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GROWTH PERFORMANCE OF BROILER CHICKENS FED DIETS CONTAINING GRADED LEVELS OF *Moringa oleifera* LEAF MEAL

Akintunde, A.R.[1,*], Al-Isa, W.[1], Oguntoye,M.A.[1], Adeoye,S.O.B.[3], Akinsola,O.M.[2], Isaac, S.[4],Istifanus, E.F.[5]Taphee, D.G.[1] and Ayuba, A.[6]

[1]Department of Animal Science, Taraba State University, Jalingo, Nigeria
[2]Department of Veterinary Theriogenology and Production, Faculty of Veterinary Medicine, University of Jos, Jos, Nigeria
[3]Department of Animal Physiology, Federal Univ. of Agriculture, Abeokuta, Nigeria
[4]Department of Agricultural Science Education, Federal College of Education (Technical) Bichi, Asaba, Nigeria
[5]Department of Animal Science, University of Uyo, Uyo, Nigeria
[6]Department of Animal Production, College of Agriculture, Jalingo, Taraba State.

***Author for Correspondence:** fola_akintunde@yahoo.com

ABSTRACT

A study was carried out to investigate the effect of graded levels of *Moringa oleifera* leaf meal (MOLM) on growth performance of broiler chickens. A total of one hundred and fifty (150) broiler were randomly assigned to five experimental dietary treatments containing MOLM at 0, 2.5, 5.0, 7.5 and 10 %. The diets were designated as T_1, T_2, T_3, T_4 and T_5 respectively with 30 broiler chicks per treatment. The five treatment groups were replicated three times with 10 chicks per replicate in a completely randomized design. Feed and clean water were supplied ad libitum. Both the starter and finisher phases lasted for 56 days. The results revealed that all the parameters evaluated at the starter phase were statistically influenced ($p<0.05$) by the dietary inclusion of MOLM except mortality (%). Final weight, total weight gain, average daily weight gain, total and daily feed intake were significantly ($P<0.05$) higher in birds fed MOLM based diets compared to those in the control group. Feed conversion ratio (1.42) and cost per kg gain were significantly ($P<0.05$) lower in birds fed the control diet compared to other treatments. At finisher phase, the result showed that final weight and total weight gain of birds on MOLM diets were comparable but significantly ($P<0.05$) higher than those in the control diet T1 (2106.67, 1060g). Higher total and daily feed intake were obtained in birds fed MOLM diets T2, T3 and T5 compared to those in other treatment groups. FCR of birds in T3 (2.50) was significantly ($P<0.05$) better than those in other treatment groups. No significant ($P>0.05$) difference was observed in feed cost per kg gain of birds across the treatments. It was therefore concluded that MOLM at 2.50% in the diets of broiler starter chicks and up to 7.50% in finisher diets can improve growth performance of broiler chickens.

Keywords: Moringa, Broiler starter, growth performance, Broiler finisher,

INTRODUCTION

One of the major challenges facing Nigeria is the satisfaction of the ever-increasing demand for animal protein. FAO (2014) recommended that the minimum intake of protein by an average person should be 65 g per day; of this, 36 g (that is, 40%) should come from animal sources. The country is presently unable to meet this requirement. Tijjani et al. (2012), asserted that the animal protein consumption in Nigeria is 15g per person per day which is a far cry from the FAO recommendation. However, the major factor militating against intensive animal production in meeting this requirement is the high cost of feed and feed ingredients, especially the conventional energy and protein feed ingredients like maize, soybean cake and groundnut cake.

Feed remains the most important cost of Animal production (Kehinde et al. 2006). The need for feed ingredients, which will reduce the cost of production has led to the discovery of novel feed ingredients that are being brought to limelight in livestock feed and production research. This is because man and his livestock are in competition for basic ingredients and such ingredients are not usually produced in sufficient quantities locally (Omojola and Adesehinwa, 2007). Therefore, availability of feed thus becomes the key factor limiting poultry production in Nigeria. Broiler feed

is based primarily on cereal grains and vegetable protein meal, which is supplied for meeting most of energy and protein requirements in poultry diets. One possible source of cheap protein is the leaf meal of tropical legumes (Etalem et al.2013). Due to their availability and relatively low cost, the incorporation of protein from leaf sources in diets of broilers has become a common production practice (Onyimonyi and Onu, 2009; Melesse et al. 2011; 2013).

