Effect of dietary *Abelmoschus esculentus* leaf meal on performance and egg quality indices of laying hens

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Abstract

Twelve weeks feeding trial involving 75 point of lay hens of black Harco breed was carried out to study the effects of dietary inclusion of Abelmoschus esculentus leaf meal (AELM) on the performance and egg quality characteristics of the birds. Fresh Abelmoschus esculentus leaves were harvested, spread out and air-dried in a green house and allowed to dry for 6 days until it became crispy. The branches were threshed carefully to separate the leaf from the twig before milling to fine particle size to form Abelmoschus esculentus leaf meal (AELM). Proximate analysis of AELM and dietary treatments were analyzed Gross energy of leaf meal was carried out using an adiabatic bomb calorimeter model CAL 2k. The 75 birds were grouped into five dietary treatments comprising 15 birds each in a completely randomized (CRD) design. The treatments were further subdivided into three replicates of five birds each. Five iso-nitrogenous and iso-caloric diets were formulated as_0, 2.5%, 5%, 7.5%, and 10% inclusion levels in diets 1, 2, 3, 4 and 5 respectively. The result of the proximate composition of AELM showed that the crude protein, crude fibre, crude fat or ether extract, ash and ME values were 13.15, 10.11, 6.0% and 1308.41 Kcal/kg respectively. Average final weight, average weight gain, feed intake and hen- day production were significantly (P<0.05) affected by the inclusion level of Abelmoschus esculentus leaf meal. Birds in the control group and those fed diet containing 5% Abelmoschus esculentus leaf meal had similar final weight (1.53kg) and higher than other treatment groups. The highest (P<0.05) hen-day production was recorded at 5% inclusion level while 2.5%, 7.5% and 10% levels had comparable values (49.13, 46.98 and 49.21). Internal and external egg qualities as affected by AELM inclusion levels showed that the egg, shell, yolk, albumen weights were significantly (P< 0.05) influenced by the dietary treatments with the group of birds on 10% recording highest values. Significant (P<0.05) improvement in yolk weight and colour was observed in the AELM treated birds compared to the control. The total lipid profile of eggs revealed significant (P<0.05) differences in the cholesterol, triglyceride, high density lipoprotein and low density lipoprotein values measured. A linear trend was observed in the recorded cholesterol, triglyceride and high density lipoprotein (HDL) values. The values decreased with increased AELM inclusion. It can therefore be concluded at the level of this study that Abelmoschus esculentus leaf meal inclusion in the diet of laying birds improved performance and egg quality indices with desirable aesthetic effect on egg yolk colour.

Keywords: *Abelmoschus esculentus,* leaf meal, layers, performance, egg quality, total lipid

Introduction

The high cost of livestock feeds necessitated by the ever increasing cost of feedstuffs arising from competition between man and livestock for the same feedstuffs has resulted in persistent decline in the poultry industry and its consequences on the sub-optimal animal protein consumption by Nigerians. Esonu *et al.* (2001) ascribed the closed down of some of the country's poultry farms to shortage of feed. This feed shortage has been blamed on high cost of the conventional sources of ingredients which Opara (1996) and Madubuike and Ekenyem (2001) have rated at 70%-80% of total cost of poultry production. Pressure from consumers of cheaper animal products have necessitated the assessment of local feed ingredients for possible utilization during periods of scarcity and soaring costs (Oluokun, 2001). The use of leaf meals as feed ingredient and alternative to conventional feed resources is a novel area of research in animal nutrition. Leaf meals of some tropical legumes and browse plants, rich in nutrients like vitamins, minerals and carotenoids, abundant and available have been reported included in the diets of poultry as a means of reducing cost and subsequently improving profit margin (Udedibie, 1987; Udedibie and Opara, 1996; Esonu*et al.,* 2002; Emenalon*et al*., 2009; Onyimonyi*et al*., 2009) and particularly the performance and egg quality characteristics responses to different dietary inclusions of leaf meals (Fasuyi*et al*., 2005; Mohammed and Khadiga, 2009). Okra, *Abelmoschusesculentus* also known as ladies fingeris a widely cultivated vegetable crop in the tropics and sub tropics and also in warm temprate areas (Kochhar, 1986). It is a tall annual dicotyledonous plant grown in a well drained humus rich soil and a pH around 6-7.The nutritional constituents of okra are high and include calcium and iron (Savello*et al*., 1980), protein and fat (Oyelade*et al*., 2003), oil and carbohydrate (Woolfe*et al*., 1977). Okra has been used in ethno medicine for the treatment of several disorders; an infusion of the roasted seeds has sudorific properties (Grieve, 1984; Chopra *et al*., 1986). Fibre and mucilage okra contains is a valuable nutrient for intestinal microorganisms for proper intestinal functionality and removal of toxic substances which loads the liver respectively (Nilesh*et al*., 2012) In view of its relative abundance and nutritional properties, the study was designed to evaluate its effects on performance and egg quality indices of the laying birds.

