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Influence of *Moringa oleifera l.* and *Adansonia digitata l.* leaf meals on performance and egg quality characteristics of Amok layers

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Target Audience: Farmers, Animal Scientist, Nutritionist, Extension experts.

Abstract

A twelve-week trial was conducted to assess the influence of dietary inclusion of Moringa oleifera and Adansonia digitata (Baobab) leaf meals on laying performance and egg quality characteristics of Amok layers. A total of 84, point of lay birds were randomly assigned to four dietary treatments namely; T1, control diet without leaf meal; T2, diet containing 2.5% Moringa oleifera Leaf Meal (MOLM), T3, diet containing 2.5% Baobab Leaf Meal (BLM) and T4, diet containing 2.5% MOLM+2.5% BLM. Each treatment had seven replicates with three birds per replicate. Feed intake in T1 and T3 birds did not differ ($p>0.05$) but was lower ($p<0.05$) than those of T2 and T4 birds. Diet had no effect ($p>0.05$) on feed conversion ratio in layers. Body weight gain was higher ($p<0.05$) in the T1 birds than in the T4 birds. Hen day production was higher ($p<0.05$) in T3 birds compared with those fed other diets. The T1 birds had lower ($p<0.05$) hen day production than that of birds fed other diets. Proximate composition of egg did not differ ($p>0.05$) between the treatments. Dietary inclusion of MOLM, and BLM influenced ($p<0.05$) the external and internal egg quality traits except egg length and Haugh unit. These results suggest that the inclusion of 2.5% MOLM, 2.5% BLM, and a combination of 2.5% MOLM and 2.5% BLM could be utilized in the diet of layers, without deleterious effects on laying performance and egg quality traits. In this respect, the inclusion of 2.5% BLM seemed to be the best.

Keywords: *egg quality, feed conversion ratio, hen day production,*

Description of Problem

Poultry industry is a predominant source of protein in both developed and developing countries (1, 2). The expansion of the poultry industry depends largely on the availability of good quality feed in sufficient quantity and at prices affordable to both producers and consumers (1). This is very important for intensive enterprise especially for layers, which are very sensitive to nutrition such that inadequacies in nutrient supply often led to fall in egg production and even cessation of lay (3). With the present trend of rising prices of feed ingredients, there has been a search for non-conventional feedstuff with potentials of improving poultry performance at reduced cost (4, 5). Of such non-conventional feed sources, leaf protein concentrates have been reported in many literatures (6, 7, 8, 9, 10, 11). *Leucaena leucocephala* leaf meal (LLM) and *Moringa oleifera* leaf meal (MOLM) are among the leaf meals that could be used as feed alternatives in commercial livestock and poultry in the tropics (12, 13).

Moringa oleifera is a multipurpose tree. Its fresh leaves and green pods are used as vegetables by humans and are rich in carotene and ascorbic acid, with a good profile of amino acids (26). It is also used as a livestock feed and has appreciable crude protein levels (10, 13, 24, 40, 47). On a dry matter basis, *Moringa oleifera* leaves contained 27.2% crude protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrates (50). The essential amino acid contents of the leaves and sulphur containing amino acids of the kernel were higher than the amino acid pattern of the FAO reference protein (11); however, other essential amino acids of the kernel were deficient (25).

Baobab (*Adansonia digitata*) is a deciduous tree, native of African savannah (49). Baobab leaf contains 11-17 % crude protein and with an amino acid composition comparing favourably with that considered the ultimate for human nutrition (44, 51,). Although there are a lot of information on the utilization of Moringa and Baobab by man and animals, information on their effect on performance and egg quality of poultry birds is scarce. The objectives of this study were to assess the influence of *Moringa oleifera* Leaf Meal (MOLM) and Baobab Leaf Meal (BLM), on performance and egg quality parameters of laying chickens

Materials and Methods

Experimental site

The study was conducted at Bature Farms, Badawa, Kano. Kano state is located in the Sudan Savannah zone of North Western Nigeria, between latitude 7^0 34' and 9^0 29' North and longitude 8^0 33' and 12^0 27' East of the equator (22). The area receives rainfall of between 787 to 1320 mm annually from May to September with an average temperature range of 21 to 44 ^oC (35). The vegetation type is composed of variety of trees, grasses and shrubs. Common plants found in the area include; *Moringa oleifera, Adansonia digitata* and *Khaya senegalenses*.

