APRW -05

Influence of Diets Supplemented with Garlic (*Allium sativum*) and Ginger (*Zingiber officinale*) on the Growth Performance and Egg Qualities of Egg-Type Chickens

O.O. Oni[1], J.O. Alabi[2] and G.M. Mene[3]

[1]Department of Agricultural Education, School of Vocational Education, Federal College of Education, Osiele, PMB 2096, Abeokuta, Ogun State, Nigeria; [2]World Bank Africa Centre of Excellence in Agricultural Development and Sustainable Environment, Federal University of Agriculture, Abeokuta, PMB 2240, Ogun State, Nigeria; [3]Department of Vocational and Technical Education, Faculty of Education, University of Benin, Benin City, PMB 1154, Edo State, Nigeria

Corresponding author: J.O. Alabi; E-mail:joelalabi@gmail.com, +23470664869499

Abstract

This study evaluated the effect of feeding layer diets supplemented with a mixture of garlic and ginger on performance and egg qualities of egg-type chickens. 216 ISA Brown pullets were randomized to 6 dietary groups of 27 birds per treatment. They were fed basal diet supplemented with no additive (T1), 2.50 g/kg Embaceryl® (T2), mixture of garlic and ginger (GGP) at 5.00 (T3), 7.50 (T4), 10.00 (T5), and 12.50 g/kg (T6) for a period of 14 weeks. Growth performance and egg quality were assessed. Data obtained were analyzed by ANOVA using PROC GLM of SAS (2007). Results showed that birds fed diets containing GGP resulted in higher live weight and body gain at 7.50 g/kg, increased egg weight at 10.0 g/kg GGP, and improved feed conversion efficiency at 7.50 g/kg and above. Dietary inclusion of GGP had a significant effect on egg qualities parameters investigated, except shape index. Significant lowest yolk weight, as well as highest albumen height and Haugh Unit (HU) values were observed in birds fed 12.5 g/kg GGP. The study concluded that dietary inclusion of ginger and garlic mixture (GGP) above 5.00 g/kg improved feed efficiency, enhanced production performance and egg qualities of egg-type chickens.

Keywords: Laying hens, feed efficiency, phytobiotics, eggs, yolk, albumen

Introduction

The increasing demand for food arising from higher population upsurge, changes in dietary feeding pattern, and the quest to meet the minimum dietary protein intake recommended by FAO is lingering the negative balance between food production and supply in Nigeria. Over the years, Nigeria is still highly deficient in animal protein security with the per capita consumption put at 10.0 g/day as against the 35 g/day FAO recommended daily allowance needed for optimum growth and development of the body (Esobhawan *et al.*, 2008).More importantly, the growing interestby the UNICEF to curb malnutrition and protein deficiency problems especially in children with a view to attaining food security in developing countries, Nigeria inclusive, necessitates the need to intensify livestock production to feed the ever-growing population.

Poultry production has been recognized as a viable contributor to animal food products due to its significant growth over the last few decades. Hence, poultry products, especially eggs, are food items of choice worldwide as hen's eggs are more routinely consumed in daily diets. This is because eggs are nutritious, palatable, affordable, and generally acceptable by all and sundry irrespective of culture, religion, and tribes. Nutritionally, it contains low-calorie, highly digestible protein and fats, an appreciable amount of minerals, myriads of fat- and water-soluble vitamins, as well as essential polyunsaturated fatty acids (Zaheer, 2005).Egg safety and quality, however, is a major concern for consumers because eggs have been implicated for a number of (zoonotic) diseases and food-borne illnesses such as Salmonellosis (Jones *et al*., 2002). Therefore, efforts to minimize the antibiotic residues in poultry eggs which might have deleterious effects on human consumers has led to the outright ban on the indiscriminate use of dietary antibiotics at sub-therapeutic dosage by the European Union. Thus, the need for suitable alternatives growth promoter of health benefits to poultry birds and man.

Both garlic (*Allium sativum* L.) and ginger (*Zingiber officinale* Rosc.) 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 products such as meat, milk or egg (Bamidele and Adejumo, 2012). Several studies have identified the separate use of these plants (Yalçin *et al*., 2006; Zhan *et al*., 2011; Akbarian *et al*., 2012). Also, Zaheer (2005), in a review, had reported that dietary supplementation of nutrients and substrates could enhance the nutritional and health benefits of eggs.

In view of this, this study aimed at evaluating the effects of feeding layer diets supplemented with amixture of garlic and ginger on performance and egg qualities of egg-type chickens.

