
PERFORMANCE AND ANTIOXIDANT STATUS OF STORED EGGS FROM HENS FED DIETARY GINGER AND CLOVE

*Adio, A.A., Ademola, S.G., Akinwumi A.O., Arasi, K.K., Shittu M.D., Ogunesan, S.T., Oyekan, O.G. and Ogunbiyi O.D.

Department of Animal Nutrition and Biotechnology, LAUTECH, Ogbomoso, Oyo State Nigeria

*corresponding author-adioabdullahi@gmail.com 08031171817

ABSTRACT

Eighty (80) 18 weeks old, grower ISA Brown strain birds were used to evaluate performance and antioxidant status of 35 day-stored eggs laid by hens fed dietary ginger and clove. The birds were randomly divided into 5 groups of 4 replicates per group. Each replicate contained 4 birds. Five experimental diets were formulated for the study namely: Basal diet without clove bud or ginger rhizome powders (control). Diet T1 was basal diet supplemented with 0.1% Clove Bud Powder (CBP) and 0.25% Ginger Rhizome Powder (GRP). The T2 was basal diet that contained 0.2% CBP and 0.25% GRP. Basal diet containing 0.1% CBP and 0.5% GRP was tagged T3. Diet T4 was basal diet supplemented with 0.2% CLP and 0.5% GRP. The results showed that dietary treatment did not significantly ($P>0.05$) influence performance and antioxidant capacity of the eggs stored. However, the interaction effect of CBP and GRP significantly influenced malondialdehyde (MDA) concentration ($P=0.053$) and Superoxide Dismutase (SOD) activity ($P=0.010$). The highest increase in MDA was observed for hens fed diet supplemented with 0.1% CBP and 0.25% GRP (T1) (3.09 versus 2.73 nmol/mg protein for the control) with low SOD activity (2.50 versus 4.75 U/mg protein for the control). Furthermore, the main effect of GRP tended to significantly ($P=0.058$) influence Glutathione Peroxidase (GPx) with the highest GPx activity noticed for hens fed 0.5% ginger powder (T3 and T4). The lowest MDA concentration with better antioxidant enzymes (SOD and GPx) were observed in T3 (0.1% CBP and 0.5% GRP).

Keywords: Laying hens, clove, ginger, antioxidant-enzymes

INTRODUCTION

Eggs are high quality protein source with many functional benefits promoting human health, and better wellbeing (Nimalaratne and Wu, 2015). The amino acid profile of eggs is adequate to meet both essential and non-essential amino acid needs for both adults and young children making it a complete protein. Eggs are also considered cheap, extremely nutritious, palatable and readily accessible across the globe (Gulcin, 2012). It is important to note that with recent developments in enriching eggs via feed additive supplementation, thereby improving its quality. Raji *et al.* (2009) stated that there was a detrimental influence on egg quality throughout the transition phase in Nigeria from the farm to the end consumers, since the eggs were kept longer than necessary.

Plants are rich natural antioxidants and researchers have picked interest in utilizing clove and ginger due to their antioxidant properties. Clove (*Syzygium aromaticum*) is an aromatic evergreen plant that is very rich in many bioactive compounds including eugenol (72–90%), flavonoids, and triterpenoids (Bhownick *et al.*, 2012). Many reports have shown that it contains antimicrobial, antioxidant, antiviral, and anticancer agents (Bhownick *et al.*, 2012). The most bioactive compound in cloves (*Syzygium aromaticum*) is eugenol, which is a potent natural antioxidant (Hemalatha *et al.*, 2016). Supplementation of poultry diets with clove oil or powder improved feed efficiency, egg production, immunity, and antioxidant activity (Şehitoğlu and Kaya, 2012). Ginger (*Zingiber officinale* Roscoe) is the underground stem (rhizome) which is used as a spice and as a preservative (Plotto, 2002). It is a strong, spicy herb that is frequently used in cooking and medicine. Ginger has strong antioxidant and antibacterial properties due to its high polyphenolic content (Stoilova *et al.*, 2007). Ginger's antioxidant properties have been linked to its bioactive constituents' defense against free radical damage (Haksar *et al.*, 2006). Research has demonstrated that 6-gingerol possesses potent anti-inflammatory properties as well as high antioxidant properties both in vivo and in vitro (Haksar *et al.*, 2006). Previous studies have reported inconsistent findings with regards to sole addition of CBP and GRP. It is hypothesized that the bioactive components in CBP and GRP could be used synergistically

to enhance the egg quality particularly during storage. The study therefore determined performance and antioxidant status of 35 days-stored eggs from hens fed dietary CBP and GRP.