Moringa oleifera leaves are a good source of proteins for monogastric animals (Makkar and Becker, 1997). Maroyi (2006) reported that, the leaves are readily eaten by cattle, sheep, goats, pigs and rabbits. *Moringa l*eaves are also known to be useful in feeding fish, chickens. Kakengi et al. (2007) reported that *Moringa oleifera* leaves and green fresh pods can be used as vegetable by humans and are rich in carotene and ascorbic acid with a good profile of amino acids and can also be used as livestock feed. Becker (1995) also reported that moringa leaves can be used as cattle feed (beef and dairy cows), swine feed, and poultry feed. In view of the great potential of moringa as an alternative poultry feed ingredient, this study was carried out to evaluate the effect of moringa leaf meal on the growth performance of broiler starter and finisher chickens.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Taraba State University, Jalingo. Jalingo is the State Capital of Taraba State and lies between latitude $8^0$11' to $8^0$50'N and longitudes $11^0$05' to $11^0$25'E. It has a total land area of about 1380 km^2 with estimated population of 139,845 and is situated in the Northern Guinea Savannah zone with an annual rainfall of 1000mm to 1500mm the ambient temperature of the area range between 38° – 41°C. The rainy season being at its peak in June and September. The dry season is between November and March with the hamattan wind blowing from the north east Sahara and Sahel region (Taraba State, Diary 2008).

Experimental Birds and management

One hundred and fifty (150) day old broiler stoves and lanterns were used as a source of heat and light, respectively. Flat feeding trays and plastic drinkers were provided in the brooding room for the chicks. Thereafter, wood shavings was spread on the cemented floor to a depth of two centimeters (2cm) and covered with newspapers to act as an insulator and also to absorb moisture from droppings. The birds were also vaccinated with Gumboro vaccines at the age of two weeks, Newcastle disease vaccine (lasota) at three weeks. All the necessary routine husbandry management practices were duly observed.

Experimental diets and design

Five experimental diets were formulated for starter and finisher phases and contained graded levels of moringa leaf meal at 0, 2.50, 5.00, 7.50 and 10.00% designated as T_1, T_2, T_3, T_4 and T_5 respectively. T1 contained0 % of moringa leaf meal and hence served as control. The composition of the experimental diets are presented in Table1 and Table 2. The one hundred and fifty (150) broiler chicks were randomly assigned to the five dietary treatments in this study with 30 birds per treatment and replicated three times with 10 birds per replicate in a Completely Randomized Design (CRD). The experiment lasted for eight (8) weeks.

Processing of moringa leaf meal

Moringa leaves used in this study were sourced and harvested from a private farm in Jalingo metropolis. The leaves were air dried under room temperature away from sunlight until they were crispy to touch while still retaining their greenish colouration. The leaves were milled and sieved to obtain MOLM and stored in sacs until its usage.

Data collection

Data were collected separately for starter and finisher phases respectively. The performance parameters evaluated were initial weight, final weight, weight gain, feed intake, feed conversation ratio (FCR), feed cost/kg gain and mortality (%). They were computed as presented below:

Total weight gain: this was determined by subtracting initial weight from final weight as follows:

Total weight gain = Final weight - Initial weight

chicks were purchased from Vertex farm, Ibadan, Oyo State. The chicks were brooded for one week using kerosene stove as a source of heat after which they were weighed and randomly assigned to the five treatment groups. Blue-flamed heating Abacha stoves and lanterns were used as a source of heat and light, respectively. Flat feeding trays and plastic drinkers were provided in the brooding room for the chicks. Thereafter, wood shavings was spread on the cemented floor to a depth of two centimeters (2cm) and covered with newspapers to act as an insulator and also to absorb moisture from droppings. The birds were also vaccinated with Gumboro vaccines at the age of two weeks, Newcastle disease vaccine (lasota) at three weeks. All the necessary routine husbandry management practices were duly observed.

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Total weight gain: This was determined by subtracting initial weight from final weight as follows:

Total weight gain = Final weight - Initial weight

Daily weight gain: This was determined by dividing total weight gain by 28days as follows:

$$\text{Daily weight gain} = \frac{\text{Total weight gain (g)}}{\text{28 days}}$$

Feed intake: Feed intake was measured by subtracting left over feed from quantity of feed served the previous day at a 24 hours interval per group. Adequate measures were taken to avoid spillage and related wastage.

$$\text{Feed intake} = \frac{\text{Quantity of feed offered - feed over}}{\text{Number of birds}}$$

Table1: Composition of experimental diets for broiler starter chicks (0-4 weeks)

MOLM = *Moringa oleifera* leaf meal, GNC = Groundnut cake, FFSB = Full Fat Soyabean