Materials and Methods

The experiment was carried out at the Poultry Unit of the Department of Agricultural Science, Federal College of Education, Osiele, Abeokuta, Ogun State, Nigeria. Fresh garlic bulbs and ginger rhizomes used were purchased from the local market in Abeokuta, Nigeria. Garlic bulbs were separated into cloves and peeled. Ginger rhizomes were cleaned and manually chopped to aid drying. They were air dried for 2-3 weeks until thedesired level of dryness was obtained, and thereafter were milled to powder and stored in air-tight bags before being incorporated into the formulated diet. One hundred and sixty-two (162), 13-week-old, ISABrown pullets used for this study were distributed to 54 cage cells and were fed a pre-experimental diet (11.23 MJ/kg; 16.80%CP) till they attain 20 weeks of age. Thereafter, they were randomizedinto six groups of 9cells (replicates) and each cell (dimension 65 x 60 x 40cm) contained three birds. Basal diet was formulated to contain 11.09 MJ/kg ME, 17.10% CP, 5.86% CF, 4.82% EE, 7.34% ash, 54.70% NFE and 89.82%DM. Itwas then divided into 6 parts, and supplemented with no additive (T1), 2.50 g/kg Embaceryl® (T2), mixture of garlic and ginger (GGP) at 5.00 (T3), 7.50 (T4), 10.00 (T5), and 12.50 g/kg (T6) to form 6 dietary treatments. Birds were fed one of 6 diets for 14 weeks (21^{st} – 34^{th} week). Feeds (mash form) and clean water was provided *ad libitum* during the study. Recommended vaccinations and medication program were observed.

Body weights were taken at the start and end of the trial. Feed intake was measuredon a replicate basis at weekly intervals. Eggs were collected twice daily. FCR was estimatedas the ratio of feed consumed to egg weight produced. For egg quality analysis, egg length and width were measured using Vernier caliper while egg weight, yolk weight and shell weight were measured using an electronic digital balance (CAMRY; Model EK 3250). Albumen height was measured using a tripod spherometer, while Haugh unit (HU) was estimated. Yolk color was scored using a colorimetric fan (DSM Yolk Color Fan).

Data collected were subjected to One-way Analysis of Variance (ANOVA) using PROC GLM of SAS (2007). Significant means among treatments were compared using Tukey's HSD test ($p<0.05$).

Results and Discussion

Highest ($p<0.05$) live weight and body gain were observed in birds fed diets containing 7.50 g/kg GGP (Table 1). Significant reduced ($p<0.05$) weight gain in birds fed 12.5 g/kg could implyhigher fat metabolismthus suggesting higher lean: meat ratio. Dietary supplementation of GGP improved ($p<0.05$) egg weight with highest values obtained in chickens fed 10.0 g/kg GGP. Feed conversion efficiency was enhanced ($p<0.05$) by adding at least 7.50 g/kg GGP to layers diets. Ginger is believed to have digestion-stimulating properties thereby enhance nutrient absorption and utilization for growth and production performance. In agreement, Ademola *et al.* (2012) had reported that dietary inclusion of garlic and ginger mixture had a significant effect on live weight, feed intake, FCR, and egg weight of laying birds.

However, previous studies found no significant effect on feed intake and FCR of laying hens fed diets containing sole garlic powder (Yalçin *et al.,* 2006) as well as egg weight in ginger powder (Zhan *et al.*, 2011; Akbarian *et al.*, 2012). This suggests that ginger and garlic mixture had positive synergistic effect of performance of laying birds. Dietary inclusion of GGP had asignificant effect ($p<0.05$) on egg qualities parameters investigated, except shape index (Table 2). Highest ($p<0.05$) egg length, shell weight and shell %were observed in birds fed 10.0 g/kg GGP. This could suggest that GGP enhance utilization of Ca and P towards better shell formation, and thus will reduce the number of cracks.

