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Effect of Supplemental *Moringa Oleifera* Leaf Meal on Performance of Starter Broiler Birds

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ABSTRACT

Ninety "Ross" unsexed day old broiler chicks were used to determine the optimum level of Moringa oleifera leaf meal supplementation in broiler diet. The experiment was laid out in a completely randomized design (CRD). The birds were randomly selected and divided into five treatment groups of eighteen birds each. Each treatment group had two replicates with nine birds per pen. The birds were fed five diets containing Moringa oleifera leaf meal at 0, 0.5, 1, 1.5 and 2 % levels of inclusion. Results revealed that feed intake of birds on diet 1 (129.39g), 2 (131.71g) and 3 (128.24g) were similar but were significantly (P<0.05) higher than those of birds fed diet 4 (126.56g) and 5 (110.60g). Similarly weight gains of birds on diet 1 (40.82g), 3 (40.20g) and 4 (39.80g) did not differ significantly (P>0.05) but birds on diet 2 (44.80g) had a higher weight gain which resulted in a significantly higher final body weight. Haemoglobin (Hb) values of birds fed diet 2 (10.8g/dl) and 5 (10.2g/dl) were similar (P>0.05) but significantly (P<0.05) higher than those of birds fed diet 1 (8.9g/dl), 3 (8.8g/dl) and 4 (9.0g/dl). Also the packed cell volume (PCV) values of birds fed diet 2 (39%) was significantly (P<0.05) higher than those fed diet 1 (32%), 3 (30%), 4 (34%) and 5 (36%) respectively. The overall result shows that birds on diet 2 (0.5%, MOLM) had significantly (P<0.05) superior body weight gain and final body weight than birds on diet 1 (0%, MOLM), 3 (1%, MOLM), 4 (1.5%, MOLM) and 5 (2%, MOLM). Also haematological values investigated were within accepted normal range for poultry, except for haemoglobin where diet 1 and 3 fell slightly below the recommended values for broiler birds.

Keywords: *Moringa oleifera, Leaf meal, Performance, Starter Broiler Birds*

INTRODUCTION

Nutrition is the most important consideration in any livestock enterprise. Its (livestock industry) survival is dependent on the availability of feedstuffs, which are mainly components of human food (Adewale et al., 2018). The aim of keeping livestock and poultry is for the production of high quality protein.

Agriculturists and Nutritionist in Nigeria have generally agreed that poultry is the fastest means of bridging the protein deficiency gap prevailing in the country (Ahaotu, 2018).

Broiler birds are fast growing birds and are described as good converters of feed and are marketed from eight to twelve weeks. Broiler birds are also regarded as the type of birds that have high feed consumption and conversion ratio of non-conventional feed ingredients that cannot be directly consumed by man into high quality meat which are needed in large quantity by man (Is-Haaq et al., 2018). However, the production of broiler birds as meat bird cannot be effective in the absence of adequate feed and feed ingredients in right proportion. The productivity of poultry in the tropics has been limited by scarcity and consequent high prices of the conventional protein and energy sources. Protein sources are especially limiting factors in poultry feed production in the tropics (Ihezuo et al., 2013).

It has been further estimated that 70-80% of poultry production inputs is been attributed to feed cost, hence making it imperative that good quality feed be available at reasonable price to make poultry production more profitable (Ebochuo et al., 2017).

Thus, the birds can only perform economically well and profitably if it consumes, on daily basis, the appropriate amount of energy, protein, vitamins and minerals (Ijarotimi et al., 2013).

Antibiotics are drugs such as penicillin, amoxicillin and tetracycline that are used to kill or inhibit the growth of harmful bacteria (Ahaotu et al., 2018b). Thus, the use of antibiotics in improving the rations of birds has been carried out by various authors. Ahaotu et al., (2012b) reported that growth depression in broiler chickens fed high fibre diet was effectively and economically alleviated by the action of the following antibiotics namely tylosin, streptomycin and neo-terramycin. Also Ayo-Enwerem et al., (2013) reported that the growth performance of broiler chicks fed a high fibre diet supplemented with antibiotics was better than those fed un-supplemented diet.

Thus, antibiotics supplementation is an effective and readily adaptable strategy, if not for the possibility of their immunosuppressive actions under prolonged usage.

