PERFORMANCE OF BROILER CHICKENS FED ON MORINGA OLEIFERA LEAF MEAL SUPPLEMENTED POULTRY FEED

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ABSTRACT
This exploratory study was conducted to investigate the effect of *Moringa oleifera* leaf meal (MoLM) supplemented diets on the performance of broiler Chickens. Four different graded levels of *Moringa oleifera* leaf meal were used to formulate poultry feed. Ration was formulated using soyabean, yellow maize and *Moringa oleifera* leaf meal as ingredient for broiler booster (20% Cruide Protein) and broiler finisher (18% Criude Protein) using Pearson Squire Method. One hundred and sixty day old unsexed broiler chicks were randomly allocated to four treatment (iso-caloric and iso-nitrogenous) diets as T1 (0% *Moringa oleifera* leaf meal), T2 (0.5% *Moringa oleifera* leaf meal), T3 (0.75% *Moringa oleifera* leaf meal) and T4 (1.0% *Moringa oleifera* leaf meal) in a Completely Randomized Design. The birds were distributed into 4 replicates comprising 10 chickens per replicate and managed under dip litter system for a period of 8 weeks. Water and feed were provided at *ad libitum*. Feed consumption, weight gain and feed conversion ratio were evaluated for the individual replicate of each dietary treatment. In addition, slaughter weight and carcass weight of the birds were recorded throughout the period. Statistical analysis was done using the general linear modeling procedure of SAS. The results obtained showed that significant differences existed in weight gain, feed intake and feed conversion ratio. It was also observed that, addition of Moringa leaf meal up to 1.0% to broiler chicks diet significantly lowered weight gain, feed efficiency and body weight during starter period. During finisher and whole periods however, supplying broiler chick's diet with 0.5% Moringa leaf meal resulted in significant increase in feed consumption, but addition of different levels of Moringa leaf meal had no significant effects on weight gain, feed efficiency and final live body weight. It was concluded that the use of Moringa leaf meal in the broiler diet adversely affected the performance during starter period, but enhanced the performance during finisher and whole period. The study also reveals that Moringa leaf meal can conveniently supplement expensive sources of protein in broiler diet without compromising performance.

Keywords: *Moringa oleifera*, Leaf Meal, Broiler, Growth and Supplementary Feed

INTRODUCTION
Poultry is the most abundant livestock species that account for more than 90% of the total bird's population of the world (Biswas *et al*. 2011) and contributes significantly to income and employment among people of Africa (Yami, 1995). The number of birds in the Nigerian poultry industry has been reported to increase from 107.065 to 156.255 million within a period of ten years from 2001 to 2011 (Strydom *et al*., 2012) representing a substantial increase in the domestic animal supply and by implication the animal protein availability in the menu of the citizens.

Feeds and feeding are integral part of poultry production that account for about 70-75% of the cost of production and at the same time dictates the production strength and quality based on the observed feeding regime and feeding quality. In most developing countries, the major sources of protein in commercial poultry production are fishmeal (FM) and Soya bean cakes. However, these ingredients

limit profitability in the poultry industry as they are usually scarce, expensive and used extensively by other livestock and humans. Thus there is a need to look for non-conventional, cheap, locally available and less competitive plant protein sources as alternative protein sources for feed formulation in poultry diets.The use of leguminous multipurpose trees and shrubs has been suggested to be a viable alternative source of proteins, vitamins and minerals for poultry feeding (Church, 1991). Plants leaves are commonly processed into leaf meals for use as poultry feed. A review of available literature shows that *Leucaena leucocephala, Gliricidia sepium, Sesbania sesban and Manihot esculenta* have been widely used in feeding non-ruminants and especially poultry resulting in improvement of their productivity (D'Mello et al., 1987). Research has shown that *Moringa oleifera* is a promising protein source for inclusion in poultry diets at low levels (Chiseva, 2006).

Moringa plant scientifically referred to as *Moringa oleifera* (genus Moringa and family Moringaceae) originates from Asia and is well distributed in Africa (Francis *et al*., 2005). The tree is considered one of the world most useful plants known for its nutritional, medicinal and significant economic importance. *Moringa oleifera* possess multiple advantages, because different parts of the tree (leaves, fruits, immature pods and flowers) are edibles and forms part of the traditional diets in many tropical and sub-tropical countries (Siddhuraju and Becker, 2003; Anhwange *et al*., 2004). The leaf of the plant contains 86% dry matter, 29.7% crude protein, 4.38% crude fiber, 29.9% either extracts, 3,056 kcal/kg energy, 0.26% calcium, 0.03% phosphorus and negligible amount of tannin etc (Kakengi *et al*., 2003). Regarding chemical composition, Compaoré *et al*. (2011) have reported that *Moringa oleifera* seeds are good source of fats, proteins and minerals.

