Performance characteristics of broilers fed graded levels of *Moringa oleifera* leaf meal

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Abstract

Cost of conventional protein sources is on the increase recently; hence, there is the need for cheaper alternative sources that will not compromise the performance characteristics of broiler birds taking into consideration the cost of production. Moringa leaf meal has been reported to increase the performance of broiler birds due to its rich protein content. Two hundred day-old broiler chicks were used to assess the effects of partial replacement of soya bean meal with Moringa (*Moringa oleifera*) leaf meal on broiler chickens in an 8-wk feeding trial. The birds were randomly assigned in equal numbers into five dietary treatments: 0, 5, 10, 15, and 20 % Moringa leaf meal (MOLM). Each treatment was replicated four times with 10 birds per replicate. The results showed that final weight, weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio were significantly (p<0.05) influenced by inclusion levels of MOLM and the birds fed with 20% MOLM inclusion level had the highest values of 2490.00 g, 2445.00 g, 43.66 g, 5212.92 g, 93.09 g and 2.13, respectively. The dressed weight, eviscerated weight and dressing percentage of carcass yield were also significantly (p<0.05) enhanced with increase in inclusion levels of MOLM with the birds fed 20% MOLM inclusion level had the highest values of 2267.50 g, 1963.75 g and 89.49%, respectively. The incorporation of MOLM in the diets did not have any significant (p>0.05) effect on primal cut parts and relative organ weight. From the results of this study, replacement of soybean meal with MOLM up to 20% did not have any adverse effect on growth performance and carcass traits of broiler chickens.

Key words: broiler chickens, Moringa leaf meal, growth performance, carcass characteristics

Introduction

Food and Agriculture Organization (2010) reported that broiler chicken farm business has grown into a complete industry with rapid development due to the increasing and rapid demand for chicken meat especially when meat products from other farm animals have high retail prices as well as religious and traditional restrictions. The success recorded in this industry also has consequences on feed-based resource which is increasing both qualitatively and quantitatively thus resulting in high price of feed ingredients, particularly the protein source which is becoming very expensive and scarce due to competition with human needs. According to Ekenyem (2002), feed costs amount to a considerable proportion of production cost in any intensive livestock production system. Hence, with the present trend of rising prices of feedstuffs, considerable attention has been placed on the search for non-conventional feedstuffs

(Esmail, 2002). Farinu *et al*. (1992) opined that the protein from leaves may be fed to poultry in the form of leaf protein concentrate. For instance, leaf meals made from shrubs have been useful to small-scale farmers (WAC, 2006). Various leaf meals such as leucaena (Udedibie and Igwe, 1989), amaranthus (Frages *et al*., 1993), centrosema (Nworgu, 2004) and cassava (Ogbonna and Oredein, 1998) have been used in poultry diets. In recent times, there is stimulated interests in the utilization of leaves from Moringa trees as an alternative affordable source of protein in poultry nutrition (Abou-Elezz *et al.*, 2011; Olugbemi *et al*., 2010). Leaves of Moringa are promising as a food source in the tropics because the tree is covered with green leaves during the dry season when other foods are scarce (Melesse *et al.*, 2009).

Moringa oleifera is a multipurpose tree, which leaves and green fresh pods are used as vegetables by humans and are rich in carotene and ascorbic acid with a good profile of amino acids (Makkar and Becker, 1997). It is also used as livestock feed and its twigs are reported to be very palatable to ruminants and have appreciable crude protein levels (Sutherland *et al.*, 1990; Sarwatt *et al*., 2002). Results of analyses by Oduro *et al*. (2008) revealed that Moringa leaf meal contained 76.53, 27.51, 19.25, 7.13, 2.23, and 43.38% of dry matter, crude protein, crude fibre, ash, ether extract and nitrogen free extract, respectively. Because of the high protein content of the Moringa leaf meal, this experiment was therefore conducted to determine the effects of Moringa leaf meal (MOLM) as a partial replacement for soybean meal on growth performance and carcass characteristics of broiler chickens.

Materials and Methods

Experimental site

This study was carried out at the Poultry Unit, Teaching and Research Farms Directorate (TREFAD) of the Federal University of Agriculture, Abeokuta, Ogun state, Nigeria. The location of the Poultry Unit lies within the rainforest vegetation zone of South West Nigeria with a mean annual rainfall of 1037 mm, a temperature of 34.7^0C and a relative humidity of 82%. It is located in the region 145 metres above sea level, with latitude 7^0 13’ 51.39’’ N and longitude 3^0 16’ 17.84’’ E (Google Earth, 2014).