However the inclusion of antibiotics in livestock rations as feed additives is being discouraged because of the negative effect on the animals and the humans who consume the final animal products (Ogbuokiri et al., 2015). This was also confirmed by Ahaotu et al., (2018d) who reported the problems of residual effect in livestock products. Thus, there is the need to evaluate potential antibiotic alternatives to improve disease resistance in intensive food animal production.

Nutritional approach to counteract the debilitating effects of stress and infection may provide products with useful alternatives to antibiotics. Improving the disease resistance of animals grown without antibiotics can benefit the animal's health, potentially increasing production efficiency and food safety. Improving disease resistance in food animals particularly in the absence of antibiotics treatment is a key strategy in the effort to increase food safety (Ezeafulukwe et al., 2017).

Hence, there is a need to search for locally available alternative sources of protein for use as feed supplement to poultry. One possible source of cheap protein to poultry is the leaf meal of some tropical legume and plants (Lakshmipriya et al., 2016).

Leaf meals of various plants have been incorporated in the diets of poultry as a means of reducing the high cost of conventional protein sources (Ayo – Enwerem et al., 2018). Ahaotu et al. (2011) stated that leaf meals do not only serve as protein source but also provide some necessary vitamins, minerals and oxycarotenoids which cause yellow colour of broiler skin, shank and egg yolk.Among various types of Moringa species, Moringa oleifera is the most economically important specie (Ihezuo et al., 2013). It is widely distributed in Nigeria (Ahaotu et al., 2018a) and is used as vegetable food for human consumption and animal feed resources during dry period (Ahaotu, 1997). The edible parts of the Moringa tree are exceptionally nutritious (Ahaotu et al., 2018a). Leaf parts are promising as a food source in the tropics because the tree is full of leaves during the dry season when other foods are typically scarce (Thurber and Fahey, 2010). Recent studies conducted by Sanchez-Machado et al. (2010) indicated that leaves of M. stenopetala are rich in protein (28.2-36.2%) and contain considerable amounts of essential amino acids. The leafy part of Moringa could thus be used as a protein supplement for poultry.

This study therefore determined the haematology and blood chemistry of starter broilers fed graded levels of Moringa oleifera leaf meal and investigated the effects of feeding different levels of Moringa oleifera leaf meal (MOLM) on nutrient intake and growth performance of starter broilers.

At a high inclusion level, leaf meals lead to depressed growth. This may be attributed to their low digestibility and inadequate metabolisable energy content. Also with older broiler chicks, Is-Haaq et al. (2018) showed that diets containing 100g leaf meal per kilogram diet significantly reduced growth without affecting dry matter intake.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry unit of the Teaching and Research farm, Imo State Polytechnic Umuagwo, Imo State. Umuagwo is in the derived savannah zone of Nigeria. The study area is located on latitudes 5^{o} 28^{1} 00^{11}N and 5^{o} 30^{1} 00^{11}N and longitudes 7^{o} 0^{1} 06^{11}E and 7^{o} 03^{1} 00^{11}. The mean annual rainfall is 1247mm with a relative humidity of between 75 and 95%. It is situated at about 600 m above sea level with a mean annual temperature of 26.2°C (IMLS, 2009).

Preparation of Experimental Diets

Moringa leaves were collected from the Poultry unit of Imo State Polytechnic Umuagwo. Branches from matured Moringa trees, were cut, twigs and leaflets were be removed by hand. The collected leaves were then spread on a (thinly sliced dried bamboo stalks and woven together like wire mesh) and dried in the open air until the leaves dried out uniformly. Using thinly sliced dried bamboo stalks and woven together like wire mesh for drying purpose was advantageous because it efficiently enhances air circulation during the drying process and prevents uneven drying of leaves by retaining the greenish color of the leaves. The dried leaves were hand-crushed and further ground using mortar and pestle at 2 mm size.

Experimental Diets

Five experimental diets were used in the study. Treatment 1 (Diet 1) served as the control with 0% of *Moringa oleifera* leaf meal, while diets 2, 3, 4 and 5 contained *Moringa oleifera* leaf meal at 0.5, 1, 1.5 and 2% level of supplementation respectively (Table 1).