Source of *Moringa oleifera* and *Adansonia digitata* leaves

The leaves of *Moringa oleifera* and *Adansonia digitata* used for the study were collected from the Teaching and Research farm of Faculty of Agriculture, Bayero University, Kano. The harvested leaves were dried under the shade for a week, for easy milling and to prevent bleaching. The dried leaves were ground and sieved to get powdered MOLM and BLM. Proximate analysis of both the Moringa and Baobab was carried out.

Experimental birds, management, and dietary treatments

A total of 84 Amok layers at 16 weeks old were used. Prior to the experiment, the birds were vaccinated against Newcastle and Gumboro diseases and weighed individually. Thereafter, birds were randomly allotted into four dietary groups. The treatments included, T1, control diet without leaf meal; T2, diet containing 2.5% MOLM, T3, diet containing 2.5% BLM, and T4, diet containing 2.5 %MOLM + 2.5% BLM. Each treatment was replicated seven times with three birds per replicate. The diets were formulated to meet the NRC requirements for laying birds (34). The chemical compositions of the dietary treatments were determined following the protocol of AOAC (6). The birds were kept under deep litter management system and sawdust was used as the litter material. At the beginning of the experiment, a preliminary period of 7 days before data collection was allowed for acclimatization of birds with experimental diets, and data was collected for twelve weeks. Birds had *ad libitum* access to water. Birds were provided with diet once daily in the morning. The amount provided in each pen was weighed. The refusals were weighed the next day just before provision of another ration. The ingredients and the chemical composition of dietary treatments are presented in Table 1.

Table 1: Ingredients and chemical composition of dietary treatments

	Dietary treatments			
Ingredients (%)	T1	T2	T3	T4
White Maize	35.5	30	27	30.5
Rice Bran	24	29	30	24
Wheat Offal	19	17	19	19
Groundnut Cake	20	20	20	20
MOLM[2]	0	2.5	0	2.5
BLM[3]	0	0	2.5	2.5
Salt	0.5	0.5	0.5	0.5
Premix	0.5	0.5	0.5	0.5
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Analyzed composition,%				
Dry matter	93.60	94.40	91.00	93.40
Ash	2.70	3.80	2.60	4.20
Crude Protein	17.60	18.30	16.90	17.80
Crude Fibre	3.90	4.10	3.30	4.50
Ether Extract	2.70	3.20	3.60	2.90
NFE	66.70	65.00	64.60	64.00
Calculated composition, %				
ME[4](kcal/kg)	2677.0	2607.0	2600.0	2612.0
Phosphorous	0.24	0.26	0.26	0.26
Methionine	0.51	0.52	0.54	0.50
Lysine	0.89	0.88	0.85	0.87

[1]T1, diet without leaf meal; T2, diet containing 2.5% *Moringa oleifera* leaf meal (MOLM), T3, diet containing 2.5% Baobab leaf meal (BLM), and T4, diet containing 2.5 % MOLM + 2.5% BLM.[2]*Moringa oleifera* leaf meal, [3]Baobab leaf meal; [4]Metabolizable energy.

Data collection

At the commencement of the experiment, the initial weight of the birds was recorded to the nearest 0.01g, and final weight was also recorded at the end of the study period. Feed intake was measured as the difference between the amount of feed offered and the amount of refusals. Eggs collected were recorded daily, and weighed to the nearest 0.01g. Linear measurements were taken with vernier caliper to the nearest 0.01cm. The internal egg characteristics were measured by the breakout method described by Monira *et al* (30). Egg contents were poured into a flat plate, weighed and the internal parameters such as yolk height, and albumen height were measured with the aid of spherometer while yolk width and albumen width were measured using a vernier caliper. Thereafter, the albumen was separated from the yolk using a separation funnel and weighed. The eggshell was air dried at room temperature for 48 h and weighed. Shell thickness was measured with micrometer screw gauge to the nearest 0.01mm.