Preparation of Moringa oleifera leaf meal and experimental diets

Moringa oleifera leaves were harvested by hand-plucking the leaves from the trees within Abeokuta metropolis. The leaves were air-dried, milled and sieved using 1-mm mesh to form Moringa leaf meal (MOLM). About 12 kg of *Moringa oleifera* leaves produced 1 kg of MOLM. Five experimental diets were formulated: MOLM included at 0% (control), 5%, 10%, 15% and 20% levels for Diets 1, 2, 3, 4, and 5, respectively. The diets were formulated as straight diets to contain almost similar chemical content as shown in Table 1.

Table 1: Ingredient inclusion levels and the chemical content of the experimental diets

Ingredients	Diet 1[1]	Diet 2[1]	Diet 3[1]	Diet 4[1]	Diet 5[1]
Maize	55.00	55.00	55.00	55.00	55.00
Soybean meal	23.00	21.85	20.70	19.55	18.40
MOLM*	0.00	1.15	2.30	3.45	4.60
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat offal	3.85	3.85	3.85	3.85	3.85
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated nutrients composition					
ME** (kcal/kg)	3104.87	3066.92	3028.97	2991.02	2948.35
Crude protein (%)	21.83	21.33	20.83	20.32	20.08
Crude fat (%)	4.20	4.18	4.14	4.10	4.12
Crude fibre (%)	3.51	3.44	3.37	3.29	3.22
Calcium (%)	1.63	1.63	1.62	1.62	1.62
Phosphorus (%)	0.94	0.93	0.93	0.92	0.91
Ash (%)	3.00	2.95	2.89	2.83	2.80

[1]Diet 1 (0% MOLM), Diet 2 (5% MOLM), Diet 3 (10% MOLM), Diet 4 (15% MOLM) and Diet 5 (20% MOLM)

*MOLM - *Moringa oleifera* leaf meal, **ME - Metabolizable Energy

Preparation of brooding house

The brooding house and its environments were thoroughly cleaned, washed and disinfected. Electric bulbs and coal pots were used as source of light and heat. Black polythene was also used to cover the brooding house during the brooding phase in order to provide additional warmth for the chicks. The temperature of the brooding house was thoroughly monitored to prevent too low or excessive heat.

Experimental birds and management

Two hundred unsexed day-old Cobb broiler chicks were assigned to five experimental diets in a complete randomized design. Each treatment had four replicates with 10 birds per replicate. Each replicate was fed with an assigned experimental diet for a period of 8 wk**.** The birds were managed under intensive, deep litter system with wood shavings as the bedding materials as standard management condition for broilers in the tropics; and also recommended routine medication and vaccination programmes were observed.

Data collection

Feed intake and weight gain were determined on a weekly basis while feed conversion ratio was calculated. Mortality was recorded as it occurred and expressed in percentage (%) while the cost benefit of feeding MOLM was also determined by using the cost of the test ingredient (MOLM) and other feed ingredients in the overall cost estimation of the feed. At the end of the feeding trial, two birds from each replicate were randomly selected and were deprived of feed for a day. They were slaughtered and eviscerated for carcass evaluation. Live weight, dressed weight, and eviscerated weights, primal cut parts and the internal organs weights were taken and expressed as a percentage of the dressed weight.

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using the General Linear Model procedure of SAS (2007). Significant means were separated using Duncan's Multiple Range Test at 5% level of probability.