Table1. *Percentage Composition of the Experimental Diet*

Ingredients	**Diets**				
	1	2	3	4	5
Moringa oleifera					
leaf meal	0	0.5	1	1.5	2
Maize	44.50	44.40	44.20	44.10	44.10
Wheat offal	13.80	13.70	13.60	13.40	13.10
Soya bean meal	9.40	9.30	9.20	9.20	9.10
Groundnut cake	14.20	14.10	14.10	14.00	14.00
Palm kernel cake	7.50	7.40	7.30	7.20	7.10
Fish meal	5.70	5.70	5.70	5.70	5.70
Blood meal	1.90	1.90	1.90	1.90	1.90
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Analysis					
Crude protein (%)	23.31	23.30	23.32	23.33	23.34
Energy (Kcal/k)	2,785.69	2,788.42	2,762.79	2,752.39	2,743.72
Crude fibre (%)	4.25	4.29	4.31	4.34	4.36
Determined Analysis					
Crude protein	24.06	24.28	23.62	24.53	24.65
Crude fibre	4.00	5.00	5.50	5.80	5.90
Ash	10	12	10	10	10
Ether extract	6	8	8	10	12
Moisture	10	10	12	10	12
NFE	45.94	40.72	40.88	39.67	37.45

Management of Birds

Few days to the arrival of the chicks, the brooding pen, the drinkers and the feeders were cleaned and disinfected. Wood shavings were spread on the floor. The hovers, feeders and drinkers were placed in position. Kerosene stoves and lanterns were used to provide the heat needed to keep the temperature within optimum range (between 33°C to 35°C). Feed and water were provided *ad-libitum*. Feeding was carried out twice, in the morning between the hours of 7 - 8am and in the evening between the hours of 5-6pm daily.

Response Parameters

Average Daily Feed Intake per Bird

This was calculated as the amount of feed left over subtracted from the total amount of feed supplied. The result was then divided by the number of days of the experiment (28 days).

Average Daily Weight Gain per Bird

This was estimated as the total weight of the birds at the end of the period (four week) less the total weight of the birds at the beginning of the study, divided by the number of days (28 days) and the result was then divided by the number of birds per replicate.

Feed Conversion Ratio

This was calculated as the average daily feed intake divided by the average weight gain.

Body Weight

This was measured on a weekly basis using a weighing balance. The birds were however weighed at the beginning of the experiment to determine their initial weight.

Hematological Studies

This was carried out using blood samples collected from each treatment. Two birds were collected from each replicate (four birds per treatment) for analysis.

The parameters analyzed included; hemoglobin (Hb), packed cell volume (PCV), total bilirubin and aspartate aminotransferase (AST).

Statistical Analysis

At the end of the study (fourth week) data obtained from the response variables were subjected to analysis of variance using a one way (ANOVA) by Steel and Torrie (1980) in a completely randomized design (CRD).

Laboratory Analysis

Some quantity of the dried Moringa Oleifera leaf meal which was obtained after processing was taken for analysis in the laboratory at Michael Opara University.

Also some quantity of feeds formulated for the birds were analyzed in the laboratory that is diet 1, 2, 3, 4 and 5 containing 0, 0.5, 1.0, 1.5 and 2.0% levels of inclusion of Moringa Oleifera leaf meal respectively.

Table2. *Proximate Composition of Moringa oleifera leaf meal*

Components	Percentage
Dry matter	89.70
Crude protein	24.06
Ash	6
Moisture	3.5
Crude fibre	12
Ether extracts	6

The result above showed that the Moringa oleifera leaf meal contains, 24.06% crude protein, 6% ash, 3.5% moisture, 12% crude fibre and 6% ether extract.

Table3. *Composition of Essential Amino Acids of Moringa oleifera leaves (g/16g N) compared to Soybean meal*

Amino acids	Soybean meal	Moringa oleifera leaves
Methionine	1.22	1.71
Cystine	1.70	2.04
Valine	4.59	5.34
Leucine	7.72	8.50
Phenylalanine	4.84	5.27
Threonine	3.76	4.45
Tryptophan	1.24	1.54
Isoleucine	4.62	5.68
Lysine	6.08	5.68
Arginine	7.13	6.4

Average Daily Weight Gain (G)

Results presented in Table 4 shows that the highest daily weight gain (g) was observed in birds fed diet 2 (0.5% MOLM), while the lowest was observed in birds fed diet 5 (2% MOLM). It was observed that the body weight gain of birds decreases with increase in dietary levels of the MOLM. The result agrees with the observation made by Is-Haaq *et al.*, (2018), where graded dietary inclusion of *Puerairia phaseoloides* leaf meal induced cause related depression in growth of chicken even when maize oil was used to compensate for low metabolizable energy value of the leaf meal.Similar observation of decreasing performance of broilers at high levels of leaf meal inclusion have been observed by Nkukwana, *et al.*,(2014) who reported that the body weight gain of broilers drastically reduced at high levels of *Moringa oleifera* leaf meal incorporation.

