The performance and egg quality characteristics of layers fed diets containing graded levels of *Garcinia kola* seed meal

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Abstract

Effects of dietary *Garcinia kola* meal (bitter kola) on the performance and egg quality characteristics of laying hens were investigated. Four layers diets were made such that diet T₀ (control) contained no *Garcinia kola* meal while diets T_{2.5}, T_{5.0} and T_{7.5} contained 2.5%, 5.0% and 7.5% *Garcinia kola* meal, respectively. Each diet was fed to a group of 30 laying hens at 30 weeks of laying life for 84 days, using completely randomized design (CRD). Each group was further sub-divided into three replicates of 10 hens each. The layers on T_{2.5} and T_{5.0} diets added significantly ($P < 0.05$) less body weight than those on T₀ and T_{7.5} diets. There were no significant differences in their feed intake ($P > 0.05$). T_{2.5} significantly ($P < 0.05$) depressed hen-day egg production but enhanced egg weight. Feed conversion ratio (g feed/ g egg) was not affected by the treatments ($P > 0.05$). Egg quality indices (egg shape index, egg specific gravity, Haugh unit, egg shell thickness, albumen index and yolk index) were not affected by the treatments ($P > 0.05$). Egg shell index was significantly ($P < 0.05$) enhanced by *Garcinia kola* meal. At 2.5% level, it significantly enhanced percent albumin and reduced percent yolk ($P < 0.05$). Cost of egg production (₦/kg eggs) was adversely increased as the level of *Garcinia kola* meal increased.

Key words: Egg production, egg quality, *Garcinia kola*, laying hens.

Introduction

There is no doubt that the costs of providing feed and drugs in livestock and poultry industry in Nigeria are steadily increasing. These costs affect the final consumers of the products. South-eastern agro-ecological zone of Nigeria is highly endowed with plants possessing nutritional and medicinal properties. It has therefore become necessary to investigate such plants for possibilities of incorporating their leaves or seeds in livestock and poultry feeds to serve as feed ingredients and/or prophylactic agents. Earlier studies at our station have shown that leaves from *Alchornea cordifolia* (Udedibie and Opara, 1998) and *Azadirachta indica* (Esonu *et al.*, 2005) could be of value in poultry diets. *Garcinia kola*, Heckel, commonly called bitter kola is an indigenous medicinal tree

belonging to the family, *Guttiferae*. It is highly valued because of its medicinal properties (Hertog *et al.*, 1993). The seeds are chewed as an aphrodisiac or used to cure cough, dysentery or chest cold in herbal medicine (Irvine, 1961). Phytochemical studies have shown that the seed's constituents include biflavoids, xanthenes and benzophenones. The seeds are believed to have antimicrobial, anti-inflammatory, anti-bacterial and anti-viral properties (Akoachere *et al.*, 2002), and very low in protein and high in carbohydrates (Ibekwe *et al.* 2007). It could therefore be used as feed additive in view of its medicinal properties or feed ingredient as source of carbohydrates

Information on the nutritive value of *Garcinia kola* in poultry diets is sketchy. Esiegwu and Udedibie (2009) reported that

Table 1: Ingredient composition of the experimental layers diets

Ingredients (%)	Experimental Diets			
	T ₀	T _{2.5}	T _{5.0}	T _{7.5}
Maize	48.00	45.50	43.00	40.50
Bitter kola	0.00	2.50	5.00	7.50
Soybean meal (48% CP)	15.00	15.00	15.00	15.00
Fishmeal (65% CP)	2.00	2.00	2.00	2.00
Blood meal	3.00	3.00	3.00	3.00
Wheat offal	14.00	14.00	14.00	14.00
Palm kernel cake	7.00	7.00	7.00	7.00
Bone meal	10.00	10.00	10.00	10.00
Salt	0.25	0.25	0.25	0.25
Tm/Vit. premix *	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25
L-methionine	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated nutrient composition (% of DM)				
CP	17.95	17.80	17.64	17.48
CF	4.52	4.96	5.41	5.85
EE	3.85	3.97	4.10	4.24
Ash	4.47	3.23	3.22	3.22
NFE	69.21	70.04	69.63	69.21
Ca	3.75	3.75	3.75	3.75
P	2.10	2.17	2.16	2.16
Lysine	1.18	1.18	1.17	1.16
Methionine	0.57	0.57	0.56	0.56
ME (Mcal/kg)	2.62	2.61	2.60	2.58

*Provided the following per kg of feed: vitamin A, 10,000 iu; vitamin D₃, 2000 iu; vitamin B₁, 0.75 mg; nicotinic acid, 25 mg; calcium pantothenate, 12.50 mg; vitamin B₁₂, 2.5 mg; vitamin k₃, 2.5 mg; vitamin E, 2.5 mg; cobalt, 0.40 mg; biotin, 0.50 mg; folic acid, 10.0 mg; choline chloride, 25 mg; copper, 8.00 mg; manganese, 64 mg; iron, 32 mg; zinc, 40 mg; iodine, 0.8 mg; flavomycine, 100 mg; spirromycine, 5 mg; DL-methionine, 50 mg; selenium, 0.16 mg; L-lysine, 120 mg.

broilers placed on *Garcinia kola* seed meal diets produced heavier body weight and superior feed conversion ratio at 2.5% dietary level.

