



**RESEARCH ARTICLE**

## **Evaluation of the Effect of Vitamin C on Egg Yolk and Serum Cholesterol Levels of Layers**

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### **ABSTRACT:**

Eggs are highly nutritious however the challenge of cholesterol has been a major concern for human consumption. The effects of graded levels of vitamin C on yolk, serum and cholesterol levels of layers were tested. Eighty (80) Isa brown layers of 28 weeks old were used for this study. The hens were grouped into 4 treatments namely T<sub>1</sub>(control), T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> with 0, 100, 150 and 200 mg vitamin C respectively in commercial layer mash. Both feed and water were given ad libitum. At 32 and 36 weeks of age, 6 eggs from each group were selected and broken to separate the yolk from the albumen for cholesterol analysis, likewise, 6 hens from each group were bled and the sera analysed for cholesterol level. Data obtained were analysed statistically using one –way ANOVA. Vitamin C reduced yolk and serum cholesterol levels (P<0.05). Serum cholesterol levels in mm/mol were T<sub>1</sub> = 3.86, T<sub>2</sub> = 3.62, T<sub>3</sub> = 2.92 and T<sub>4</sub> = 1.12 while yolk cholesterol for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were 105.25, 61.47, 48.66 and 37.75 mm/mol respectively. Vitamin C supplementation in layers' feed was beneficial to the hens since it also helped in producing low cholesterol eggs for human consumption with very levels.

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**Keywords:** *Cholesterol, Layers, Vitamin C, Egg Yolk*

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### **INTRODUCTION**

Eggs have been described as the nature's complete food that contains the basic dietary needs of man. Poultry eggs contribute to the palatability of many dishes and have also attained industrial importance as a major ingredient in the baking of confectioneries and the use of egg albumen in the making of shampoo and book binding (Rahman and Yakubu, 2005).

The use of vitamins supplementation in the diets of laying birds to control effects of heat stress on production performance

and egg quality have been reported (Lin *et al.*, 2002; Chung *et al.*, 2005; Ciftci *et al.*, 2005.; Ipek *et al.*, 2007; Mohiti-Asli *et al.*, 2010; Ajakaiye *et al.*, 2010; Ajakaiye *et al.*, 2011). Vitamin C (Ascorbic acid) is a water soluble antioxidant which functions in the synthesis of hydroxy-proline, an important component of collagen and thereby all connective tissues. Avian species have the inherent ability to synthesize Vitamin C (Keshavarz, 1996) therefore; this vitamin may not be required in poultry diets under normal conditions.

However, Ajakaiye *et al.* (2011) reported that usage of this vitamin far outweighs

production under praxis condition. The most significant increase in ascorbic acid demand usually takes place during acute environmental stress such as excessive hot or cool weather (Bains, 1997), and under stress condition that increase the metabolic need for this vitamin or that decrease the innate capacity of biosynthesis (Bell and Marion, 1990). Under such conditions supplementing the poultry diet with vitamin C may have a beneficial effect on performance (Pardue *et al.*, 1993; Tillman, 1993). There were several research reports that revealed improvement in shell quality, albumen quality, egg weight, egg production due to supplementing the hens' diet with vitamin C under elevated environmental temperature (Chung *et al.*, 2005; Mohiti-Asli *et al.*, 2010; Ajakaiye *et al.*, 2011).

Researchers have focused on producing eggs that do not only provide nutritional satisfaction to the consumers, but could also serve therapeutic functions. Dietary manipulation that try to reduce egg cholesterol contents and enhance concentration of essential vitamins such as vitamin A could help to produce specialized eggs referred to as "functional or diet egg" (Van Elswyk, 1997; Shakeel, 2010).

Although egg is considered a functional food (Stadelman, 1999) and is an excellent source of protein, essential lipids, vitamins and minerals (Zeidler, 2002), many people reduce their consumption of eggs because they consider that high egg cholesterol content may result into cardiovascular diseases. Over the last three decades, many researchers have been trying to reduce the egg cholesterol content by genetic selection, inclusion of drugs in the ration, or dietary manipulation of hens'

diet (Shakeel, 2010). Lipids are not easily oxidized in fresh eggs (Pike and Peng, 1985) or even during storage (Marshall *et al.*, 1994). However, the control of lipid oxidization is required to prevent the loss of nutritional values as well as to prevent the formation of toxic substances (Chow, 1992).

For this purpose, antioxidants are often used in the food industry. Vitamin A is a reliable antioxidant which has been tested successfully in several food products and can function as an effective radical trapping antioxidant as it is a very effective quencher of signal oxygen (McDowell, 1989).

Many researches have been reported with respect to the effect of large doses of vitamin C (Ajakaiye *et al.*, 2010; El-sheikh and Salama, 2010). However, the effect of vitamin C on yolk and serum cholesterol has not been established in Isa brown layers in Nigeria.

The objectives of this study were to investigate the effect of graded levels of vitamin C supplementation in feed on the cholesterol level in the egg yolk and the serum of the layers.

## MATERIALS AND METHODS

This study was carried out at the Poultry Unit of the Livestock Teaching and Research Farm of Kogi State University, Anyigba, Kogi State, Nigeria. "Anyigba, the study area is located in the derived savannah of Nigeria on latitude 7° 15'-7° 29' N and longitude 7° 11'-7° 32' E and with an average altitude of 420 meters above sea level" (Ifatimehin and Ufuah, 2006). The zone is characterized by 6 – 7 months of annual rainfall ranging from 1400 – 1500 mm and day temperature range of 25°C –

35°C with the highest temperature being in March and April.