MATERIALS AND METHODS

Site of the Experiment:

The experiment was conducted at Layer Unit, Teaching and Research Farm of LAUTECH, Ogbomoso, Oyo State, Nigeria.

Preparation of Test Ingredients:

Clove buds and ginger rhizome were purchased from Oja Jagun market in Ogbomoso, Oyo State. Ginger rhizomes were sliced into 2mm pieces, and sundried until constant weight is achieved. Dried sliced ginger was ground in a mechanical grinder and sieved using a 1mm mesh to obtain ginger rhizome powder (GRP). The dried clove materials was pulverized into fine powder using a mechanical blender to obtain clove bud powder (CBP).

Experimental Diets, Birds and Management

Five experimental diets were formulated for the study. Basal diet without test ingredients served as the control. Basal diet + 0.1% CBP and 0.25% GRP (T1); Basal diet + 0.2% CBP and 0.25% GRP (T2). Basal diet + 0.1% CBP and 0.5% GRP (T3). Basal diet + 0.2% CBP and 0.5% GRP (T4). The gross composition of basal diet is as follows: 50% maize, 15.8% maize offal, 3% wheat offal, 18% SBM, 3% fishmeal, 0.1% methionine, 0.25% salt, 0.25% vitamin premix, 1.8% bone meal, 7.8% limestone. Basal diet was characterized by 2739.90 kcal ME/kg and 16.97% CP. Eighty (80) 18 weeks old, grower birds of ISA Brown strain were used for the study. Daily egg production was at 20% when the experimental diets were introduced to the birds. These birds were randomly divided into 5 treatment groups of 4 replicates per treatment. Each replicate contained 4 birds. Normal management procedure was observed during the study. All necessary medication and vaccination were administered appropriately. A period of 12 weeks was used for the experiment.

Experimental Design: Completely Randomized Design (CRD) was adopted for the study. A 2X2 factorial arrangement for CBP and GRP was also used. The two factors were CBP (0.1 and 0.2%) and GRP (0.25 and 0.50%) with each at two inclusion levels.

Data Collection

Laying Performance: During the study, daily egg production were monitored. The number of eggs laid and their weight were recorded daily using digital sensitive scale. Hen day production (HDP), ADFI and feed conversion were calculated. Feed efficiency per dozen was calculated using Kg of feed consumed x 12/ Total numbers of eggs laid. To calculate egg mass, the weight of the egg were multiplied by HDP.

Antioxidant Assay of Stored Eggs: On the 42nd day of the experiment, eight (8) fresh eggs were selected from each treatment (2 eggs per replicate), making a total of 40 eggs that were used for the study. The eggs were stored for 35 days. The whole egg homogenate was assayed for contents of glutathione peroxidase (GPx), superoxide dismutase (SOD) and malondialdehyde (MDA) according to the procedures as described by Zhang *et al.* (2009). The activities of antioxidant enzymes and the content of MDA were expressed as units per milligram of protein for egg.

Statistical Analysis: Data collected were analyzed using One-Way Analysis of Variance of SAS (SAS 2003) software package at $P < 0.050$. The main and interaction effects were assessed using 2x2 factorial ANOVA. Duncan's option of the same software was used to compare the means..

RESULTS AND DISCUSSION:

The performance of laying hens fed dietary CBP and GRP is displayed in Table 1. Dietary treatment did not significantly influence egg weight ($P=0.550$), hen day production ($P= 0.151$), average daily feed intake (ADFI, $P= 0.169$), feed conversion (FC, $P= 0.322$), feed efficiency per dozen eggs (FEDP, $P= 0.345$ and egg mass ($P= 0.156$). However, numerically higher HDP, egg mass and ADFI were observed in hens fed diets supplemented with CBP and GRP than the control. Hens fed diet supplemented with 0.1% clove and 0.25% ginger (T1) had numerically highest egg mass. The latter finding agreed with the finding of (Wen *et al.*, 2019) who reported that ginger extract increases egg weight of laying hens. The highest ADFI of laying hens fed diet containing 0.1% CBP and 0.5% GRP (T3) was similar to the work of Ademola *et al.* (2009) who reported higher feed intake of broilers on diet supplemented with ginger. The ADFI for laying hens fed diets supplemented with CBP and GRP

was higher than control which was at variance with the report of Herawati, (2010) who stated that significantly lower feed intake for broilers fed 2% dried supplementary ginger meal than those on the control diet. The high inclusion level of ginger in the study of Herawati, (2010) may account for variation from the present study. High feed intake of birds placed on CBP and GRP (in combination) even at low concentration exploited the property of ginger as an appetizer.