Table4. *Effects of Varying Levels of Supplemental Moringa oleifera leaf meal on the Performance of Broiler Birds*

Parameters	Dietary Treatment					
	(0%)	2(0.5%)	3(1%)	4(1.5%)	5(2%)	SEM
Initial Body Weight (g)	70	73	75	72	74	0.61
Weight (g) Avg Daily	620^{b}	580^{a}	570^{c}	530^{c}	490^{d}	3.25

Avg. Daily Weight Gain (g).	40.82^{b}	44.80^{a}	40.20^{b}	39.80^{b}	32.36^{c}	0.43
Avg. Daily Feed intake(g)	129.39^{a}	131.71^{a}	128.24^{a}	126.56^{b}	110.60^{c}	1.74
Feed Conversion Ratio (g)	3.17^{b}	2.94^{c}	3.19^{b}	3.18^{b}	3.43^{a}	0.03

Also the work of Ahaotu *et al.* (2018e) follows the same suit with the incorporation of high levels of *Carica papaya* leaf meal. The effect observed above could have resulted from imbalance nutrient value and improper metabolism associated with the *Moringa oleifera* leaf meal as reported by Ihezuo *et al.* (2013).

Other workers (Ahaotu *et al.*, 2018g) have also reported the effect of nutrient imbalance on monogastric animals fed high levels of unconventional feed ingredients. This could also be probably due to the effects of incomplete elimination of toxic factors as reported by Okonkwo and Ahaotu, (2014).

Average Daily Feed Intake

The analysis of variance conducted on the daily feed intake shows that there was significant ($p<0.05$) differences among the treatment means. The feed consumption of birds fed diet 1, 2 and 3 were similar ($p>0.05$) but significantly ($p<0.05$) higher than those of birds fed diets 4 and 5.

However the feed intake of birds fed diet 5 was significantly ($p<0.05$) lower than that of birds fed diet 4.The observed general trend was that of decreasing average feed intake as level of supplementation increased. This might be attributed to the bitter nature of the *Moringa oleifera* leaf which reduced the palatability of the feed. This is in consonance with the observations of Ahaotu *et al.*, (2013a) who fed rabbits with raw Moringa seed cakes and reported reduced feed consumption among the rabbits on the test diets. Ahaotu *et al*. (2013b) has also established the presence of bitter triterpenoids in the *Moringa oleifera* seeds. However, debitterization through water washing, alkali soaking and urea ammoniation to improve palatability has been recommended (Hossain and Becker, 2001). Also the decrease in feed intake observed could be as a result of anti-nutritional factors present in the test ingredient.

This agrees with the findings of Melesse *et al.*, (2009) that incorporated different leaf meals noted for their anti-nutritional factors in the diets of poultry, and observed decreases in feed intake.

Feed Conversion Ratio

The analysis of variance shows that there were significant ($P<0.05$) differences among the treatment means. As shown in table 5, the amounts of feed consumed by birds fed diet 1(0% MOLM), diet 3 (1% MOLM) and diet 4 (1.5 % MOLM) to gain the same unit (kg) of bodyweight, were similar ($P>0.05$).

However, birds fed diet 2 (0.5%, MOLM) were significantly ($P<0.05$) higher than those birds fed diet 5 (2%) to gain the same unit of body weight. The efficiency of feed conversion of birds fed diets containing more than 0.5% MOLM were significantly ($P<0.05$) lower when compared to those of birds fed diet 2 (0.5%, MOLM). The poor utilization of diets containing higher levels of MOLM might be related to the inability of the birds' enzyme to break down the active bitter substance in the MOLM and also the imbalance nutrient value and improper metabolism associated with the *Moringa oleifera* leaf meal as reported by Ahaotu *et al.* (2013a).