Moringa oleifera has been under investigation in many counties for its utility in water treatment, human nutrition and immune boosting properties. Jahn (1986) has reported that rural women in Sudan use *Moringa oleifera* seeds instead of alum to remove turbidity from Nile water. Similarly, Madsen *et al*. (1987) have documented that *Moringa oleifera* seeds were used to reduce bacterial count of turbid Nile water in Sudan by 1-4 log units (90-99.9%) within the first 1-2 hours of treatment. *Moringa oleifera* seeds have also been reported to have antimicrobial effects (Eilert *et al*. 1981). In addition, Walter *et al*. (2011) have observed that *Moringa oleifera* and *Moringa stenopetala* methanol and n-hexane seed extracts produced inhibition effect on *Salmonella typhii, Vibrio cholerae* and *Escherichia coli*, which normally cause water borne diseases. *Moringa* plant (miracle tree) has been reported to have many medicinal use such as possession of hypocholesterolemic properties (Olugbemi *et al*., 2010) and impaction of carotenoid compound into the poultry muscle and as such could substitute conventional feedstuffs as it possesses useful characteristic (Sarwalt *et al*., 2002). The objective of this study was to evaluate the performance of broiler chicks in terms of growth and meat yield when fed on *Moringa oleifera* leaf meal as a protein supplement.

MATERIAL AND METHODS

Study Site: The experiment was conducted at the experimental poultry farm (open sided house) of the Department of Agricultural Technology, College of Science and Technology, Kaduna Polytechnic, Kaduna, Nigeria.

Experimental procedure: One hundred and sixty (160) day old vaccinated broiler chicks (mixed sexes) purchased from a commercial hatchery were randomly allocated into 16 wire cages that were then divided into 4 groups (treatments, 4 cages per treatment). One of the groups was fed basal diet only (control) and others were fed the three experimental Diets containing 0.5%, 0.75% and 1.0% of *Moringa oleifera* leaf meal inclusions respectively. The experiment was arranged as a complete randomized design and cages were used as replicate units with 10 birds per replicate.

The birds were raised in deep litter and brooded for the first three (3) weeks of age. The first and second Gumboro disease vaccines were administered on the 10^{th} and 24^{th} days of age. Newcastle disease vaccine (Lasota strain) was administered at the fifth week of age. Water and feed were provided *ad-libitum*. Broilers were fed a starter diet from d 1 to 21 and a grower diet from d 22 to 42. Diets were formulated to meet nutrient requirements for starter and grower broiler chickens and the diet compositions are shown in Table 1. All diets were prepared in one batch. Moringa leaf meal powder was first mixed with premix that was subsequently mixed with other ingredients and then stored in covered containers before feeding.

Preparation of Moringa leaf meal: *Moringa oleifera* plants were harvested from a local farm (Kaduna Polytechnic Quarters Farm) and leaves were removed from the stems, sorted, cleaned with tap water, and dried under shade for 1-2 days. The dried Moringa leaf then ground to pass 1 mm screen to get Moringa leaf powder. To avoid chemically and microbiology damages, the Moringa leaf powder was stored in impermeable glass tubes at ambient temperature (21 to 24°C) before being mixed into diets.

Formulation of experimental diets: Four diets (T1, T2, T3 and T4) were formulated for both the starter and finisher phases. Diet T1 the basal diet served as control (without moringa leaf inclusion). The other three experimental Diets T2, T3 and T4 contained 5.0g, 7.5g and 10.0g *Moringa oleifera* leaf meal inclusions per 1.0kg diet, respectively. Crude protein value for Moringa was based on proximate analysis (Table 3) and that of maize and soya beans were based on figures from literature (McDonald et al., 1995).