Ingredients (%)	Treatments				
	T_1 (0.00% MOLM)	T_2 (2.50% MOLM)	T_3 (5.00% MOLM)	T_4 (7.50% MOLM)	T_5 (10.00% MOLM)
Maize	46.00	43.00	43.00	41.50	41.00
MOLM	0.00	2.50	5.00	7.50	10.00
Wheat offal	6.05	6.05	6.05	6.05	6.05
FFSB	32.00	32.50	30.00	29.00	27.00
GNC	10.00	10.00	10.00	10.00	10.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
*Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis (%)					
ME (Kcal/kg)	2,984.70	2,985.90	299940	3,006.75	3,018.20
Crude Protein	23.55	24.03	23.67	23.73	23.52
Ether Extract	8.61	8.63	8.23	8.04	7.71
Crude Fiber	3.71	3.89	3.95	4.07	4.16
Calcium	0.91	0.92	0.91	0.91	0.90
Available. Phosphorus	0.57	0.57	1.45	1.45	1.36
Lysine	1.51	1.52	1.45	1.45	136
Methionine	0.64	0.64	0.62	0.61	0.60

Feed Conversion Ratio (FCR)

The feed conversion ratio of the experimental birds was measured as an index of feed utilization for each treatment group. It was measured by dividing the feed intake per bird in grams by the live weight gain per bird for each treatment group as follows.

$$\text{Feed conversion ratio} = \frac{\text{feed intake}}{\text{weight gain}}$$

Mortality

Mortality was recorded as it occurred during the experimental period. In each phase of the experiment, the percentage mortality was obtained as;

$$\text{Percentage mortality} = \frac{\text{Number of dead birds}}{\text{Total number of birds housed}} \times 100$$

Table 1: Composition of experimental diets for broiler starter chicks (0-4 weeks)

Ingredients (%)	Treatments				
	T 1 (0.00% MOLM)	T 2 (2.50% MOLM)	T 3 (5.00% MOLM)	T 4 (7.50% MOLM)	T 5 (10.00% MOLM)
Maize	58.00	57.55	55.05	52.55	50.05
MOLM	0.00	2.50	5.00	7.50	10.00
Wheat offal	6.00	6.00	6.00	6.00	6.00
FFSB	20.00	20.00	20.00	20.00	20.00
GNC	9.00	8.00	8.00	8.00	8.00
Fish meal	3.00	2.00	2.00	2.00	2.00
Bone meal	3 .00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
*Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
ME (Kcal/kg)	3,035.30	3,05 2.96	3,056.21	3,059.46	3,062.71
Crude Protein	20.45	19.83	20.17	20.51	20.86
Ether Extract	6.97	6.84	6.79	6.74	6.69
Crude Fiber	3.225	3.39	3.54	3.70	3.85
Calcium	0.91	0.89	0.89	0.89	0.89
Available. Phosphorus	0.56	0.54	0.54	0.54	0.54
Lysine	1.25	1.17	1.17	1.16	1.15
Methionine	0.60	0.57	0.57	0.57	0.56

MOLN = *Moringa oleifera* leaf meal, GNC = Groundnut cake, FFSB = Full Fat Soyabean

Statistical analysis

All data collected were subjected to Analysis of Variance (ANOVA) using general linear model procedure of Statistical Analysis System (SAS, 2008). Means were separated using Duncan Multiple Range Test (Duncan, 1955).

RESULTS

Growth Performance of Starter Broiler Chicks Fed Diets Containing *Moringa oleifera* leaf Meal (MOLM) (0-4 weeks)

Growth performance of starter broiler chicks fed diets containing graded levels of *Moringa oleifera* leaf meal is presented in Table 3. The results showed that there was significant ($p<0.05$) effect of *Moringa oleifera* leaf meal on the performance of broiler starter chicks in all the parameters measured. There was significant ($p<0.05$) difference in final weight of the birds. Higher final weight (1131.67g) was observed in birds fed diet T2 containing 2.5% of MOLM and this was statistically at par with other MOLM based diets. However, birds in the control group (T1)recorded the least final weight (940g).The same trend was recorded for total weight gain and average daily weight gain where birds on the control diets (0% MOLM) recorded lower values of 786.67g and 28.09g for total weight gain and average daily weight gain respectively. Birds on T2 (981.34g, 35.05g), T3 (913.34g, 32.62g), T4 (936.67g, 33.45g) and T5 ((896.67g, 32.02g) were statistically similar but significantly ($P<0.05$)

higher than those in the control group in terms of total weight gain and average daily weight gain respectively. The total feed intake and daily feed intake of birds fed diets containing MOLM were comparable and significantly ($p<0.05$) higher compared to those in the control group (T_1) which had the least values of 1111.70g and 39.67g respectively. However, feed conversion ratio was significantly ($p<0.05$) higher in birds fed diets T2, T3, T4 and T5 containing MOLM when compared to those on the control diet(T1) which had the least value (1.42). It was observed that the control diet had better feed conversion ratio than the MOLM based diets. Feed cost/kg gain (N) was higher in birds fed diet T3 containing 5% MOLM (N218.50) compared to those of other dietary treatments.

