35.05 ± 1.14	39.47 ± 0.68	40.35 ± 0.92	42.4 ± 1.51	34.38 ± 1.06

Mean values with different superscripts in a row vary significantly ($p<0.01$)

Egg production varied in all the treatment groups fed with 250, 500 and 750 mg garlic oil kg^{-1} feed, respectively. The egg production increased linearly with increasing levels of dietary garlic oil. As a result maximum increase (35.27%) was obtained in birds fed with 750 mg garlic oil kg^{-1}. Canogullari *et al.* (2009) also reported increased egg production in quails on 0.5 and 1% garlic powder supplementation in feed.

The variations in egg weight between intervals within treatments were significant ($p<0.05$) whereas those between treatments within group were non-significant ($p>0.05$). The maximum increase in egg weight was observed in garlic oil group supplemented with 250 mg kg^{-1} (4.48%) on 42^{nd} and 56^{th} day of treatment (Table 6). Ghasemi *et al*. (2010) reported that dietary inclusion of garlic 0, 1 and 2 g kg^{-1} feed have beneficial effects on performance of laying hens in terms of improvement in egg weight ($p\leq0.05$). Chowdhury *et al*. (2002) reported no difference in egg weight of 28 week old laying hens of different strains fed with 2, 4, 6, 8 and 10% of sun dried garlic paste for a period of 6 weeks. Results indicated that the initial feed intake in both supplementation trials was almost the same. On 56^{th} day the feed consumption decreased by 5.7% as the concentration of garlic oil was increased from 250 to 750 mg kg^{-1} feed (119.9, 119.0, 116.1 and 113.1 g day^{-1} for birds fed with 250, 500 and 750 mg garlic oil kg^{-1} feed, respectively on 56^{th} day). Chowdhury *et al*. (2002) reported decreased in feed efficiency with increasing levels of dietary garlic. Ghasemi *et al*. (2010) reported no significant effect on feed intake in laying hens.

Table 6: Effect of garlic oil supplementation in diet on egg weight (g) of Jabalpur colour birds (mean ± SE; n = 6)

Garlic oil (mg kg^{-1} feed)	Feeding period (days)				
	0-14	15-28	29-42	43-56	Mean
0	56.59 ± 0.50	57.39 ± 1.43	56.79 ± 0.57	55.35 ± 0.37	56.53 ± 0.71
250	55.31^{b} ± 0.86	55.28^{b} ± 0.54	57.72^{a} ± 0.62	57.70^{a} ± 0.42	56.50 ± 0.61
500	57.20^{a} ± 0.98	55.07^{b} ± 0.67	56.01^{ab} ± 0.47	57.30^{a} ± 0.84	56.39 ± 0.74
750	56.71 ± 0.80	55.05 ± 0.47	56.03 ± 0.61	56.05 ± 0.98	55.96 ± 0.71
Mean	56.45 ± 0.78	55.69 ± 0.77	56.63 ± 0.56	56.60 ± 0.36	56.34 ± 0.69

Mean values with different superscripts in a row vary significantly ($P< 0.05$)

Conclusions: The study revealed that garlic oil supplementation @ 750 mg kg^{-1} diet significantly improves egg production in Jabalpur colour birds between $43\text{-}56^{th}$ day of feeding. Garlic oil supplementation in diet reduced egg cholesterol level and feed consumption but increased poultry body and egg weight even at 250 mg garlic oil kg^{-1} diet. Garlic oil can be effectively used for reducing total lipids, cholesterol and triglyceride contents in egg-yolk of poultry birds and eggs from such birds can be consumed safely without the risk of cardiovascular diseases.

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