EFFECT OF DIETARY GARLIC POWDER ON THE EGG QUALITY TRAITS AND CHOLESTEROL PROFILE OF JAPANESE QUAIL EGGS

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Abstract
This experiment was conducted to investigate the effect of garlic powder on the egg quality characteristics and cholesterol level of the quail egg. A total of One hundred and eight (108) eight-week old quail hens were used for the study. The birds were randomly divided into four dietary treatments with 27 birds per treatment and further replicated three times with 9 birds per replicate in a completely randomized design (CRD) experiment. Garlic powder was incorporated into the commercially procured feed at 0, 5, 10, and 15g/kg level of inclusion. The birds were fed the diets and provided clean drinking water ad libitum. Other routine management practices were carried out as at when due. The experiment lasted for five weeks (35days). Eggs were picked on daily basis and recorded according to treatments and replicates. At the end of the experiment period, three eggs per replicate were randomly selected for internal and external egg characteristics and lipid profile analysis. The results showed that the external and internal egg characteristics were significantly ($P<0.05$) affected by the dietary treatments. In the cholesterol profile, Triglyceride and High density lipoprotein were significantly ($P<0.05$) affected by the dietary treatments whereas, Total cholesterol and Low density lipoprotein were not significantly ($P>0.05$) influenced among the treatments. Based on the results of this experiment, supplementation of garlic at 15g/kg improved the external egg traits and increased the good cholesterol (HDL) level of the eggs.

Key Words: Garlic, egg trait, cholesterol profile and quail

Introduction

The Japanese quail (*Coturnix coturnix japonica*) is one of the poultry birds introduced into Nigeria in 1992 and are kept for both meat and egg (Ezea, 1994). It is a hardy bird that can adapt easily to different environments (NRC, 1994). Its distinct characteristics includes fast growth, early sexual maturity, short generation interval, less feed and space requirement than those for chicken and high rate of lay (Thiyagasundaran, 1989).

Quail eggs contains a total of 14 calories, 1g of fat, 0.4g simple sugar, 1.17g of protein which is 2.3 percent of the daily value for protein, Vitamins and minerals such as Vitamin B12, B2, selenium, pantothenic acid phosphorus and little quantities of Vitamin A and folate are also present (Lawson, 1998). According to Lawson (1998), the cholesterol content of the quail egg is 76mg or about 25 percent of the daily value for cholesterol and this value has been a topic of debate for nutritionists who argue that the high cholesterol content of the egg can lead to increase in the cholesterol levels of the consumers. Currently, this fact has been put right by researchers; Shoetan *et al.* (1984); Qureshi *et al.* (1983) who have found out that the High Density Lipoproteins (HDL or good cholesterol) concentration of the quail egg is in a much greater ratio to the Low Density Lipoproteins (LDL or bad cholesterol). Therefore, it is a very safe protein source for both adults and children.

Garlic (*Allium sativum)* which belongs to the family *Alliaceae*, is used widely for its medical and therapeutic properties (Shoetan *et al.*, 1984). The major active ingredients of the garlic are: allicin, ajoene and s-allycystein. Nutritionally it is made up of calcium, folate, iron, magnesium, phosphorous, potassium, selenium, zinc, vitamins B1 (thiamin), B2 (riboflavin), B3 (niacin), Vit. C. (Lawson, 1998). Garlic has been found to demonstrate antimicrobial activity, lower serum and liver cholesterol and improve performances of broilers and laying hens (Fayed *et al.*, 2011). In terms of mechanism of action, it reduces cholesterol syntheses, inhibits fatty acid syntheses, platelet aggregation and prevents thrombosis (Tanamai *et al.*, 2004). Garlic has been found to lower hyperlipidemia in animal studies. It was reported in literature that chickens whose diets were supplemented with garlic powder had significant reductions of plasma and tissue cholesterol and plasma triacylglycerols (Qureshi *et al.*, 1983). Experiments carried out by Yalcin *et al.* (2006) showed that garlic powder inclusion at the level of 5 and 10 g/kg increased egg weight, decreased egg yolk cholesterol concentration as mg/g yolk, serum triglyceride and cholesterol concentrations without adverse effects on performance and egg traits of laying hens. Therefore, this study was designed to investigate

the effects of garlic powder on the egg quality characteristics and egg cholesterol level of quail hens.

Materials and Methods

Study location

The study was carried out at the poultry unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka, Nigeria. Nsukka lies in the derived savannah region. Average diurnal minimum temperature ranges from 22-24.7°C while the average minimum temperature ranges from 33-37°C. Annual rainfall ranges from 168-1700 mm (Energy Research Centre, UNN, 2011).

