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ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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# Effect of Garlic (*Allium sativum* L.) and Ginger (*Zingiber officinale* Roscoe) Mixtures on Performance Characteristics and Cholesterol Profile of Growing Pullets

O. Bamidele[1] and I.O. Adejumo[2]
[1]Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria
[2]Department of Animal Science, Landmark University, P.M.B. 1001, Omu-Aran, Kwara State, Nigeria

**Abstract:** Animal products, especially poultry products are relatively affordable and accessible sources of protein in human diets. However, the risk of cholesterol accumulation in the blood stream as well as its associated diseases has placed a constraint on the consumption of poultry products. Cholesterol aids metabolic and biochemical functions of the body but is potentially unhealthy at increased levels. Dietary therapy has been recommended as a major remedy for cardiovascular diseases as well as other cholesterol-related diseases. Hence, the study assessed the combined effect of garlic and ginger mixtures on the cholesterol profile of growing pullets. The results of the study revealed that garlic and ginger mixtures at the supplemented levels significantly ($p<0.01$) reduced the total cholesterol and Low-Density Lipoprotein (LDL) cholesterol of the growing pullets. The mixtures however had no significant ($p>0.05$) effect on growth performance and is also considered non toxic as shown by the White Blood Cell (WBC) count. The experimental diets containing 1.00% garlic and 0.50% ginger mixtures and 2.00% and 0.75% ginger mixtures had the best results for total cholesterol and LDL cholesterol of the growing pullets.

**Key words:** Cholesterol, garlic, ginger, low-density lipoprotein (LDL), pullets

## INTRODUCTION

Animal products, especially the two poultry products (meat and eggs) are major sources of protein in human diets. The increasing concern of consumers to the nutritional value of food (Kalavathy *et al*., 2003) has awakened the poultry industry to the fact that "all men are grass". Consequently, the industry is assuming responsibility towards alleviating the health challenges associated with the consumption of poultry products. In order to achieve this, several measures are constantly being tested and adopted. These measures are spread across the two fundamentals of animal husbandry namely: Breeding and Nutrition.

Every animal is as good as what it eats so the availability of good poultry nutrition is crucial to the improvement of poultry products. The competition between humans and the domestic fowl for some feedstuffs greatly hampers the production of quality meat and eggs. This competition affects the relative availability and affordability of the basic feed ingredients used in poultry nutrition (Onifade, 1993). In response to the high competition and the implicated cost of providing quality feed, the poultry industry has succumbed to the use of some relatively available low value feed ingredients such as rice bran, corn bran, wheat offal etc. Consequently, this has undermined the nutritive value of poultry products and compromised animal welfare. According to Aletor *et al*. (2000), feeding of low protein diets to broilers resulted in increased abdominal fat deposition. Thus efforts are being made to re-model poultry feeding indices to accommodate the challenges of competition, cost and production of nutritious poultry products.

Recently, research has become more focused on the use of naturally occurring phytobiotics in replacing the chemically based feed additives (Herawati and Marjuki, 2011). Some phytogenic feed additives have been successfully incorporated into the feeding standard of poultry birds without any deleterious effect or toxic residues (Oyekunle and Owonikoko, 2002). There are several naturally existing medicinal plants which could be used in preventing the accumulation of lipids; fats and cholesterol. Prominent among these plants are garlic (*Allium sativum*) and ginger (*Zingiber officinale* Roscoe, Zingiberacea).

Both garlic and ginger have gained prominence due to their wide range of properties not only in reducing lipids but, in many other ways where the utmost aim is to improve the nutritive value of the animal product (meat, milk or egg). Several studies have identified the separate use of these plants but, this study focuses on the combined therapeutic effect of garlic (*Allium sativum*) and ginger (*Zingiber officinale*). The combined effect of garlic and ginger has been used to prevent high blood pressure, high cholesterol level and cholesterol oxidation which are the primary causes of atherosclerosis, the precursor of cardiovascular diseases (Keith, 2001).

**Corresponding Author:** O. Bamidele, Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

The study aimed at investigating the combined effect of garlic and ginger mixtures on the growth performance, haematology (blood cells) and cholesterol level of growing pullets.

## MATERIALS AND METHODS

**Management of experimental birds:** The experiment lasted for 14 weeks. The garlic and ginger used for this study were purchased from Kano, a town in the northern part of Nigeria. The garlic used were separated into cloves, peeled and air dried for about two weeks at temperature of 39.83±1.77°C. The dried garlic was stored in an air-tight sac before being used. The stored, dried garlic still maintained the pungent odour, after which they were pounded and sieved for use. The ginger which was bought dried, were pounded and milled. They also maintained their characteristic odour.

225 birds were used for the study. The birds were grouped into five treatments and each treatment had 3 replicates with 15 birds per replicate in a complete randomized design. Each group was fed with corresponding experimental diet. Fresh feed and clean, cool water were served *ad libitum*. The control diet did not contain garlic and ginger mixtures. Garlic supplements were added at 0.50%, 1.00%, 1.50% and 2.00% to dietary treatment T1, T2, T3 and T4 respectively. Ginger was added at 0.50% for T1 and T2 while T3 and T4 contained 0.75% of ginger. The gross composition of the experimental diets is as shown in Table 1.