The Haugh unit (Hu) was calculated using the formula

$$Hu = 100 \text{ Log } (H + 7.5 - 1.7W^{0.37})$$

Where H is height of albumen in mm and W is the weight of the eggs

Hen-Day Production (HDP) was estimated using the formula:

$$HDP (\%) = \frac{\text{Number of eggs laid}}{\text{Number of days x number of hens}} \times 100$$

Statistical analysis

The experiment followed a completely randomized design model. Data collected were subjected to the General Linear Model procedure of SAS (41). Means were separated using fisher least significant difference. Level of significance was set at $p<0.05$.

Results

Performance characteristics

The impact of dietary treatments on the production performance of Amok layers are presented in Table 2. The control birds had higher ($p<0.05$) final body weight than the T3 birds. The final body weight of birds fed T2 and T4 did not differ ($p>0.05$) from that of birds fed other diets. Body weight gain in the control birds was higher ($p<0.05$) than that of the T4 birds. Body weight gain in the T2 and T3 birds was not significantly different ($p>0.05$) from those of birds fed other diets. Feed intake in the control and T3 birds did not differ ($p>0.05$) but was lower ($p<0.05$) than those of T2 and T4 birds. The feed conversion ratio (weight of feed consumed/weight of egg produced) was not significantly different ($p>0.05$) between the treatments. Hen day production was higher ($p<0.05$) in T3 birds compared with those fed other diets. The control birds had lower ($p<0.05$) HDP than that of birds fed other dietary treatments.

Table 2: Performance characteristics of Amok Layers fed different leaf meals

	Treatments[1]				
Parameters	**T1**	**T2**	**T3**	**T4**	**LSD**
Initial weight (g)	1568.61	1565.04	1561.87	1568.04	NS
Final weight (g)	1787.95^{a}	1774.95^{ab}	1770.14^{b}	1772.23^{ab}	17.79
Weight gain (g)	219.33^{a}	209.90^{ab}	208.29^{ab}	205.52^{b}	13.16
Feed intake (g/bird/day)	104.92^{b}	114.60^{a}	109.52^{b}	114.60^{a}	6.04
Weight of egg produced (kg)	4.38	3.99	4.74	4.13	0.25
Feed conversion ratio	2.01	2.41	1.94	2.33	0.16
Hen day production (%)	71.42^{d}	85.71^{b}	90.47^{a}	80.95^{c}	4.56

^{ab}Means with different superscripts within the same row differ significantly ($p<0.05$). [1]T1, control diet without leaf meal; T2, diet containing 2.5% *Moringa oleifera* leaf meal (MOLM), T3, diet containing 2.5% Baobab leaf meal (BLM), and T4, diet containing 2.5 % MOLM + 2.5% BLM

Proximate composition of eggs

The chemical composition of eggs obtained from birds fed different leaf meals is presented in Table 3. Dietary treatments did not affect ($p>0.05$) the chemical composition of egg.

Table 3: Proximate Composition of egg obtained from Amok layers fed different leaf meals

	Dietary treatments			
Nutrient (%)	**T1**	**T2**	**T3**	**T4**
Ash	0.77	0.68	0.99	1.12
Moisture	14.85	12.58	15.98	13.48
Crude Protein	11.03	12.35	13.78	11.13
Ether Extract	11.25	10.36	9.60	11.13

[1]T1, control diet without leaf meal; T2, diet containing 2.5% *Moringa oleifera* leaf meal (MOLM), T3, diet containing 2.5% Baobab leaf meal (BLM), and T4, diet containing 2.5 % MOLM + 2.5% BLM

External egg quality parameters

The external quality traits of eggs obtained from birds fed diet with different leaf meals are presented in Table 4. Apart from egg length, all the parameters showed significant differences ($p < 0.05$) with the inclusion of MOLM and BLM in the diet of layers. The T3 birds had higher ($p<0.05$) egg shape index compared with those fed the T4 and control diets. The T2 birds had similar ($p>0.05$) egg shape index as those fed the T3 and control diets. The T1 and T4 eggs had similar egg shape index. Egg weights in T3 and T4 birds did not differ ($p>0.05$) but was higher than that of T1 and T2 birds. Egg width was greater ($p<0.05$) in the T4 birds than in the T1 and T2 birds. There was no significant difference ($p>0.05$) in the egg width between the T1 and T2 birds and between the T2 and T3 birds. The T1 and T2 eggs had lower ($p<0.05$) shell weight than the T3 and T4 eggs. The control eggs had higher ($p<0.05$) shell thickness than the T2 and T3 eggs. Shell thickness in the T4 birds did not differ ($p>0.05$) from those of other birds.