Table 1: Growth and laying performance of birds fed graded levels of ginger and garlic mixture

Items	T1	T2	T3	T4	T5	T6	Pooled SEM	p-value
Initial weight (g)	1380.69	1389.42	1373.51	1372.76	1372.51	1382.16	8.18	0.1085
Final weight (g)	1716.80^{ab}	1697.75^{c}	1696.51^{c}	1722.76^{a}	1705.88^{bc}	1671.15^{d}	44.20	<0.0001
Weight gain (g)	336.11^{b}	308.33^{e}	323.00^{d}	350.00^{a}	333.37^{c}	288.99^{f}	35.03	0.0020
Daily Feed intake (g)	110.04	110.39	109.66	110.12	110.12	109.88	23.86	0.2016
HDP (%)	61.58	61.87	62.33	64.04	63.07	62.79	8.57	0.5813
Egg weight (g)	54.93^{e}	53.61^{f}	55.29^{d}	55.60^{c}	56.23^{a}	55.91^{b}	0.96	0.0037
FCR	3.21^{ab}	3.33^{a}	3.20^{ab}	3.11^{b}	3.11^{b}	3.13^{b}	0.68	0.0010

^{abcdef}Mean on the same row having different superscripts are significantly different ($p<0.05$);

HDP – Hen-Day Production, SEM – Standard Error of Mean

Table 2: Egg qualities of laying chickens fed graded levels of ginger and garlic mixture

Parameters	T1	T2	T3	T4	T5	T6	PooledSEM	P-Value
Egg length (cm)	4.00^{b}	4.00^{b}	3.80^{c}	4.10^{ab}	4.20^{a}	4.10^{ab}	4.71	0.0425
Egg width (cm)	2.80^{a}	2.80^{a}	2.50^{b}	2.90^{a}	2.80^{a}	2.80^{a}	5.77	0.0058
Shape index	70.00	70.00	70.00	70.02	70.03	70.02	1.30	0.6209
Shell weight (g)	5.59^{f}	5.73^{e}	6.94^{c}	6.94^{d}	7.52^{a}	7.21^{b}	5.44	0.0063
Shell %	11.67^{e}	10.21^{f}	12.48^{d}	12.61^{c}	13.61^{a}	12.90^{b}	10.00	0.0218
Yolk weight (g)	11.34^{e}	14.08^{a}	11.73^{d}	12.95^{b}	12.62^{c}	9.72^{f}	5.77	0.0364
Yolk %	20.40^{e}	26.26^{a}	25.53^{b}	23.03^{c}	22.83^{d}	17.39^{f}	9.53	0.0172
Yolk colour	1.00^{b}	1.00^{b}	1.00^{b}	1.00^{b}	2.00^{a}	2.00^{a}	4.97	0.0410
Albumen height (mm)	8.89^{d}	8.73^{e}	7.84^{f}	9.99^{b}	9.99^{b}	12.26^{a}	6.38	0.0052
HaughUnit	95.28^{c}	94.99^{d}	92.58^{e}	100.17^{ab}	99.94^{b}	109.10^{a}	2.91	0.0219

^{abcdef}Mean on the same row having different superscripts are significantly different (P<0.05);
SEM – Standard Error of Mean

Lowest (p<0.05)yolk weight and yolk % observed in birds fed 12.5 g/kg GGP confirms their hypocholesterolemic and hypoglycemic properties. Ginger is known to have significant effect in lowering serum glucose, cholesterol and triacylglycerol while the garlic organ sulfur components (allium compounds) are responsible for decreasing plasma cholesterol levels and protecting LDL from oxidation. In agreement, Bamidele and Adejumo (2012) also found that mixture of garlic and ginger had significant influence on the lipid profile of growing pullets. Increased yolk colour (p<0.05) observed in birds fed diets containing GGP at and beyond 10.0 g/kg points out that the concentration of natural pigments in ginger and garlic at such level would be required to enhance yolk colour of hen's eggs. Highest (p<0.05) albumen height and Haugh Unit (HU) values were observed in birds fed 12.50 g/kg.

Results of this study are strongly supported by Safaa (2007) who found that addition of dietary garlic or fenugreek increased the yolk colour and HU of eggs. This implies that synergistic effect of phytochemical substances in garlic and ginger improved the internal quality of eggs because of the higher the HU value which indicates better egg quality. More so, eggs with higher albumen content and greater HU would have better storability as the onset of lipid oxidation process would be delayed. This further confirms the antioxidant properties of flavonoids present in garlic and ginger.

Conclusion

The study concluded that dietary inclusion of ginger and garlic mixture (GGP) resulted to increased egg weight and improved feed conversion above 7.50 g/kg. Reduced weight gain, yolk weight and yolk %, as well as higher albumen height and Haugh Unit (HU) values were observed in birds fed 12.5 g/kg GGP. The synergy of bioactive substances in ginger and garlic mixture supported egg production and enhance the egg quality.

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