Experimental design and Management

A total of One hundred and eight (108) eight-week old quail hens were used for the study. The birds were randomly divided into four dietary treatments with 27 birds per treatment and further replicated three times with 9 birds per replicate in a CRD experiment. Garlic powder was incorporated into the commercially procured feed at 0, 5, 10, and 15g/kg level of inclusion. The mixture was homogenized with a mixer machine at Nsukka Feed Mill. The birds were fed with the feed and provided clean drinking water *ad libitum*. Other routine management practices were carried out as at when due. The experiment lasted for five weeks (35days). Eggs were picked on daily basis and recorded according to treatments and replicates. At the end of the experiment period, three eggs per replicate were randomly selected for internal and external egg characteristics and lipid profile analysis. The lipid profile analysis was carried out at the Department of Zoology and Environmental Science Laboratory, University of Nigeria, Nsukka.

Experimental Diet

Garlic powder at different inclusion levels was thoroughly mixed with supreme commercial layers mash. The proximate analysis of the mixed feed at different treatment levels is as follows:

Table 1: Proximate analysis of Experimental Diet

COMPOSITION	T1(control)	T2 (5g/kg)	T3 (10g/kg)	T4 (15g/kg)
Dry matter (%)	90.5	90.5	89.00	87.5
Protein	15.32	17.13	18.06	18.30
Fiber	4.5	4.5	7.5	12.5
Ash	4.0	4.3	4.5	5.0
Ether extract	6.00	6.50	6.50	6.50
NFE	60.68	62.87	51.39	45.20

NFE = Nitrogen Free Extract

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1980). Significant means were detected and separated using Duncan's New Multiple Range Test (Duncan, 1955).

Result and Discussion

The effect of garlic powder on the internal egg quality traits of quail eggs is as shown in Table 2. The result showed that albumin weight, egg height, egg width and yolk width were significantly ($P<0.05$) affected by the dietary treatments, whereas, albumin height, albumin width, yolk height, yolk weight and haugh unit were not affected ($P>0.05$). Albumin weight followed similar trend, thus, decreased as the inclusion of garlic powder increased, but yolk width varied in values. Lowest value of 5.54±0.18g and 1.93 ± 0.08mm were recorded for albumin weight and yolk width, respectively. These values were lower than 7.13±0.24 and 7.32±0.21 reported by **Yalçın *et al.* (2007) on albumin index of eggs of quail hens fed dietary garlic.** This result is in agreement with Sakine and Onbasilor (2006) who observed that the supplementation of garlic powder had no significant effect ($p> 0.05$) on the albumin index, yolk index and haugh units.

Table 2: Effect of garlic powder on the internal egg quality traits of quail eggs

Parameter	T1 (control)	T2 (5g/kg)	T3 (10g/kg)	T4 (15g/kg)	Sig
Albumin Height (mm)	3.40 ± 0.27	3.52 ± 0.12	3.32 ± 0.08	3.38 ± 0.03	NS
Albumin Weight (g)	6.30 ± 0.06^{ab}	6.50 ± 0.52^{a}	5.81 ± 0.06^{ab}	5.54 ± 0.18^{b}	**
Albumin width (mm)	2.79 ± 0.32	2.56 ± 0.08	2.63 ± 0.09	2.64 ± 0.04	NS
Egg height (mm)	3.66 ± 0.07^{ab}	3.65 ± 0.08^{ab}	3.54 ± 0.07^{b}	3.79 ± 0.04^{a}	**
Egg Width (mm)	2.83 ± 0.06^{ab}	2.83 ± 0.07^{ab}	2.68 ± 0.03^{b}	2.97 ± 0.05^{a}	**
Yolk Height (mm)	2.51 ± 0.17	2.31 ± 0.08	2.32 ± 0.18	2.29 ± 0.12	NS
Yolk Weight (g)	3.57 ± 0.06	3.52 ± 0.05	3.39 ± 0.03	3.52 ± 0.18	NS
Yolk Width (mm)	2.43 ± 0.24^{a}	1.94 ± 0.06^{b}	2.19 ± 0.06^{ab}	1.93 ± 0.08^{b}	**
Haugh Unit	106.95 ± 2.71	107.94 ± 0.16	106.25 ± 0.63	106.45 ± 0.64	NS

^{abc} Row means with different superscripts are significant ($P<0.05$), NS = not significant ($P>0.05$).