The study herein reported was therefore designed to determine the effects of graded levels of *Garcinia kola* seed meal on the performance of laying hens.

Materials and methods

The *Garcinia kola* seeds used in this study were bought from Omuma market in Oru East Local Government Area of Imo State,

Nigeria. The seeds were cut into small pieces and sun-dried until they became crispy. They were then milled in a hammer mill with 2 mm sieve to produce *Garcinia kola* seed meal. Samples were subjected to proximate and mineral analyses according to AOAC (1990).

Experimental diets

Four layers diets were compounded, incorporating *Garcinia kola* seed meal at 0%, 2.5%, 5.0% and 7.5% inclusion levels, respectively, partly replacing maize in the control diet. The diets were thus designated

as T_0 , $T_{2.5}$, $T_{5.0}$ and $T_{7.5}$, respectively, with T_0 serving as the control. The ingredient and nutrient compositions of the diets are shown in Table 1.

Experimental birds and designs

One hundred and twenty (120) laying hens of Hyline strain at 30 weeks of laying life were randomly divided into four groups of 30 layers each and each group randomly assigned to one of the four treatment diets in a completely randomized design (CRD). Each group was further sub-divided into three replicates of 10 layers each and each replicate housed in a deep litter compartment measuring 1.5 m x 2 m. Feed and water were provided *ad libitum*.

Data collection and analysis

The birds were weighed at the beginning of and end of the feeding trial to obtain their body weight changes. Records on daily feed intake were taken by weighing the feed given and the left-over the following day. Feed conversion ratio was recorded as daily feed intake per daily egg weights (g feed/ g egg). The following egg parameters were determined: hen-day egg production, egg weight, shell weight, shell-thickness, yolk index, albumen index and Haugh unit. Egg yolk index were determined according to Funk (1948), albumen index according to Heiman and Carver (1936) and Haugh unit using the simplified formula of Haugh (1937) as cited by Asuquo *et al.* (1992).

Three eggs were collected weekly from each replicate and analysed for egg quality indices while a crate of eggs from each replicate was weighed weekly to obtain average egg weights. Data collected were subjected to analysis of variance (Snedecor and Cochran, 1978). Where analysis of variance indicated significant treatment effects, means were compared using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (1990).

Results and discussion

Proximate and mineral composition

The proximate and mineral compositions of *Garcinia kola* used for the experiment are shown in Table 2. With exception of crude fibre, which was 20.51%, other values (crude protein, ether extract and ash) were in agreement with the values obtained by Ibekwe (2000). The values for Mn, Mg, Ca and K were close to the values of 2.01 mg/100 g for Mn, 0.42 mg/100g for Mg, 0.80 mg /100g for Ca and 2.50 mg/100g for K respectively, reported by Okwu (2005). The value for Zn (0.003 mg/g) tended to disagree with the value of 2.03 mg/100g and 2.23 mg/kg reported by Okwu (2005) and Odebunmi *et al.* (2009), respectively, possibly because of the differences in locations of the studies as soil and other climatic conduction can affect nutrient composition of plants. The variability in the values is, however, not too wide.

Performance of the experimental laying hens

The performance of the experimental laying hens is presented in Table 3. There were no significant differences ($P > 0.05$) in feed intake and feed conversion ratio among the treatments. The layers on $T_{2.5}$ and $T_{5.0}$ added significantly ($P < 0.05$) less body weight than those on T_0 and $T_{7.5}$ diets. Similar trend in body weight had earlier been reported by Esiegwu and Udedibie (2009) on broilers fed similar levels of *Garcinia kola* seed meal. Uko *et al.* (2001) also reported that water extract from *Garcinia kola* fed to rats had depressive effect on feed intake. There were no treatment effects on hen-day egg production ($P > 0.05$) at inclusion levels of 5.0 and 7.5%. The reason for the significantly ($P < 0.05$) poor performance of the group on 2.5% inclusion level cannot be immediately established. The results tended to contradict the findings of Adedeji

Table 2: Proximate and mineral composition of *Garcinia kola* seeds (DM basis)

Proximate composition (% of DM)	
Dry matter, %	92.70
Crude protein	2.64
Crude fibre	20.51
Ether extract	9.47
Ash	1.07
Nitrogen free extract	57.54
Macro elements (mg/g)	
Magnesium	0.28
Calcium	0.25
Potassium	1.61
Phosphorus	0.057
Sodium	0.282
Chlorine	0.400
Sulphur	0.073
Micro elements (mg/g)	
Fe	0.02
Zinc	0.003
Copper	0.05
Manganese	0.012

et al. (2008) that *Garcinia kola* tended to significantly ($P < 0.05$) enhance hen-day egg production. This could be as a result of the differences in ingredient composition of the diets used in the two trials.