Materials and methods

The experiment was carried out at the poultry unit of the Directorate of University Farms (DUFARMS) of the Federal University of Agriculture Abeokuta, Ogun State Nigeria. The area lies on latitude $7^0$15'N and longitude $3^0$21'E, it is 76m above sea level and located in the tropical rainforest vegetation zone with an average temperature of 34.7^{0}C and relative humidity of 82%. Mean annual temperature and humidity are 34.7^{0}C and 82% respectively. Seasonal distribution of rainfall is approximately 44.96mm in the late dry season (January-March), 212.4mm in the early wet season (April-June), 259.3mm in the late wet season (July-September) and 48.1mm in the early dry season (October-December). (Google Earth, 2012).

Fresh okra leaves (*Abelmoschus esculentus)* were sourced from Idere, Ibarapa Central local Government, Igbo-Ora, Oyo state. The leaves were spread out and air-dried in a greenhouse and allowed to dry for 6 days until it became crispy while still retaining its greenish colouration. The branches were threshed carefully to separate the leaf from the twig before milling to fine particle size using attrition mill with 2mm screen size to form *Abelmoschus esculentus leaf meal (AELM)*. Five iso_nitrogenous and iso_caloric experimental diets were formulated such that AELM was incorporated into the diets at 0, 2.5, 5, 7.5, and 10% inclusion levels respectively. (Table1).

Table1 : Gross composition of the experimental diet (%)

	AELM Levels				
Ingredients	0	2.5	5.0	7.5	10.0%
Maize	47.0	46.5	46.0	45.5	45.0
Soya bean	13.0	12.5	12.0	11.5	11.0
GNC	7.5	7.5	7.5	7.5	7.5
AELM	0	2.5	5.0	7.5	10.0
PKC	5.0	5.0	5.0	5.0	5.0
Wheat offal	15.3	13.8	12.3	10.8	9.3
Bone meal	2.5	2.5	2.5	2.5	2.5
Oyster shell	8.0	8.0	8.0	8.0	8.0
Layers premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100
Determined Composition					
CP (%)	16.00	16.28	16.65	16.75	16.88
EE (%)	3.61	3.69	3.77	3.73	3.82
CF (%)	3.78	4.46	4.62	4.69	4.78
Ash(%)	6.88	7.05	7.71	7.82	7.69
DM (%)	90.76	90.93	90.68	90.89	91.03
NFE	63.14	62.52	61.26	61.01	60.83
Calculated Analysis					
Crude Protein (%)	17.41	17.29	17.12	16.94	16.76
Energy (KJ/kg)	10.88	10.77	10.67	10.56	10.45

A total of 75 Harco Black hens (18 weeks old) were sourced from a reputable farm in Ogun state. The birds were grouped into five dietary treatments of 15 birds per group; these were further divided into 3 sub- groups of 5 birds each. Before the arrival of the birds, pen and other equipment were thoroughly washed and disinfected. All other management protocols such as routine vaccination, medication were properly administered and proper hygiene was maintained. Feed and water were provided *ad libitum*.

Chemical analyses

Proximate analysis of the leaf meal and dietary treatments were conducted using standard methods (AOAC, 1995) to determine their chemical compositions. Gross energy of leaf meal was carried out using an adiabatic bomb calorimeter model CAL 2k.