The experimental diets were made iso-caloric and iso-nitrogenous and formulated to meet or exceed the National Research Council, (1994) requirements of broiler chicks. The diets were also formulated to meet all the bird's dietary nutrient requirements for pre-starter (0 to 7days), starter (8 to 28days), and finisher (29 to 42days) phases. Starter and finisher diets were formulated to contain 20% and 18.79 % crude protein, respectively. Both diets had a metabolizable energy of 3200 kcal/kg and 3100 kcal/kg, respectively and supplemented with required vitamins, minerals and amino acids. The ingredient and nutrient composition calculated analysis of experimental diets for starter and finisher are shown in Table 1.

Table 1: Ingredient composition of broiler booster and finisher diets formulated with inclusion of Moringa leaf meal (%)

	Broiler Booster				Broiler Finisher			
	T1	T2	T3	T4	T1	T2	T3	T4
	0.00	0.50	0.75	1.00	0.00	0.50	0.75	1.00
Ingredients	←			**Percent**				→
Maize meal	58.00	57.50	57.50	57.50	61.00	61.00	61.00	61.50
Soya beans cake	16.40	16.57	16.65	17.10	08.10	08.10	08.35	08.60
Fish meal	14.00	14.00	14.00	14.00	11.00	11.00	11.00	11.50
Rice bran	02.50	02.50	02.00	00.80	09.50	09,13	08.50	06.50
Super concentrate	05.00	05.00	05.00	05.00	05.00	05.00	05.00	05.00
lysine	00.10	00.10	00.10	00.10	00.10	00.10	00.10	00.10
Calcium phosphate	00.30	00.30	00.30	00.30	00.70	00.70	00.70	00.69
Sunflower oil	01.20	01.20	01.20	01.20	00.60	00.60	00.60	00.61
Lime stone	02.00	02.00	02.00	02.00	03.50	03.50	03.50	03.50
Sodium chloride	00.25	00.25	00.25	00.25	00.25	00.25	00.25	00.25
Vit+miniral premix	00.25	00.25	00.25	00.25	00.25	00.25	00.25	00.25
Moringa leaf meal	==	00.50	00.75	01.00	==	00.50	00.75	01.00
Total	100	100	100	100	100	100	100	100

Data collection: Live performance (average BW, feed consumption and feed conversion ratio-FCR, and mortality) was assessed weekly up to the final age (42 days). In order to obtain carcass data, at 42 days one bird per pen was sampled, weighed, and slaughtered by a sharp knife for complete bleeding and feathers were plucked. Head, viscera and shanks were removed. Carcass was left for one hour to remove excess water. Dressing percentage was calculated without giblets using the following equation:

$$\text{Dressing percentage} = \frac{\text{Carcass weight}}{\text{Live body weight}} \times 100$$

Weekly average feed intake was recorded by subtracting feed left over from quantity of feed given during the week. Body weight was also recorded on weekly basis by subtracting previous week's body weight from the current weight for each week and average daily gain were also calculated. Mortality was recorded throughout the period of the study as it occurred.

Statistical analysis: The data generated from the experiment were subjected to the analysis of variance (ANOVA) using SAS (2005). The individual treatment means were compared using the least significant deference (LSD) test procedure at 5% level.

RESULTS

Effect of feeding *Moringa oleifera* leaf meal supplemented diet on growth performance of broiler during grower period (8-28 days) is presented in table 5. The results indicate that significant difference exist in live body weight, weight gain and daily weight of broiler at the grower stage. However, differences in feed consumption and feed conversion were not significant in response to the feeding of broiler with *Moringa oleifera* leaf meal supplemented diet.

Supplementation of 0.5% MoLM to broiler chick diet was statistically ($P<0.05$) comparable to the basal (no Moringa) diet and significantly higher than the broiler feed supplemented with 0.75 and 1.00

Moringa leaf meal in terms of live body weight. Increased level of Moringa leaf meal supplement to poultry diet from 0.5 up to 1.0% resulted in increased daily and weekly body weight gain. Birds fed with 1.0% Moringa supplemented diets had the highest weight gain/wk that was statically at per with those fed with 0.75% Moringa supplemented feed. The basal diet was statistically comparable to 0.5 and 0.75% MoLM supplemented diet in terms of weekly weight gain. With respect to daily weight gain, the 1.0% Moringa supplemented diet treatment resulted in the highest daily gain in body weight that was statistically similar to the control treatment but significantly higher the other Moringa supplemented treatments.