Results and Discussion

The performance characteristics of broiler chickens fed graded levels of *Moringa oleifera* leaf meal is shown in Table 2, with significant ($p<0.05$) difference observed in most of the parameters examined. Final weight was significantly ($p<0.05$) enhanced with birds fed 20% inclusion level of *Moringa oleifera* leaf meal having the highest ($p<0.05$) value of 2490.0 g followed by those fed 15% MOLM while birds fed diet with 0% (control) had the least value of 1902.5 g. Also, the weight gain was significantly ($p<0.05$) influenced by MOLM inclusion levels with birds fed diets 20% inclusion level had highest values of 2445.0 g while diet with 0% (control) inclusion level had the least mean value of 1857.5 g. Daily weight gain was significantly ($p<0.05$) highest in birds fed diet containing 20% inclusion level of MOLM with the mean value of 43.7 g and lowest ($p<0.05$) in 0% (control) with the mean value of 33.2g. These results indicate that MOLM improved the growth performance of broilers, which is consistent with Ayssiwede *et al.* (2011) who reported that *M. oleifera* leaf meal added to broiler diets significantly increased the average daily weight gain of the broilers. Hence, the improved weight gain of the birds fed MOLM authenticate the nutritional potency of *Moringa oleifera* leaf meal and strengthen the feed protein. Zarkadas *et al*. (1995) reported that proteins of *Moringa oleifera* have very high biological value and all the essential amino acids present in it are in a concentration greater than that of soyabean. Likewise, the total feed intake and daily feed intake were significantly ($p<0.05$) highest in birds fed 15 and 20 % MOLM (5040.9 g and 90.02 g) and (5212.9 g and 93.1 g), respectively, while their counterparts in the control and lower level of MOLM diets were similar. The significant increase in feed intake observed at higher inclusion levels is in accordance with the observations of Gadzirayi *et al*. (2012) who reported an increase in feed intake of broilers receiving solvent-extracted soybean meal supplemented with *Moringa oleifera* leaf meal. According to the researchers, the observed increase in feed intake might be attributed to increased bulkiness of the feed and metabolizable energy concentration of the diets. It, however, disagrees with the report of Onu *et al*. (2014) who reported lower feed intake at 7.5% dietary level of MOLM. Feed conversion ratio was significantly ($p<0.05$) better in all the birds fed MOLM than the control diet. A low FCR is a good indication of high quality feed (Hascik *et al*., 2010). The improvement in the feed conversion ratio of the birds fed on *Moringa oleifera* leaf meal based diets as compared to control group may be because the birds fed *Moringa oleifera* leaf meal based diets adequately utilized the nutrients in the diets they consumed. The results coincide with the finding of Ebenebe *et al*. (2012) who reported that chicks fed on *Moringa oleifera* leaf meal based diets performed significantly (p<0.05) better than the birds of control group in terms of higher weight gain and better feed conversion ratio. Approximately, 2.5% mortality was observed among all the groups except the group fed with 5% MOLM which was considered to be an anomaly. As has been reported that the addition of MOLM as a feed supplement does not produce any adverse effects on the health and mortality of broiler chickens (Zanu *et al*., 2012). Thus, the *Moringa oleifera* leaf meal was excluded as a factor for the increase in the mortality rate but plays a major role in improving growth performance of chicken as it is enriched with nutritional constituents.

Table 2: Growth performance indices of Cobb broiler chickens fed with graded levels of *Moringa oleifera* leaf meal (MOLM)

Parameters	Diet 1[1]	Diet 2[1]	Diet 3[1]	Diet 4[1]	Diet 5[1]	SEM**
Initial weight, g	44.8	44.9	45.0	45.1	44.8	1.15
Final weight, g	1902.5^{d}	2157.5^{c}	2096.8^{c}	2362.5^{b}	2490.0^{a}	33.92
Weight gain, g	1857.7^{d}	2112.6^{c}	2051.8^{c}	2317.4^{b}	2445.2^{a}	33.92
Daily weight gain, g	33.2^{d}	37.7^{c}	36.6^{c}	41.4^{b}	43.7^{a}	0.61
Total feed intake, g	4561.4^{b}	4473.4^{b}	4336.2^{b}	5041.0^{a}	5212.9^{a}	126.26
Daily feed intake, g	81.5^{b}	79.9^{b}	77.4^{b}	90.0^{a}	93.1^{a}	2.20
FCR*	2.5^{b}	2.1^{a}	2.1^{a}	2.2^{a}	2.1^{a}	0.05
Mortality, %	2.5	2.5	2.5	5.0	2.5	2.58

[abcd]Means on the same row having different superscripts are significantly (p<0.05) different
[1]Diet 1 (0% MOLM), Diet 2 (5% MOLM), Diet 3 (10% MOLM), Diet 4 (15% MOLM) and Diet 5 (20% MOLM)
*FCR - Feed conversion ratio, **SEM – Standard error of mean

The result of the carcass characteristics of Cobb broiler chicken fed with experimental diets is shown in Table 3. The inclusion of *Moringa oleifera* leaf meal in the diets significantly (p<0.05) enhanced the dressed weight, eviscerated weight and dressing percentage. The dressed weight ranged from 1817.5 g to 2267.5 g with 20% MOLM inclusion level had the highest (p<0.05) dressed weight of 2267.5 g. The eviscerated weight and dressing percentage of birds fed 20% MOLM inclusion level had the highest (p<0.05) value 1963.8 g and 89.5%, respectively. This result is in agreement with the report of Ologhobo *et al.* (2014) who mentioned that higher mean values of slaughter weights were recorded for birds fed diets containing *Moringa oleifera* leaf meal as compared to those fed on the control diet which had the lowest mean. In addition, the researchers concluded that the *Moringa oleifera* at 200, 400 and 600 g levels had no negative influence on the carcass quality, but rather improved the breast and drumstick portions of broiler chicks. However, there was no significant (p>0.05) difference observed in all the primal cut parts (breast, drum stick, thigh, back, neck, wing, head and shank) and the relative organ weights. This result is similar to the finding of Zanu *et al.* (2012) who indicated that none of the parameters measured for carcass characteristics in birds fed diets containing *Moringa oleifera* was affected significantly by inclusion level and the mean value for slaughter weight, heart, proportion of thigh, breast and drumstick were within the range reported by Asafa *et al.* (2012).