**Collection of data:** Feed intake was obtained by subtracting the quantity of feed left over from the quantity of feed fed. Feed conversion ratio was obtained by dividing the average feed intake by average body weight gain.

Feed conversion ratio = Average feed intake/average weight gain

Weight gain of the birds was determined by subtracting the initial live weight from the final live weight.

**Blood and cholesterol analyses:** Blood samples for haematological and cholesterol analyses were collected from two birds of similar weights from each treatment. The blood samples were collected at week $12^{th}$ and $14^{th}$. Packed Cell Volume (PCV) and haemoglobin concentrations were analyzed according to Wintrobe's microhaematocrit and Cyanohaemoglobin methods respectively (Mitruka and Rawnsley, 1977), while total cholesterol, LDL-cholesterol and HDL cholesterol concentrations were determined according to Friedewald *et al*. (1972) method.

**Statistical analysis:** The data collected were subjected to one way Analysis of Variance (ANOVA) and significant differences between the means were separated by using Duncan's Multiple Range test (Steel and Torrie, 1980).

## RESULTS

The gross composition of the experimental diets, performance characteristics, haematological indices and blood cholesterol of growing pullets fed garlic and ginger mixtures are shown in Table 1, 2 and 3 respectively. The results of the experiment revealed that initial weight, final live weight, weight gain, feed intake and feed conversion ratio were not significantly ($p>0.05$) different across the treatments.

Birds fed experimental diets containing 1.00% garlic and 0.50% ginger mixture (27.50%), 1.50% garlic and 0.75% ginger mixture (26.67%) and 2.00% garlic and 0.75% ginger mixture (26.25%) had significantly ($p<0.001$) higher values for packed cell volume than those fed the control diet (18.00%). Those fed 0.50% garlic and 0.50% ginger mixture (24.00%) were slightly different from those on other treatments. Birds on diet containing

Table 1: Gross composition of experimental diets

| Ingredients | Control | T1 | T2 | T3 | T4 |
|---|---|---|---|---|---|
| Maize | 34.15 | 34.15 | 34.15 | 34.15 | 34.15 |
| Soybean meal | 8.35 | 8.35 | 8.35 | 8.35 | 8.35 |
| Maize bran | 12.00 | 11.70 | 11.55 | 11.25 | 11.00 |
| Wheat bran | 20.00 | 19.70 | 19.55 | 19.40 | 19.25 |
| Palm kernel meal | 14.90 | 14.50 | 14.30 | 14.00 | 13.90 |
| Groundnut cake | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| Bone meal | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Oyster shell | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Methionine | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Garlic | - | 0.50 | 1.00 | 1.50 | 2.00 |
| Ginger | - | 0.50 | 0.50 | 1.00 | 1.00 |
| Energy (kcal ME/kg) | 2556.81 | 2535.00 | 2524.10 | 2509.44 | 2502.29 |
| Protein (%) | 16.23 | 16.14 | 16.10 | 16.07 | 15.03 |

T1 = 0.50% garlic and 0.50% ginger; T2 = 1.00% garlic and 0.50% ginger; T3 = 1.50% garlic and 0.75% ginger; T4 = 2.00% garlic and 0.75% ginger

Table 2: Growth performance of growing pullets fed garlic and ginger mixtures

| Parameters | Control | T1 | T2 | T3 | T4 | SEM |
|---|---|---|---|---|---|---|
| Initial weight (g) | 34.00 | 34.00 | 33.00 | 33.00 | 34.00 | 0.40 |
| Final weight (g) | 600.00 | 535.38 | 625.00 | 562.83 | 630.00 | 16.34 |
| Weight gain (g) | 566.00 | 501.38 | 592.00 | 529.83 | 596.13 | 16.41 |
| Feed intake (g) | 4327.12 | 3119.81 | 4653.93 | 3709.39 | 4975.02 | 250.14 |
| Feed conversion | 7.64 | 6.33 | 7.88 | 7.01 | 8.39 | 0.36 |

Rows with different superscripts are significantly different (**p<0.01; ***p<0.001). T1 = 0.50% garlic and 0.50% ginger; T2 = 1.00% garlic and 0.50% ginger; T3 = 1.50% garlic and 0.75% ginger; T4 = 2.00% garlic and 0.75% ginger

Table 3: Haematological indices and blood cholesterol of growing pullets fed garlic and ginger mixtures

| Parameters | Control | T1 | T2 | T3 | T4 | SEM |
|---|---|---|---|---|---|---|
| PCV (%) | $18.00^{c}$ | $24.00^{abc}$ | $27.50^{a}$ | $26.67^{ab}$ | $26.25^{ab}$ | 0.95*** |
| Haemoglobin (g/dl) | $5.98^{b}$ | $7.98^{ab}$ | $9.22^{a}$ | $8.86^{a}$ | $8.72^{a}$ | 0.32*** |
| WBC ($x10^3/mm^3$) | 4950.00 | 4300.00 | 5000.00 | 4366.67 | 4700.00 | 136.28 |
| Total cholesterol (g/dl) | $108.00^{a}$ | $90.75^{b}$ | $90.25^{b}$ | $83.50^{b}$ | $94.00^{ab}$ | 2.44** |
| LDL cholesterol (g/dl) | $27.50^{a}$ | $15.75^{b}$ | $10.00^{b}$ | $11.00^{b}$ | $13.50^{b}$ | 1.62** |
| HDL cholesterol (g/dl) | 49.50 | 58.50 | 57.75 | 53.25 | 63.75 | 2.06 |