Data collection

A known quantity of feed was given to birds while the leftover of feed was weighed to determine daily feed intake and consequently weekly feed intake. The birds were weighed on replicate basis at the commencement of the experiment and subsequently on weekly basis.

The feed conversion ratio (FCR) of each group of birds was determined by calculating the ratio of feed intake to weight gain. Percentage hen day production was computed as the total number of eggs over the number of hen multiplied by 100.

Two eggs per replicate were randomly selected from the eggs laid on the last day of every week for egg quality measurement. Egg weight was measured using Mettler top-loading weighing balance. The length and width of each egg was measured using digital vernier calipers. Egg shape index (ESI) was calculated as the percentage of the egg breadth (width) to the egg length. Egg shells were air-dried and later weighed to obtain the shell weight. The percentage shell weight was calculated by expressing the shell weight as a percentage of the weight of the whole egg. The thickness of individual air-dried shells was measured to the nearest 0.01mm using digital micrometer screw gauge. The eggs were broken and the maximum albumen height was measured with spherometer. The yolk weight in percentage was calculated as the yolk weight expressed as a percentage of the whole egg. Percentage albumen weight was calculated by expressing the albumen weight as a percentage of the whole egg weight. Yolk colour was determined by using F.Hoffman-La-Roche yolk colour fan which ranges from 1-15. Haugh Unit (HU) was calculated according to Haugh (1937).

Two eggs per replicate making a total of 30 eggs were taken for egg total lipid analysis. The eggs collected were weighed and recorded, the eggs were later boiled and the yolk was removed. Each of the yolk was weighed and oven dried until a constant weight was obtained. About 5g of hard cooked yolk was dissolved in 50mls of a mixture of chloroform and methanol in the ratio 2:1(v/v) and kept overnight for complete extraction of lipid. Total lipids in egg yolk were determined according to Solver *et al*. (1978). Cholesterol concentration in egg was determined following Liebermann-Burchard method developed by Solver *et al*. (1978)

Statistical analysis

All data were subjected to analysis of variance (ANOVA) using Completely Randomized Design (CRD) while the mean differences were separated using Duncan Multiple Range Test (Duncan, 1955).

Results

The result of the proximate composition of AELM is as shown in Table 2.

Table 2: Proximate composition of okra (*Abelmoscus esculentus*) leaf

Parameter	Compostion
Moisture (%)	10.50
Crude protein (%)	13.15
Crude fibre (%)	15.10
Crude fat (%)	10.11
Ash (%)	6.00
NFE (%)	45.14
Energy (Kcal/kg)	1308.41

Proximate composition analysis results showed crude protein, crude fibre, ether extract, ash and ME values to be 13.15, 15.10, 10.11, 6.0% and 1308.41kcal/kg respectively. Table 3 shows the effect of *AELM* on performance of laying hen. The result showed that average final weight, average weight gain, feed intake and hen day production were significantly ($P<0.05$) affected by the inclusion level of *AELM*. Birds in the control group and those fed diet containing 5% *AELM* had similar final weight (1.53kg) and higher than other treatment groups.

The daily weight gain ranged between 0.17-0.30kg/bird with the control birds performing better than AELM based diets.Daily feed intake ranged between 0.13-0.14g with the control diet recording highest value than AELM based diets.The highest ($P<0.05$) hen-day production was recorded at 0% inclusion level followed by 5% level while 2.5%, 7.5% and 10% levels had comparable values (49.13, 46.98 and 49.21). The egg qualities as affected by *AELM* inclusion levels are presented in Table 4.

The egg, shell, yolk, albumen weights were significantly ($P< 0.05$) influenced by the dietary treatments with the group of birds on 10% *AELM* recording highest values. Significant ($P<0.05$) improvement in egg weight, yolk weight and yolk colour was observed in the AELM treated birds compared to the control. The inclusion of AELM affected the egg and yolk weights with AELM based diets having higher values compared to the control.The use of AELM in layers diets positively enhanced ($P<0.05$) the egg yolk colour.