Table 4: External quality parameters of eggs obtained from layers fed different leaf meals

Egg Parameters	Dietary treatments					
	T1	T2	T3	T4	LSD	LS
Egg shape index (mm)	129.41^{bc}	134.42^{ab}	135.79^{a}	126.53^{c}	6.175	0.012
Egg Weight (g)	56.95^{b}	55.79^{b}	61.34^{a}	57.55^{a}	1.500	0.000
Egg Length (mm)	56.70	56.00	57.40	68.30	NS	0.404
Egg Width (mm)	42.50^{bc}	42.09^{c}	42.84^{ab}	43.07^{a}	0.517	0.002
Shell Weight (g)	4.33^{b}	4.32^{b}	4.71^{a}	4.75^{a}	0.320	0.007
Shell Thickness (mm)	0.41^{a}	0.34^{b}	0.36^{b}	0.37^{ab}	0.040	0.024

[abc]Means with different superscripts within the same row differ significantly ($p<0.05$). [1]T1, control diet without leaf meal; T2, diet containing 2.5% *Moringa oleifera* leaf meal (MOLM), T3, diet containing 2.5% Baobab leaf meal (BLM), and T4, diet containing 2.5 % MOLM + 2.5% BLM

Internal egg quality parameters

The internal quality traits of eggs obtained from birds fed diet supplemented with different leaf meal are presented in Table 5. The control birds had heavier ($p<0.05$) yolk than that of birds fed other dietary treatments. Yolk weight in T2, T3 and T4 eggs was similar ($p>0.05$). Yolk height was higher ($p<0.05$) in the T2 and T4 eggs compared with the control and T3 eggs. The T3 eggs had heavier ($p<0.05$) albumen weight than the control eggs. Albumen weight in T2 and T4 eggs was similar to that of other eggs. Albumen height and haugh unit were not affected ($p>0.05$) by dietary treatments.

Table 5: Internal quality parameters of egg obtained from layers fed different leaf meals

	Dietary treatment					
Parameters	T1	T2	T3	T4	LSD	LS
Yolk Weight (g)	40.92^{a}	34.08^{b}	34.86^{b}	36.87^{b}	3.420	0.000
Yolk Height (cm)	0.49^{b}	0.65^{a}	0.54^{b}	0.65^{a}	0.065	0.000
Albumen Weight (g)	16.12^{b}	16.57^{ab}	17.26^{a}	16.62^{ab}	0.706	0.019
Albumen Height (mm)	6.60	6.62	6.92	6.62	0.084	0.061
Haugh unit	82.00	82.40	82.60	81.70	5.341	0.215

[abc]Means with different superscripts within the same row differ significantly ($p<0.05$). [1]T1, control diet without leaf meal; T2, diet containing 2.5% *Moringa oleifera* leaf meal (MOLM), T3, diet containing 2.5% Baobab leaf meal (BLM), and T4, diet containing 2.5 % MOLM + 2.5% BLM.

Discussion

The high cost of conventional feedstuff and the competition between man and livestock for conventional feedstuff heightens the need to explore the potentials of unconventional feedstuffs in the poultry diets (9, 45). Herein, we examined the suitability of including MOLM, BLM and their combination in the diets of layers. The inclusion of MOLM and BLM combination affected body weight changes in layers. This observation was unexpected due to the isocaloric and isonitrogenous nature of the dietary treatments. Energy and protein levels are the major factors influencing body weight gain in layers (1). The lower body weight gain in the T4 birds compared with the control birds could be attributed to the phytochemical contents of the leaf meals, which can modulate fat metabolism in chickens. Contrarily, the supplementation of leaf meal had no effect on the body weight gain of layers (2).