Table 3: Carcass characteristics of Cobb broiler chickens(fed with graded levels of *Moringa oleifera* leaf meal (MOLM)

Parameters	Diet 1[1]	Diet 2[1]	Diet 3[1]	Diet 4[1]	Diet 5[1]	SEM**
Live weight, g	2182.5[b]	2053.5[b]	2065.0[b]	2400.0[a]	2537.0[a]	60.26
Dressed weight, g	1863.0[c]	1833.3[c]	1817.5[c]	1990.0[b]	2267.5[a]	42.15
Eviscerated weight, g	1637.5[c]	1582.5[c]	1557.5[c]	1780.0[b]	1963.8[a]	37.48
Dressing percentage, %	85.5[ab]	89.2[a]	88.1[a]	83.0[b]	89.5[a]	1.52
<u>Primal cut part, %</u>						
Breast	24.9	26.3	26.1	25.4	27.5	0.92
Drumstick	10.7	11.03	10.22	10.67	10.2	0.59
Thigh	11.2	11.1	11.7	11.1	12.8	0.55
Back	13.5	13.4	13.3	13.2	13.2	0.58
Neck	4.7	4.6	4.8	4.5	5.1	0.32
Wing	7.9	8.2	8.0	7.6	8.2	0.32
Head	2.4	2.4	2.5	2.5	2.7	0.12
Shank	3.9	4.2	4.4	4.2	4.4	0.22
<u>Organ weight, %</u>						
Liver	1.8	2.1	2.0	1.8	1.9	0.15
Heart	0.4	0.5	0.4	0.5	0.5	0.05
Spleen	0.1	0.2	0.1	0.1	0.1	0.03
Lungs	0.6	0.7	0.6	0.5	0.7	0.08
Gizzard	1.6	1.8	1.6	1.6	1.7	0.11
Offals, %						
Intestine	5.3	5.1	5.5	4.2	4.7	0.51
Abdominal fat	0.2	0.5	0.4	0.3	0.4	0.25

[abc] Means on the same row having different superscripts are significantly different ($p<0.05$)
[1]Diet 1 (0% MOLM), Diet 2 (5% MOLM), Diet 3 (10% MOLM), Diet 4 (15% MOLM) and Diet 5 (20% MOLM)

The cost benefit analysis of the experimental diets fed to the broiler chickens is presented in Table 4. There were significant ($p<0.05$) differences in the quantity of feed consumed, feed cost (in Nigerian currency, ₦), cost of the feed consumed (₦/kg) and feed cost per weight gain (₦/kg). The feed consumed per bird ranged from 4.56 to 5.21 kg. Feed cost were significantly ($p<0.05$) different with birds fed 20% MOLM inclusion level diet had the highest feed cost of ₦123.74, followed by birds fed 15% MOLM inclusion level diet which was ₦120.99 and 10%, 5%, and 0% inclusion level diets had the least values. Also, the cost of the feed consumed were significantly ($p<0.05$) influenced by the level of inclusion of MOLM. The cost of feed consumed increased with increase in the level of inclusion of MOLM. Furthermore, feed cost per weight gain was also significantly ($p<0.05$) influenced by the level of inclusion of MOLM. The highest cost (₦264.06) was recorded in Diet 1 (0% MOLM inclusion level) while the least cost (₦236.55) was recorded in Diet 2 (5% MOLM inclusion level). This result shows that feeding MOLM gave a higher incidence cost. Widespread claims on the health benefits in humans have increased the demand and the price of Moringa leaves. Hence, planting of Moringa trees should be encouraged among farmers for its multipurpose benefits.

Table 4: Cost benefits of broiler chickens fed graded levels of *Moringa oleifera* leaf meal (MOLM)

Parameter	Inclusion levels of MOLM					SEM
	0%	5%	10%	15%	20%	
Feed consumed, kg	4.56[c]	4.47[d]	4.33[e]	5.04[b]	5.21[a]	0.02
Feed cost, kg	107.6[a]	111.6[b]	114.2[c]	121.0[d]	123.7[e]	0.06
Cost of feed consumed. ₦/kg	491.2[a]	499.1[c]	495.6[b]	609.8[d]	644.7[e]	0.09
Feed cost/ weight gain, ₦/kg	264.1[e]	236.6[a]	241.8[b]	262.9[c]	263.1[d]	0.06

[abcde] Means in a row followed by the same superscript are not significantly different (p>0.05)
*SEM – Standard error of means

Conclusion

From the results obtained in this study, inclusion of MOLM did not have any adverse effect on growth performance and carcass traits of broiler chickens rather it enhanced their quality. Hence, soybean meal could be replaced with MOLM up to 20% in broiler diet.

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