Table5. *Effect of Supplemental Moringa oleiferaLeaf Meal on the Hematological Values of Broiler Birds*

Dietary Treatments Parameters	1	2	3	4	5	SEM
Hb (g/dl)	8.9^{b}	10.8^{a}	8.8^{b}	9.0^{b}	10.2^{a}	0.60
PCV (%)	32^{c}	39^{a}	30^{c}	34^{b}	36^{b}	1.85
Total Bilirubin(mg/dl)	2.35^{a}	2.15^{ab}	2.25^{a}	2.15^{ab}	2.05^{ab}	0.21
AST (Unit/l)	10.05^{ab}	10.15^{a}	10.25^{a}	9.98^{ab}	10.10^{a}	0.24

Haemoglobin (Hb) Values

The result of the hematological values of broiler birds revealed that there were significant difference ($P<0.05$) among the treatments. Hbvalues of birds fed diets 2 and 5 were similar ($P>0.05$) but significantly ($P<0.05$) higher than those of birds fed diets 1, 3 and 4.which were themselves similar ($P>0.05$).The results of the haemoglobin values of the birds on diet 3 and 1 fall slightly below the recommended range of 9-13g/dl as reported by Nkwocha *et al.*,**(**2018). However, the values obtained for birds on diet 2, 4 and 5 fall within the accepted range as (7.2 - 11.4) reported by Okonkwo and Ahaotu (2014).

This result implies that including MOLM in the diets of broilers as supplemental feed had little or no effect on the relative quantity of the complex iron containing the conjugate protein. This gives a clear-cut reason why the redness of the broiler bird's blood was not impaired.

Packed Cell Volume (PCV) Values

The result of the Packed Cell Volume (PCV) revealed that birds on diet 2, 4 and 5 were similar (P>0.05) but significantly (P<0.05) higher than those of birds fed diet 1 and 3, which were themselves similar (P>0.05). The highest value of packed cell volume was obtained in birds on diet 2 (0.5% MOLM).

Thus the values obtained for PCV across the treatment groups were within the normal range of 30- 40% as reported by Adeyeye *et al.*, (2013). This result implies that including MOLM in the diets of broiler birds as supplemental feed ingredient had little or no effect on the relative quantity of blood cells as compared with the total volume of blood (Onyekwere *et al.*, 2016).

Aspartate Aminotransferase (Ast) Values

The result of the hematological values for Aspartate aminotransferase (AST) shows that, there was no significant difference (P>0.05) among the treatments.

The result obtained for AST across the treatment groups were within the accepted normal range of 3-45 units/l as reported by Ayo – Enwerem et al., (2017).

This is also in accordance to the findings of Ahaotu et al., (2013a) who reported that usually low levels of AST are normally found in the blood of Poultry birds, but when high levels are found (400-4,000unit/1) then there is likely to be cases such as viral hepatitis and carbon tetrachloride poisoning.

Bilirubin Values

The result of the hematological values for total bilirubin shows that there was no significant difference (P>0.05) among the treatments. The low level of bilirubin obtained across the treatment groups is an indication of the normalcy of the blood level of the birds.

High levels of bilirubin usually reveal that too much is being produced (usually due to increased destruction of red blood cells or that the liver is incapable of adequately removing bilirubin in a timely manner (due to blockage of bile ducts and liver diseases such as cirrhosis and acute hepatitis) (Ahaotu, 2011).

Conclusion

An experiment was conducted with Ninety "ROSS" unsexed day old chicks to determine the optimum level of supplementation of Moringa oleifera leaf meal in broiler diets. The experiment was laid-out in a completely randomized design (CRD). The birds were randomly allocated to five treatment groups of eighteen birds per treatment.

Each treatment was replicated twice with nine birds per replicate. The five groups were randomly allocated to five diets containing varying levels of Moringa oleifera leaf meal (MOLM) of 0% (diet 1), 0.5% (diet 2), 1.0% (diet 3), 1.5% (diet 4) and 2.0% (diet 5).

The birds' performances were measured and calculated on daily basis in terms of body weight gain, feed intake and feed conversion ratio. At the end of the experiment the haematological values were determined. The parameters determined for include hemoglobin (Hg), aspartate aminotransferase (AST), bilirubin and packed cell volume (PCV).

The results of this study showed that there were significant (P<0.05) difference among the performance of birds across the various treatments in terms of average body weight gain, feed intake, and feed conversion ratio. Further supplementation of MOLM beyond 0.5% showed decrease in average bodyweight gain and average final weight of the birds.

This study also showed that the supplementation of MOLM had little or no effect on the hematological values of the birds, as the parameters evaluated for across the treatment groups fell within the accepted normal ranges for poultry birds.

The results of this study showed that the *Moringa oleifera* leaf meal supplementation in broiler diets could be effectively utilized at 0.5% to obtain reasonably good growth rate and reduced disease infection risk in the finished broiler birds.

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