Table 1: Laying performance of laying hens fed clove bud and ginger rhizome diets

Parameters	Control	T1	T2	T3	T4	P-value	SEM	CBP	GRP	Interaction
CBP →	0.00	0.1%	0.2%	0.1%	0.2%					
GRP →	0.00	0.25%	0.25%	0.5%	0.5%					
Egg Weight (g/egg)	49.44	49.22	49.78	50.48	50.42	0.550	0.57	0.700	0.159	0.629
HDP (%)	76.41	86.38	83.04	83.26	84.00	0.151	2.37	0.404	0.487	0.199
ADFI (g/bird)	32.03	32.58	33.93	33.93	33.650	0.169	0.57	0.419	0.419	0.230
Feed conversion ratio	2.55	2.28	2.45	2.41	2.37	0.322	0.08	0.313	0.729	0.116
FEDP	1.51	1.35	1.46	1.46	1.43	0.345	0.05	0.347	0.398	0.145
Egg Mass (g/egg/day)	37.82	42.51	41.33	42.01	42.35	0.156	1.25	0.596	0.742	0.347

The antioxidant status of 35 day-stored eggs is shown in Table 2. Dietary treatment did not significantly affect antioxidant capacity of the eggs stored for 5 weeks. The interaction effect of CBP and GRP significantly influenced MDA concentration ($P=0.053$) and SOD activity ($P=0.010$). The highest MDA was noticed in hens fed diet supplemented with 0.1% CBP and 0.25% GRP (T1) [3.09 versus 2.73 nmol/mg protein for the control. The lowest MDA (2.32 nmol/mg protein) was observed in hens fed diet supplemented with 0.1% CBP and 0.5% GRP (T3). The lowest MDA in T3 with better SOD and glutathione peroxidase activity showed the stored eggs in T3 had the best antioxidant status. This indicated the group of stored eggs of hens in T3 have better shelf life. This finding is in agreement with the observation of Zhao *et al.*, (2011), who reported increased SOD activity and reduced MDA concentration in eggs of laying hens fed diets supplemented with 1.5 g/kg ginger powder. Alizadeh *et al.*, (2015) observed that when 4g/kg clove bud was used, the MDA content of the egg yolk decreased in eggs that were stored for 15 days under storage settings and 30 days in the refrigerator. The supplementation of 0.1% CBP and 0.5% GRP (T3) in layer diet suggested that the antioxidant potential of clove bud and ginger rhizome powder were effective to serve as preservative for storage of eggs stored up to 35 days. According to Jirovetz *et al.* (2006), inclusion of clove buds in food can stop the creation of hydroxyl radicals, which are secondary products of lipid peroxidation. Similarly, clove oil can act as a powerful antioxidant even when lipid peroxidation is at its latter stages during the beta-oxidation process. The antioxidant properties present in these spices (CBP and GRP) is assumed to protect lipids from oxidation.

Table 2: Antioxidant status of 14 days stored eggs laid by hens fed clove bud and ginger rhizome diets

Parameters	Control	T1	T2	T3	T4	P-value	SEM	CBP	GRP	Interaction
CBP →		0.1%	0.2%	0.1%	0.2%					
GRP →		0.25%	0.25%	0.5%	0.5%					
MDA (nmol/mg)	2.73	3.09	2.78	2.32	2.82	0.188	0.21	0.653	0.078	0.053
SOD (U/mg)	4.75	2.50	5.00	4.88	2.50	0.084	0.85	0.942	0.942	0.010
GPx (x10 ³ , μmol/mg)	3,236.67	3,280.00	1,791.67	3,781.67	5,440.00	0.198	1.02	0.935	0.058	0.142

^{abc} Means along the same row with different superscripts are significantly different ($P<0.050$).

MDA = Malondialdehyde, SOD= Superoxide dismutase GPx = Glutathione peroxidase

CONCLUSION AND APPLICATION

It was concluded that, dietary supplementation of 0.1% clove bud powder and 0.25% ginger rhizome powder to layer diet numerically improved egg mass and interaction effect of 0.1% CBP with 0.5% GRP significantly enhanced antioxidant status of eggs stored for 35 days. The use of clove bud and ginger rhizome at the latter dosages when supplemented to feed of laying hens will address the marketing challenges leading to loss in egg quality from the farm to the final consumer.

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