Table 5 presents the effect of *AELM* inclusion on the total lipid profile of laying hens egg. Significant ($P<0.05$) differences were observed in all the parameters measured by the inclusion levels. A linear trend was observed in the recorded cholesterol, triglyceride and high density lipoprotein (HDL) values.

Table 3: Performance characteristics of laying hens fed diets containing varying levels of okra leaf meal.

	Level of inclusion (%) of AELM					
Parameters	0	2.5	5	7.5	10	SEM
Average initial weight(kg/b)	1.23	1.21	1.25	1.22	1.26	0.02
Average final weight (kg/b)	1.53[a]	1.45[ab]	1.53[a]	1.39[b]	1.45[ab]	0.14
Average weight gain (kg/b)	0.30[a]	0.24[b]	0.28[b]	0.17[c]	0.19[c]	0.13
Feed intake (g/b/d)	140.14[a]	133.13[b]	135.55[ab]	130.13[b]	128.25[b]	3.01
Hen day production (%)	55.80[a]	49.13[c]	50.33[b]	46.98[c]	49.21[bc]	2.32
Feed per dozen egg	3.28	3.90	3.30	4.12	4.10	0.05
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

abc means on the same row with different superscripts are significantly different ($p<0.05$)

Table 4: Effect of *Abelmoschus esculentus* leaf meal on egg quality characteristics of laying hens

	Levels of leaf meal (%)					
Parameters	0	2.5	5.0	7.5	10	SEM
Egg Weight (g)	50.57[b]	60.33[b]	61.18[b]	60.03[b]	62.15[a]	1.25
Egg Shape Index	0.68	0.70	0.71	0.68	0.68	0.04
Shell Weight (g)	5.18[b]	5.95[ab]	5.22[b]	5.22[b]	6.35[a]	0.16
Shell Thickness (mm)	0.52	0.52	0.51	0.52	0.52	0.02
Yolk Weight	13.10[b]	16.10[b]	18.63[a]	15.17[b]	16.45[b]	0.43
Albumen Weight	32.29[b]	38.27[b]	38.87[b]	38.75[b]	40.35[a]	0.83
Haugh Unit	70.85	79.46	82.03	79.20	79.52	1.48
Yolk Colour	2.00[b]	3.00[b]	4.16[a]	4.00[ab]	4.10[ab]	0.41

abc means on the same row with different superscripts are significantly different ($p<0.05$)

Table 5: Effect of *Abelmoschus esculentus* leaf meal on total lipid profile of laying Hens egg

	Levels of leaf meal (%)					
Parameters	0	2.5	5.0	7.5	10	SEM
Cholesterol (mg/dl)	239.90[a]	192.20[ab]	110.90[b]	95.40[c]	92.50[c]	3.42
Triglyceride (mg/dl)	359.00[a]	351.50[a]	269.00[ab]	230.80[b]	227.60[b]	6.39
HDL (mg/dl)	86.40[a]	58.10[ab]	42.00[ab]	36.00[ab]	13.20[b]	5.14
LDL (mg/dl)	81.70[a]	63.80[b]	15.10[c]	13.20[c]	18.20[c]	8.69

abc means on the same row with different superscripts are significantly different ($p<0.05$)