Table 3. Growth performance of starter broiler chicks fed diets containing *Moringa oleifera* meal (0 – 4 weeks)

PARAMETERS	Dietary treatments					
	T1 (0% MOLM)	T2 (2.50% MOLM)	T3 (5.00% MOLM)	T4 (7.50% MOLM)	T5 (10.00% MOLM)	SEM
Initial Weight (g/bird)	153.33	150.33	153.33	153.33	160.00	1.63
Final Weight (g/bird)	940.00^{b}	1131.67^{a}	1066.67^{a}	1090.00^{a}	1056.67^{a}	24.63
Total Weight Gain (g/bird)	786.67^{b}	981.34^{a}	913.34^{a}	936.67^{a}	896.00^{a}	24.41
Daily Weight Gain (g/bird/day)	28.09^{b}	35.05^{a}	32.62^{a}	33.45^{a}	32.02^{a}	1.76
Total Feed Intake (g/bird)	1111.70^{b}	1616.70^{a}	1676.70^{a}	1565.00^{a}	1613.30^{a}	64.68
Daily Feed Intake (g/bird/day)	39.67^{b}	57.73^{a}	59.88^{a}	55.88^{a}	57.61^{a}	2.31
FCR	1.42^{b}	1.66^{a}	1.84$^{a`}$	1.70^{a}	1.79^{a}	0.66
Feed cost/kg gain (₦)	169.49	196.51	218.50	205.29	214.37	0.00
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

[ab] Mean in the same row with different superscripts are significantly different ($P<0.05$), SEM= Standard Error of Mean, FCR= feed conversion ratio.

The least feed cost per kg gain (N169.49) was recorded in the control group. No mortality was recorded throughout the period of the study.

Growth performance of finisher broiler chickens fed diets containing *Moringa oleifera* leaf meal (MOLM) (5 – 8 weeks)

Growth performance of finisher broiler chickens fed diets containing graded levels of *Moringa oleifera* leaf meal (MOLM) is presented in Table 4. Results obtained showed that there was significant ($p<0.05$) effect of treatments on all the performance parameters measured across the treatments. Birds on diets T2 (2.50%MOLM), T3 (5.00% MOLM) and T4 (7.50% MOLM) respectively recorded statistically ($P<0.05$) higher final weight, total weight gain, and daily weight compared to those in the control group ((1060.00g, 37.86g),) and T5 (1023.34g, 36.55g) containing 10.00% MOLM. These parameters were seen to be better in birds fed MOLM based diets T2, T3 and T4 and lower in diets T1 (0% MOLM) and T5 with higher inclusion level of MOLM Feed intake was

also influenced (p<0.05) by MOLM inclusion in broiler finisher diets. Broiler finisher chickens fed the control diet. (3116.70; 111.31g) and T4 (3215.00; 114.82g) recorded significantly (P<0.05) lower total feed intake and daily feed intake in comparison to those in other treatment groups T2, T3 and T5 containing MOLM. However, the feed conversion ratio of birds in T1 (3.26), and T5 (3.25) were comparable to those in T2 (2.77) andT4 (2.86). However, FCR was significantly (P<0.05) better in T3 (2.50) compared to other treatment groups. The result also revealed that birds fed diets containing MOLM had lower feed cost/kg gain (N)compared to those in the control group (N 352.92).

DISCUSSION

Growth performance of starter broiler chicks fed diets containing *Moringa oleifera* leaf meal (MOLM) (0-4 weeks)

The result of growth performance of broiler starter chicks fed diets containing *Moringa oleifera* leaf meal obtained in this study agrees with the findings of Banjo (2012) who reported increased weight gain in broiler birds fed diets containing 2% of MOLM. The significant increase in these performance parameters could be attributed to high protein content of Moringa leaf meal as reported by Kakengi et al.(2007) and Olugbemi et al.(2010). Lower weight gain recorded in birds fed higher level of MOLM could be a function of increased fiber content of the diets which may have impaired nutrient digestibility and absorption (Ige et al.2006) and Onu and Anebo (2011) while the reduced weight gain of broilers fed the control diet (T1) may be ascribed to low crude protein content of the diets compared to other diets. The negative effect of the anti-nutritional factors and phytochemical compounds present in *Moringa oleifrea* leaf meal on the birds could be responsible for decreasing performance in birds fed diets T4 (7.5%) and T5(10%) MOLM.