Rows with different superscripts are significantly different (**p<0.01; ***p<0.001). T1 = 0.50% garlic and 0.50% ginger; T2 = 1.00% garlic and 0.50% ginger; T3 = 1.50% garlic and 0.75% ginger; T4 = 2.00% garlic and 0.75% ginger

1.00% garlic and 0.50% ginger mixture had the highest value (27.50%). Values for haemoglobin concentrations had similar trend, with birds on control diet having the least mean value (5.98 g/dl), while those on diet containing 1.00% garlic and 0.50% ginger mixture had the highest mean value (9.22 g/dl). There was no significant (p>0.05) difference across the treatments for White Blood Cell counts. However, birds on 0.50% garlic and 0.50% ginger mixture had the least value (4300.00 x $10^3/mm^3$), while those on diets containing 1.00% garlic and 0.50% ginger mixture had the highest numerical mean value (5000.00 x $10^3/mm^3$).

Mean value total cholesterol for birds on 0.50% garlic and 0.50% ginger mixture (90.75 g/dl), 1.00% garlic and 0.50% ginger mixture (90.25 g/dl) and 1.50% garlic and 0.75% ginger mixture (83.50 g/dl) were significantly (p<0.01) lower than those on control diet (108.00 g/dl), followed by those fed 2.00% garlic and 0.75% ginger mixture (94.00 g/dl), while those fed 1.50% garlic and 0.75% ginger mixture (83.50 g/dl) had the lowest value. The low-density lipoprotein cholesterol of birds fed the experimental diets were statistically (p<0.001) lower than those fed control diet (27.50g/dl). The control diet had the highest value of LDL, followed by those fed 0.50% garlic and 0.50% ginger mixture (15.75 g/dl), while those on 1.00% garlic and 0.50% ginger mixture (10.00 g/dl) had the lowest mean value.

## DISCUSSION

The result obtained for the performance characteristics revealed that garlic and ginger mixtures had no significant effect on growth performance. Hence could not be used as growth promoters for growing pullets at the levels of inclusion used. According to El-Deek *et al.* (2002), inclusion of 1 g/kg of ginger did not affect growth performance. Farinu *et al.* (2004) however reported slight improvement in the growth performance of broilers fed ginger supplements at the levels of 5, 10, 15 g/kg. On the other hand, Al-Homidan (2005) reported reduced growth rate of broiler starters fed ginger at the rate of 20 g and 60 g/kg. This result could be due to their use of synthetic garlic 'G-PRO' in place of the naturally prepared garlic supplements which our study used. Ademola *et al.* (2009) reported that mixtures of garlic and ginger significantly improved the growth of the chicks than garlic and ginger as sole agent in broiler diets. It can then be inferred that the effect of garlic and ginger on the growth performance of poultry birds (broilers/layers) is dependent on its dose and preparation.

The result of haematological parameters showed that the Packed Cell Volume (PCV) of the birds across the treatments ranged between 18.00% and 27.50% and this did not follow a specific trend. The normal range for normal adult chicken by Mitruka and Rawnsley (1977) was 26.00%-45.20%. Hence, the values obtained could be considered normal. The concentration of haemoglobin obtained ranged between 5.98 g/dl and 9.22 g/dl which could also be considered normal. When compared with the normal range of haemoglobin of normal adult chicken (7.50 g/dl and 13.10 g/dl) reported by Mitruka and Rawnsley (1977). White Blood Cell (WBC) counts had no significant (p>0.05) difference across the treatments, which implies that the experimental diets at the levels of inclusion could be tolerated without compromising the welfare or immunity of the birds.

There were significant reductions in the total cholesterol which is as a result of the significant reduction in the LDL cholesterol concentration. This agrees with the studies conducted by Prasad *et al.* (2009) and Yeh and Liu (2001) where garlic was effective in lowering the total cholesterol via its effect on the plasma concentration of

LDL cholesterol. Also, Herawati and Marjuki (2011) reported a reduction in the fat content of broilers fed ginger. This present findings suggest that the mixture of garlic and ginger supplementation in feed is effective in regulation of lipid metabolism in pullets.

**Conclusion:** It could be concluded that garlic and ginger mixtures do not enhance growth performance and as such cannot be used as growth promoters for pullet birds. The haematology parameters reveal there is no toxicity associated with the consumption of garlic and ginger mixtures at the inclusion levels considered. The combined effect of garlic and ginger mixtures has greater influence as an anti-hypercholesterolemic agent.

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