The eggs of the *Garcinia kola* groups were heavier than the control with 2.5% and 5.0% inclusion levels having significant treatment effect ($P < 0.05$). Adedeji *et al.* (2008) observed no significant differences in egg weight.

Economics of production showed that feed cost increased as the dietary level of *Garcinia kola* meal increased due to the high cost of the test material. This invariably resulted in very high egg production cost as the dietary levels of the meal increased.

Egg quality indices

There were no treatment effects ($P > 0.05$) on egg shape index, egg shell index, egg shell weight, egg specific gravity, Haugh unit, egg shell thickness, albumen index

and yolk index. T_{2.5} had significantly ($P < 0.05$) heavier percent albumen than the other treatments while the control had significantly ($P < 0.05$) heavier percent yolk. Harms and Hussein (1993) reported that eggs containing a large proportion of thick white albumen are regarded as being of high quality. This implies that *Garcinia kola* produces good quality eggs. The findings tended to indicate that *Garcinia kola* meal had no negative effects on the quality of the eggs produced.

Conclusion

The results of the study have shown that *Garcinia kola*, nutritionally speaking, is mainly a carbohydrate concentrate. The results also showed that the meal at dietary levels of 2.5 – 7.5% slightly reduced egg production but enhanced egg weights of laying hens. It did not adversely affect egg quality. However, at its current market price, it cannot be recommended as feed

Table 3: Performance indices of laying hens fed graded levels of *Garcinia kola*

Parameters	Experimental Diets				SEM
	T ₀	T _{2.5}	T _{5.0}	T _{7.5}	
Av. initial body weight (kg)	1540.1	1565.7	1503.3	1527.2	10.21
Av. final body weight (kg)	1751.1	1680.0	1630.6	1711.2	19.38
Av. body weight changes (g)	211.00 ^a	123.33 ^b	130.67 ^b	190.00 ^a	12.87
Av. daily feed intake (g)	133.02	132.38	135.84	136.74	0.78
Hen-day egg production (%)	67.43 ^a	54.83 ^b	63.73 ^a	59.00 ^{ab}	3.25
Egg weight (g)	58.54 ^b	0.27 ^a	60.78 ^a	59.55 ^{ab}	0.36
Feed conversion ratio					
(g feed/g egg)	2.27	2.20	2.23	2.30	0.02
Cost of feed (₦/kg feed)	82.61	109.26	135.91	162.56	-
Cost of production (₦/kg egg)	187.52	240.37	303.08	373.89	
Mortality	0.00	0.00	0.00	0.00	-

^{ab}Means within the same row with different superscripts are significantly different (P<0.05).

Table 4: Egg quality indices of the experimental laying hens

Parameters	Expeirmental Diets				SEM
	T ₀	T _{2.5}	T _{5.0}	T _{7.5}	
<u>External egg quality</u>					
Egg weight (g)	60.09 ^b	64.80 ^a	64.86 ^a	63.77 ^a	0.85
Egg shape index	0.74	0.77	0.75	0.74	0.01
<u>Internal egg quality</u>					
Haugh unit (HU)	53.60	52.60	50.81	51.15	0.53
Albumen index	0.16	0.18	0.16	0.18	0.03
Yolk index	0.40	0.41	0.35	0.37	0.07
Percent albumen	59.04 ^b	73.42 ^a	58.61 ^b	62.18 ^b	2.04
Percent yolk	26.17 ^a	20.77 ^c	23.18 ^{bc}	24.83 ^{ab}	0.70
Shell weight (g)	4.80	5.05	5.99	5.59	0.25
Egg shell index	10.98 ^b	10.97 ^b	13.03 ^a	12.12 ^{ab}	0.55
Egg shell thickness (mm)	0.34	0.30	0.31	0.31	0.02
Egg specific gravity	1.08	1.07	1.08	1.08	0.00

^{abc}Means within the same row with different superscripts are significantly different (P<0.05)

ingredient in laying diets in view of its negative effect on feed cost and cost of egg production.

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