A total of eighty (80) layers at the age of 28 weeks were used for this study. The birds were fed a commercial layers mash. They were randomly allotted to four treatments of 20 birds per treatment in a completely randomized design using a deep litter system.

The feed was supplemented with Vitamin C at 0, 100, 150 and 200 mg/kg respectively. The study lasted for 8 weeks. The layer's mash (Topfeed®) had a composition as revealed on the label as follows: Energy (minimum) - 2500 Kcal/kg ME, Crude Protein (CP) -16.50%, Fat/oil - 5.00%, Crude fibre - 6.00%, Calcium - 3.60%, available Phosphorus - 0.45%, Lysine - 0.80%, Methionine - 0.34% and Salt (minimum) - 0.30%.

Six (6) eggs per treatment were broken to evaluate the yolk cholesterol level using an auto analyser when the hens were 32 and 36 weeks old. Albumen and yolk were separated by using a sterile 10 ml syringe to suck into plain sample bottles. Egg samples were analysed for cholesterol level as described by Emmanuel *et al.* (2011).

Blood samples were collected from 6 birds per treatment via the wing vein at 32 and 36 weeks of age. Sera samples were analysed for cholesterol concentration as described by Roeschlau *et al.* (1974).

Data obtained from both the yolk and serum cholesterol were analysed statistically using one way ANOVA and the means separated using Duncan multiple range test.

## RESULTS AND DISCUSSION

The results of the effects of graded levels of vitamin C on egg yolk and serum cholesterol levels are as shown in Table 1.

From Table 1, T<sub>4</sub> with 200 mg vitamin C had a significantly lower (P<0.05) serum cholesterol level (1.12 mm/mol) than T<sub>3</sub> (2.92 mm/mol), T<sub>2</sub> (3.62 mm/mol) and T<sub>1</sub> (3.86 mm/mol). Also T<sub>3</sub> was significantly lower (P<0.05) than T<sub>2</sub> and T<sub>1</sub>, while T<sub>1</sub> (control) had the highest serum cholesterol level. The higher the vitamin C inclusion in the diet, the lower the serum cholesterol level of the hens. This is an indication that vitamin C is beneficial in maintaining the health status of the layers. The serum cholesterol level ranged from 1.12 to 3.86 mm/mol in this study.

The trend in the egg yolk cholesterol level obtained in this study was similar to the serum cholesterol level obtained such that the higher level of vitamin C supplement gave lower yolk cholesterol level (P<0.05). T<sub>4</sub> and T<sub>3</sub> were significantly lower (P<0.05) than T<sub>2</sub> with values ranging from 37.75 for T<sub>4</sub> to 105.25 (mm/mol) for T<sub>1</sub>.

The results of this study is in agreement with the findings of Sanda (2015) who worked with layers using waterleaf (*Talinum triangulare*) mucilage and reported that the groups with the mucilage had reduced cholesterol levels than the control. Waterleaf is reported to be highly rich in Vitamin C (Leung *et al.*, 1968).

The results of the serum and yolk cholesterol levels of vitamin C – fortified layers obtained in this study are in agreement with the findings of Sahin *et al.* (2003) and Mohiti- Asli *et al.* (2007). It also agreed with the findings of Ajakaiye *et al.* (2011) who reported that vitamin C supplementation caused a decline of 13 to

37% in serum and yolk cholesterol levels of laying hens.

#### CONCLUSION AND RECOMMENDATIONS

The reduction in cholesterol levels indicated that ascorbic acid could be used as a nutritional tool to reducing egg cholesterol level thus producing 'functional' egg for healthy human consumption. It is recommended that higher levels of Vitamin C be used in further research studies.

#### CONFLICT OF INTERESTS

The authors declare no conflict of interests.

#### CONTRIBUTION OF AUTHORS

SME was responsible for experimental and project design and made conceptual contributions. SA performed most of the experiments and prepared the samples and calculations. All authors read and approved of the final manuscript.

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**Table 1: Mean Cholesterol Levels in Eggs and Sera of Layers supplemented with Vitamin C**

| Traits<br>(mm/mol)  | T <sub>1</sub><br>(0 mg) | T <sub>2</sub><br>(100 mg) | T <sub>3</sub><br>(150 mg) | T <sub>4</sub><br>(200 mg) | SEM   | LOS |
|---------------------|--------------------------|----------------------------|----------------------------|----------------------------|-------|-----|
| Serum Cholesterol   | 3.86 <sup>c</sup>        | 3.62 <sup>c</sup>          | 2.92 <sup>b</sup>          | 1.12 <sup>a</sup>          | 0.23  | *   |
| Albumen Cholesterol | ND                       | ND                         | ND                         | ND                         | -     | NS  |
| Yolk Cholesterol    | 105.25 <sup>c</sup>      | 61.47 <sup>b</sup>         | 48.66 <sup>ab</sup>        | 37.75 <sup>a</sup>         | 17.66 | *   |

a,b,c = Means with different superscripts across the same row show significant difference

NS = not significant, ND = not detected, \* = Significantly different at P < 0.05

SEM = Standard Error of Means, LOS = Level of Significance