The increase in feed intake in layers fed diets containing MOLM and blend of MOLM and BLM might be due to phytochemicals present in the leaf meals. Phytochemicals, vitamins and minerals in medicinal plants can stimulate feed intake (16, 19, 46,). Our finding is consistent with that of Adeosun et al. (4) who reported that the inclusion of 3.5% baobab fruit pulp meal enhanced feed intake in laying birds. However, the inclusion of 10.5% baobab fruit pulp meal reduced feed intake in laying birds (32). In addition, Bale *et al.* (7) observed that feeding graded levels of baobab seed meal based diets up to 30% to broiler starter had no significant ($p<0.05$) effect on feed intake, weight gain and feed conversion ratio. The values obtained for feed intake were consistent with those reported by Bolu *et al.* (8). In spite of the changes in feed intake, the FCR did not differ from the treatments suggesting homogeneity in feed efficiency. Contrarily, (37) reported that the inclusion of MOLM up to 10% to cassava chips-based diet in laying birds had no effect on feed intake.

Hen day production is an important indicator for the productivity of laying birds. In this study, the inclusion of leaf meal enhanced HDP in laying birds. This finding could be attributed to the phytochemicals in leaf meal, which stimulated egg production. Our finding is contrary to that of Gakuya *et al.* (14, 15) who recorded a decreased average egg laid as levels of MOLM were increased, which was attributed to decrease in feed intake. The current observation is consistent with that of Abou-Elezz *et al*. (2) who reported that 5% Leucaena leaf meal or MOLM enhanced HDP in Rhode Island Red hens, while using higher levels (10 and 15%) adversely affected the egg laying rate and egg mass production. Thus, our findings imply that the level of leaf meal used was well tolerated by the laying birds.

The chemical composition of egg was not influenced by dietary treatments. This observation could be due to the homogenous energy and protein contents of the dietary treatments. The values of proximate components of egg observed in our study are in tandem with the report of Tharrington *et al.* (48).

The inclusion of MOLM and BLM affected all external egg parameters except egg length. The highest values of egg shape index (135.79 mm), egg weight (61.34 g) and albumen weight (17.26 g) were obtained in T3. However, T4 recorded the highest values of egg width (43.07mm), shell weight (4.75 g) and yolk height (0.65 cm), while T1 had the highest figures in shell thickness (0.41 mm) and yolk weight (40.92 g). These results contrasted with the study of (8) who reported that BLM inclusion in the diet of Black Harco layers showed no significant effect on egg external quality traits. Adeosun *et al.* (4) reported that the inclusion of baobab fruit pulp meal was tolerated up to 3.5% and it decreased feed cost per dozen eggs and improved Haugh unit value. Abou-Elezz *et al.* (2) reported that the increased albumen proportion and decreased yolk proportion accompanied the increase of MOLM levels in the diet of Rhode Island Red hens. In addition, (20) observed that the values of Roche colour scores and albumen percentage increased with the increase in the level of MOLM. Abou-Elezz *et al.* (2) concluded that no adverse effects were found on the shell weight and lower yolk proportion percentage, shell thickness percentage or egg shape index due to the MOLM or Leucaena leaf meal treatments, and their inclusion could be acceptable up to 10% in Rhode Island Red hens' diet.

Egg weights with a range of 52.30g to 61.19g were observed in the study. These values were within the values reported by previous studies (2, 20). The values also agreed with a range egg weight values observed by (29) when Leucaena leaf meal (LLM) was fed to laying chickens. However, mean egg weight values were slightly lower compared with standard egg weight (58g) reported by (23, 43).. The egg weigh in the present study were lower than egg weight value of 57g reported by (27). The reason for the lower egg weight values could be due to fact that laying chickens used in the present study were within the first phase of egg production. Eggs in first phase are usually smaller than in the 2nd and 3rd phase (33). The variability suggested that egg weight was influenced by other factors than nutrition such as genotype, stage of laying and climate.

Conclusion and Applications

1. The results of this study showed that the inclusion of MOLM, BLM and their combination induced significant changes in laying performance, and internal and external egg quality attributes of laying birds.
2. The results evinced the potentials of MOLM and BLM leaf meals and their blend in the diets of laying birds. From the result obtained, inclusion of Baobab leaf meal at 2.5% in the diet of laying birds is recommended.

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