Table 2: Effect of feeding *Moringa oleifera* leaf meal supplemented diet on growth performance of broiler during grower period (8-28 days)

	Dietary level of Moringa leaf meal (%)				
Parameters	**0**	**0.5**	**0.75**	**1.00**	**Sign.**
Live body weight (g)	2073a	2770a	1538b	1636b	*
Weight gain (g/bird/week)	285b	289b	311ab	356a	*
Daily weight gain (g)	45.7ab	41.4b	42.9b	47.5a	*
Feed consumption (g/bird/week)	366.7a	437.9a	436.3a	384.9a	NS
Feed conversion ratio (feed:gain)	1.3a	1.6a	1.4a	1.5a	NS
Mortality (%)	0.00	0.00	0.00	0.00	0.00

Values in the same raw with different superscripts are significantly different

Table 6 present data on the influence of dietary graded level of Moringa leaf meal on growth performance of broiler during finisher period (8-28 days). The data indicated that all the boiler growth performance parameters were not significantly affected by the experimental diet except live body weight and weight gain. Live body weight was observed to decreased with increasing dietary level of the Moringa leaf meal supplement. The highest live body weight of 2970g was recorded by 0.5% Moringa supplemented diet that was statistically comparable to the basal diet and significantly higher than other experimental feed stuff. There was no statistically significant variation in weekly weight gain in response to the application of Moringa leaf supplement in poultry diets. The no Moringa leaf meal control treatment resulted in the highest body weight gain that was statistically comparable to 0.5 and 1.0% Moringa supplemented poultry feeds during the finisher period.

Table 3: Effect of feeding *Moringa oleifera* leaf meal supplemented diet on growth performance of broiler during finisher period (29-42 days)

	Dietary level of Moringa leaf meal (%)				
Parameters	**0**	**0.5**	**0.75**	**1.00**	**Sign.**
Live body weight (g)	2373a	2970a	1638b	1636b	*
Weight gain (g/bird/week)	659a	603ab	572b	638ab	*
Daily weight gain (g)	138.3a	130.7a	133.1a	132.8a	NS
Feed consumption (g/bird/week)	1936.6a	1132.1a	981.5a	1032.4a	NS
Feed conversion ratio (feed: gain)	1.8a	2.0a	2.1a	1.8a	NS
Mortality (%)	0.00	0.00	0.00	0.00	0.00

Values in the same raw with different superscripts are significance

The influence of ingesting *Moringa oleifera* leaf meal supplemented diet on growth performance of broiler during whole period (8-42 days) is shown Table 7. The result revealed that there was a statistically significant difference in live body weight, weekly weight gain and daily weight increase in response to the addition of *Moringa oleifera* leaf meal in poultry feed. The variation in feed

consumption and feed conversion efficiency with respect to the application of the experimental treatments were however not significant. Live body weight was observed to decrease in value following an increase in Moringa leaf meal inclusion in diet from 0.5 to 0.75 % after which it statistically levels up. Broilers fed with 0,5% Moringa leaf meal inclusion in the diet recoded the highest live body weight (2970g) comparable to those fed with basal diet. Addition of 0.75% Moringa leaf meal resulted in significantly higher weekly weight gain compared to the other Moringa supplemented diet treatments and the control feed that were statistically similar. The results for daily poultry weight gain followed similar pattern as that of weekly weight gain, where inclusion of 0.75% Moringa resulted in the maximum weight gain par day that was statistically similar to the other experimental diets except the one with 1.0% Moringa leaf meal inclusion.

Although the Moringa supplemented poultry feeds did not significantly differ from thee no Moringa inclusion control diets in terms of feed consumption and feed conversion efficiency, the values obtained from the birds fed with Moringa supplemented feed stuff were better than those for broilers fed with the basal diets.

Table 4: Effect of feeding *Moringa oleifera* leaf meal supplemented diet on growth performance of broiler during whole period (8-42 days)

	Dietary level of Moringa leaf meal (%)				
Parameters	**0**	**0.5**	**0.75**	**1.00**	**Sign.**
Live body weight (g)	2773a	2970a	1638b	1619b	*
Weight gain (g/bird/week)	916bc	888bc	1049a	890bc	*
Daily weight gain (g)	360.9ab	351.7ab	376.7a	336.8b	*
Feed consumption (g/bird/week)	1203.5a	1344.6a	1165.6a	1199.9a	NS
Feed conversion ratio (feed: gain)	1.0a	1.3a	1.1a	1.3a	NS
Mortality (%)	0.00	0.00	0.00	0.00	0.00