HDL: High density lipoprotein LDL: Low density lipoprotein

Discussion

The crude protein value obtained in this study was lower than 30.12, 17.3 and 25.10% values reported by (Onyimonyi and Ernest, 2009; Esonu *et al*., 2002 and Iheukwumere *et al*., 2008) for *Carica papaya, Microdesmis puberula* and *Manihot esculentus* leaf meals respectively. The crude protein content of AELM may suggests its utilization as a possible protein feedstuff in the diet of laying hen that does not require high protein diet compared to broilers. The crude fibre of 15.10% is lower than the 24.8% observed for M*icrodesmis puberula* (Esonu *et al*., 2002), but higher than 5.60, 11.4, 12.00 and 12.93% reported for pawpaw, cassava, neem and mucuna leaf meals by (Onyimonyi and Ernest, 2009; Iheukwumere*et al*., 2008; Onyimonyi*et al*., 2009 and Emenalom *et al*., 2009). The relatively high AELM crude fibre may make it a potentially energy diluents feed ingredient for laying birds. The depressed growth rate observed in the AELM based diets agrees with the previous observations that inclusion of leaf meal in poultry diets causes depression in the growth performances (D'Mello and Acamovic, 1989; Esonu *et al.* 2003). The depressed growth as the levels of AELM in the diets increased might be attributed to the low crude protein content of AELM and relatively high fibre level which could impair dietary utilization (Nwokolo *et al., 1985*).AELM might contain residual anti-nutrient factors and the concentration may be at higher levels of dietary inclusion limiting the nutritive value of leaf protein to cause the observed depressive effect (Aletor and Adeogun, 1995). The observed reduced intake in AELM diets does not agree with earlier work of Esonu *et al*. (2003) who opined that the inclusion of a fibrous material in a feeding trial had an energy dilution effect on feed and consequently increased intake. In the meantime,Nworgu and Fasogbon (2007) reported reduced feed intake for Black Nera pullets fed diets containing 2%, 4% and 6% *Centrosema pubescens* leaf meal which was in agreement with current study. The reduced feed intake reported in the AELM based diets compared with control diet might be responsible for the pattern of egg production recorded in this study. Also, it may be due to the increase in the amount of fibre as the AELM increased in the diet. Dietary fibre has been reported to form complexes with other nutrients thereby preventing their breakdown and utilization and thus, reduced egg production (Mohamed and Khadiga, 2009). The reduced hen day production is in agreement with the work of Fasuyi *et al*. (2005). The absence of mortality among all the experimental birds seems to have given AELM a clean bill of health as regards its utilization in livestock nutrition. According to Abeke (1997) egg weight is more of a function of the age of birds and the quality of feed, the improved egg and yolk weights recorded in AELM based diets is suggestive of the nutritional quality of the diets. Similarly, the higher shell weight values compared to control diet observed in AELM treated birds might be due to adequate calcium and phosphorus levels in the diets. The non_significance of shell thickness implied all the dietary treatments were adequate in calcium which is similar to a finding by Lawal (1992. Shell thickness is a function of calcium and phosphorus levels in layers ration and also, an indication of the specific gravity (Oluyemi and Roberts, 1979). It could therefore be inferred that the inclusion of AELM has no depressing effects on the specific gravity of egg. Positive enhancement of *Abelmoschus esculentus* leaf meal (AELM) in layers diets is in agreement with the results of Odunsi *et al*., 2002; Odunsi, 2003) who recorded increased egg yolk colour for layers fed gliricidia and lablab leaf meals respectively. Also, in agreement with the results of Machii (2000) who observed that the yolk from eggs laid by hens receiving diets incorporating mulberry leaf meal (MLM) progressively increased in colour. Moller *et al*. (2000) reported that increased yolk colour is due to a greater content of carotenoids in egg yolk. Even though the xanthophylls content of AELM was not analyzed, the increase in egg yolk coloration was indication of high bio-availability of the xanthophylls in the leaf meals (Udedibie, 1987; Udedibie and Opara, 1998). Lipid profile values decreased with increased *Abelmoschus esculentus* leaf meal inclusion. This could be attributed to higher fibre content of AELM based diet. Story and Furumoto (1998) opined that dietary fibre often results in reduction of cholesterol for incorporation into lipoprotein.Similar result was obtained from Machii (2000) who found reduced egg-yolk cholesterol with mulberry leaf meal. Liver is the organ that regulates the deposition of lipids and phospholipids in egg-yolk (Bell and Freeman, 1971). *Abelmoschus esculentus*has been found to wash away toxic substances and cholesterol in the liver (Nilesh *et al*., 2012).

Conclusion

It can be concluded from this study that feeding laying hens with 5% inclusion level of *Abelmoschus esculentus*leaf meal increased final weight, yolk weight and yolk colour of laying hens. Laying hens can be fed with *Abelmoschus esculentus*leaf meal up to 10% inclusion level for reduced lipid profile.

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Received 23rd December, 2016
Accepted 6th March, 2017