Table 3 shows the result of the effect of garlic powder on the external egg quality traits of quail eggs. The result shows that shell thickness and shell weight were not significantly affected (P>0.05) by the diets. These results are in agreement with the results of study involving laying hen fed diets supplemented with garlic powder (Yalçın *et al.*, 2006). Lim *et al.* (2006) also reported that egg shell thickness was not affected by the dietary supplementation of garlic powder. However, egg weight and egg diameter were significantly (P<0.05) affected by the diets. This was contrary to the findings of some researchers (Reddy *et al.*, 1991; Chowdhury *et al.*, 2002; Lim *et al.*, 2006) who found that garlic products had no effect on egg weight. Also, Safaa (2007) indicated that egg weight and production performance were not affected by 2% garlic inclusion. These differences may be due to the use of different commercial garlic products and the preparation methods of garlic powder.

Table 3: Effect of garlic powder on the external egg quality traits of quail eggs

Parameter	T1 (control)	T2 (5g/kg)	T3 (10g/kg)	T4 (15g/kg)	Sig
Egg weight (g)	11.35 ± 0.55^{a}	10.43 ± 0.13^{ab}	10.21 ± 0.33^{b}	10.02 ± 0.12^{b}	**
Egg Diameter (mm)	1.42 ± 0.03^{ab}	1.42 ± 0.03^{ab}	1.34 ± 0.02^{b}	1.48 ± 0.02^{a}	**
Shell Weight (g)	1.25 ± 0.14	1.28 ± 0.11	1.03 ± 0.33	1.17 ± 0.10	NS
Shell Thickness (mm)	2.07 ± 0.06	2.31 ± 0.16	2.41 ± 0.16	2.30 ± 0.27	NS

^{abc} Row means with different superscripts are significant (P<0.05), NS = not significant (P>0.05).

The effect of garlic powder on the egg cholesterol content of the quail eggs are shown in Table 4. The result showed that total cholesterol and low density lipoproteins were not significantly affected (P>0.05) by the dietary inclusion of garlic powder across the treatments. This in agreement with Reddy *et al.* (1991) who found that 0.2 g/kg garlic oil in the diets of laying hens did not significantly reduce total plasma cholesterol, but contradicts the finding of Konjufca *et al.* (1997) who reported reduction in the activities of HMG-CoA reductase and cholesterol 7α-hydroxylase in broilers fed garlic. However, high density lipoprotein (good cholesterol) and triglyceride were significantly (P<0.05) affected by inclusion of garlic powder in the diets of the quail hens. This is not in agreement with Yalçın *et al.* (2007) who reported that adding 5 and 10 g/kg garlic powder to the laying quail diets reduced egg yolk cholesterol and blood serum cholesterol concentration significantly; rather, it agreed with Matthew (2014) who found that supplementation of garlic in quail's diets reduced the level of triglyceride in the eggs. Triglycerides are esters formed from glycerol and three fatty acid groups they are the main constituents of natural fats and oil. The slight increase in level of HDL over LDL in is a proof that garlic inclusion in diets of laying hens improves the cholesterol content of the eggs. This fact supports earlier researchers: Shoetan *et al.* (1984); Qureshi *et al.* (1983) who have found out that the High Density Lipoproteins (HDL or good cholesterol) concentration of the quail egg is in a much greater ratio to the Low Density Lipoproteins (LDL or bad cholesterol).

Table 4: Effect of garlic powder on the cholesterol profile of quail eggs

Parameter	T1 (control)	T2 (5g/kg)	T3 (10g/kg)	T4 (15g/kg)	Sig
TC(mg/dl)	103.69±20.78	117.25±27.90	117.36±18.84	120.17±15.79	NS
HDL(mg/dl)	6.36 ± 0.81^{b}	7.90 ± 0.44^{ab}	7.88 ± 0.47^{ab}	9.39 ± 0.42^{a}	**
LDL(mg/dl)	10.09±0.36	9.59±1.35	7.78±0.66	8.16±0.47	NS
TG(mg/dl)	$2.39^{ab} \pm 0.15$	$2.92^{a} \pm 0.06$	$2.02^{ab} \pm 0.33$	$2.03^{b} \pm 0.16$	**

^{abc} Row means with differe nt superscripts are significant(p<0.05) . Where HDL= High density lipoprotein, LDL= low density lipoprotein, TG=Triglyceride, TC=Total cholesterol.

Conclusion

It is concluded that garlic powder can be included in diets for laying quails at the levels of 5 or 10 and 15g/kg without any adverse effect on the external and internal egg quality traits. The main important result of dietary garlic powder supplementation is the significant reduction of low density lipoprotein and increase in high density lipoprotein (good cholesterol) eggs of laying quails.

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