Values in the same raw with different superscripts are significance

DISCUSION

The appreciable performance of broiler fed with Moringa supplemented diets over those birds fed with the control diet without moringa in terms of live body weight, weight gain and daily body weight gain in this experiment during the grower, finisher and whole periods (Tables 5, 6 and 7) may be due to the presence of benefit factors in Moringa leaf meal including antibacterial materials as reported by Eilert *et al*. (1981). Also Madsen *et al*. (1987) noted that the use of *Moringa oleifera* leaf meal reduced bacterial count of turbid Nile water in Sudan by 1-4 log units (90-99.9%) within the first 1-2 hours of treatment. Furthermore, Walter *et al*. (2011) noticed that *Moringa oleifera* and *Moringa stenopetala* methanol and n-hexane seed extracts produced inhibition effect on *Salmonella typhii*, *Vibrio cholerae* and *Escherichia coli*, which normally cause water borne diseases. Compaoré *et al*. (2011) mentioned that *Moringa oleifera* leaves are considered as a good source of fat, protein, antioxidants and minerals (Mg and Zn), so it can overcome malnutrition due to micronutrients deficiencies in children. Increase in abdominal fat weight with increased *Escherichia coli*, which normally cause water borne diseases. Regarding chemical composition, Compaoré *et al*. (2011) reported that *Moringa oleifera* leaves are good source of fats, proteins and minerals.

The use of Moringa oleifera leaf meal as an additive on broiler chickens feed stuff had no significant effect (P>0.05) on feed consumption and feed conversion ratio (Table 5, 6 and 7). These observations are similar to the ones reported by Tekeli *et al*. (2011) , indicating that antibiotics or plant extract supplementation in a broiler experiment did not influence body weight gain, feed intake and feed

conversion efficiency of the chickens. Similarly, there are other research findings showing that ration supplemented with plant extract and propolis additives did not have significant effect on the improvement of feed conversion efficiency of poultry (Botsoglou *et al*., 2004).

Folorunso and Onibi (2012), also observed no differences on mean weight gain, feed intake and efficiency of food conversion of broilers when fed with diets containing different levels of protein, reason being due to varying dietary protein levels showing that the birds were able to consume at fairly the same level regardless of the quantity of protein in the diet. However, in our observations it may be due to the fact that the nutrients in the diets provided to the broilers were not in same quantities and could have affected the performance of the chickens. Another reason could be that the level of *M.oleifera* provided was too little to have any effects on feed conversion ratio, feed consumption and daily weight gain. The anti-nutritional factors, such as condensed tannins in MOLM could also play a significant role in the nutrition of animals, causing either adverse or beneficial effects on nutrient utilization, health and production (Hoste *et al.,* 2006). Some anti-nutritional factors are reported to affect palatability of diets which in turn will affect feed intake.

body weight gain and live body weight differed significantly in response to the application of Moringa oleifera leaf meal at grower, finisher and whole periods, with the no moringa supplementation control having the highest value at all the production periods . There was no significant difference in daily weight in response to the experimental treatments during the finisher period of poultry production in this experiment (Table 6). The none significant differences observed in average daily weight increase at the finisher stage could be due to the fact that Moringa leaf meal was added in small amounts so there was not much difference between the treatments with Moringa leaf meal that without out it. These findings contradict that of Denil *et al.* (2003) that showed supplementation of additives in broiler diets enhanced nutrient utilization, growth and feed conversion efficiency (FCE) of broilers. Ayssiwede *et al*. (2011) observed that the inclusion of *M.oleifera* leaf meal in the diet of growing traditional Senegal chickens had no negative impact on live body weight, average daily weight gain, feed conversion ratio, carcass and organ characteristics in birds. However, they reported a significant decrease in daily feed intake in treatments that contained different levels of *M.oleifera* leaf meal.

CONCLUSION

Overall, the present study has provided promising data for the use of Moringa oleifera leaf meal as an additive in broiler feed. The results of the study also suggest that a 0.5% inclusion level of *Moringa oleifera* leaf meal could be used in broiler diets to improve growth performance, carcass yield and economic output of broiler chickens. The study also reveals that MoLM can conveniently supplement expensive sources of protein in broiler diet without compromising performance and favoring production cost positively. Hence, poultry farmers are encouraged to patronize the use of MoLM as feed source for their broiler. In addition, further research is necessary to determine how to increase the nutritive value if *Moringa oleifera* leaf meal for broilers and layer chickens in view of its cheapness and abundance.

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