Tijani et al. (2016) had earlier reported a significant (p<0.05) difference in feed intake of broiler chickens fed MOLM based diets at the starter phase. Higher feed intake observed in birds fed MOLM based diets may be attributed to significant amounts of vitamin A, B and C, Calcium, Iron, and Proteins in *Moringa oleifera* leaves as reported by Verman et al. (1976). These class of vitamins and minerals may enhance the palatability of *Moringa oleifera* based diets hence, the higher feed intake.

Table 4: Growth performances of finisher broiler chickens fed diets containing *Moringa oleifera* meal

PARAMETERS	T1 (0.00% MOLM)	T2 (2.50% MOLM)	T3 (5.00% MOLM)	T4 (7.50% MOLM)	T5 (10.00% MOLM)	SEM
Initial Weight(g/bird)	1046.67	1053.33	1053.33	1053.33	1053.33	1.44
Final Weight (g/bird)	2106.67^{b}	2263.33^{a}	2270.00^{a}	2196.67^{ab}	2076.67^{b}	33.81
Total Weight Gain(g/bird)	1060.00^{b}	1210.00^{a}	1217.00^{a}	1143.34^{ab}	1023.34^{b}	595.87
Total Feed Intake (g/bird)	3116.70^{b}	3366.70^{a}	3273.00^{a}	3215.00^{b}	3400.00^{a}	80.19
Daily Feed Intake (g/bird/day)	111.31^{b}	120.24^{a}	116.89^{a}	114.82^{b}	121.43^{a}	2.83
FCR	3.26^{a}	2.77^{ab}	2.50^{b}	2.86^{ab}	3.25^{a}	0.13
Feed cost/kg gain (₦)	352.92	288.13	269.76	308.19	345.67	0.00
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

[ab] Mean in the same row with different superscripts are significantly different (P<0.05), SEM= Standard Error of Mean, FCR= feed conversion ratio

The feed conversion ratio (FCR) result obtained in this study agrees with the findings of Onunkwo and George (2015) but disagrees with the report of Abdulsalam et al. (2015) who reported that MOLM based diets had no effect on feed conversion ratio of broiler chickens. The variation could be attributed to different levels of inclusion used by the researchers. Ugwuowo et al. (2019) in his study observed that the inclusion of MOLM affected the cost of feed as seen in this study. The zero mortality observed in this study is consistent with the findings of Nworgu and Fasogbon (2007) and Abdulsalam et al. (2015) who observed no mortality, when chicks were fed diets containing different levels of moringa leaf meal. The presence of antioxidants in Moringa leaves may be responsible for the zero mortality in chicks fed MOLM diets due to its ability to enhance the immune system of animals (Yang et al. 2006). Supplementation of M. oleifera might have increased immune ability of broilers as reported by Du et al. (2007).

Growth performances of finisher broiler chickens fed diets containing moringa oleifera meal The weight gain results observed in this study disagrees with the findings of Onunkwo and George (2015) who reported that broiler chickens fed diets with 0% Moringa oleifera leaf meal gained significantly ($P<0.05$) higher weight than birds fed Moringa oleifera leaf meal-based diets. This disparity could be attributed to location and varietal differences or stage of leaf harvest of Moringa leaves. Higher feed intake in broiler finisher chickens fed dietary levels of moringa leaf meal may be attributed to improved palatability of the feed. This observation agrees with the findings of Niddaulah et al. (2010) who reported that smell and taste were critical traits in food selection. The result of FCR of broiler finisher chickens in this study disagrees with the findings of Onunkwo and George (2015) who reported a better FCR in their control diet (0% MOLM). It also did not agree with that of Abdulsalam et al. (2015) who reported that MOLM based diets had no effect on feed conversion ratio of broiler chickens. The variation could be attributed to different levels of inclusion used by the researchers.

Moringa leaf meal in broiler finisher diets reduced feed cost per kg gain (N) especially diets T2 (N288.13) and T3 (N269.76). No mortality was recorded also in this phase of the study.

CONCLUSION

It is evident from the findings of this study that *Moringa oleifera* leave meal enhanced the weight gain and feed consumption of broiler chickens at both the starter and finisher phases. Therefore, it was concluded that *Moringa oleifera* leave meal (MOLM) can be used up to 7.50% in the diets of broiler finisher chickens and at 2.50% in the diets of broiler starter chicks without any harmful effect on growth performance and health status of broiler chickens.

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