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# PERFORMANCE, NUTRIENT DIGESTIBILITY AND CARCASS QUALITY OF BROILER CHICKENS FED MORINGA OLEIFERA LEAF MEAL

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The study was carried out to determine the effects of *Moringa oleifera* leaf meal (MOLM) on the performance, nutrient digestibility and carcass characteristics of broiler chickens. Fresh leaves of *Moringa oleifera* were harvested and sundried for four days and milled. Two hundred broilers chickens (Anak strain) were randomly allotted to five treatment groups. Each group was replicated four times at 10 birds per replicate. MOLM was incorporated into the broiler starter and finisher diets at 0% , 5%, 10% 15% and 20% levels respectively. Feed intake values at the starter phase were significantly (P<0.05) different across the groups of birds, but similar (P>0.05) at the finisher phase. The weight gain (WG) was statistically similar (P>0.05) at the starter phase but significantly (P<0.05) different at the finisher phase, with birds fed with 15% MOLM based diet having the highest WG. The feed conversion ratio of the birds were similar (P>0.05) at the starter phase, but differed (P<0.05) at the finisher phase. Protein efficiency ratio (PER) was higher (P<0.05) in birds fed the control diet and 15% MOLM.. Higher (P<0.05) crude protein digestibility was obtained in birds fed control diet and 15% MOLM. Carcass characteristics showed higher significant (P<0.05) values of dressing percentage in birds fed control diet and 15% MOLM. Lower values of breast, wings, and abdominal fat were obtained in birds fed with 10% and 20%% MOLM. Overall, the best significant improvement in the response indices were obtained in birds fed 15% MOLM.

**Key words:** Moringa, broilers, performance, nutrient digestibility, carcass

Plant protein sources are good sources of dietary fiber low fat content, particularly saturated fats and deficient in one or more of the essential amino acids. (Dousa *et al.*, 2011). However, among the conventional plant protein sources in the poultry industry is the soya bean, but its increasing price is a concern (Catootjie , 2009). As a result, it has become necessary to evaluate alternative protein sources, among which are the leaf meals. Presently, there has been continued researches into the leaf meal of Moringa oleifera especially in view of the quality and quantity of food nutrients( John and Kenaleone ,2014)

*Moringa oleifera* is among plants that can be integrated with livestock production to increase feed quality and availability as it can be used as a cheap protein supplement to improve digestibility of other diets. *Moringa oleifera* has been widely esteemed as a versatile plant due to its multipurpose uses. The leaves, fruits, flowers and immature pods of Moringa are edible and they form a part of traditional diet in many countries of the tropics and sub tropics ( Siddhuraju and Berker, 2003; Anhwange *et al.*, 2004). The leaves of *Moringa oleifera* are a good source of protein, vitamin A, B and C, and mineral such as calcium and iron (Dahot, 1988). According to Abbas (2013), the leaves of the Moringa tree are the preferred part for use in animal diets as leaf meal. Ghasi *et al.*, (1999) reported that juice extracted from moringa leaves was a potent hypocholesterolemic agent. An in-vitro study has validated the traditional use of *Moringa oleifera* leaf as an anti-cancer agent (Khalafalla *et al.*, 2011), anti-trypanosomal (Mekonnen *et al.*, 1999), anti-oxidant

  

(Ogbunugafor *et al.,* 2011) and hepatoprotective (Buraimah *et al.,* 2011). This study was therefore carried out to determine the effects of *Moringa oleifera* leaf meal on performance, nutrient digestibility and carcass quality of broiler chickens

## MATERIALS AND METHODS

Fresh leaves of *Moringa oleifera* were harvested within the premises of the Lagos State Polytechnic, and College of Agricultural Sciences, Olabisi Onabanjo University, South Western Nigeria. The harvested leaves were shade dried for four days and milled in a hammer mill fitted with 2mm sieve. The product here was tagged *Moringa oleifera* leaf meal .

**Experimental diets**

Five starter and finisher diets (Tables 1 and 2) were formulated. *Moringa oleifera* leaf meal (MOLM) was incorporated into the diets at 0%, 5%, 10%, 15% and 20% levels respectively. Minor adjustments were made in other ingredients to make the diets isonitrogeneous and isocaloric. Methionine and lysine were added into the diets at 0.3% and 0.1% levels so as to ensure the amino acids were not limiting.

**Experimental birds**

Two hundred (200) day-old unsexed broiler chicks (Anak strain) were randomly distributed into five treatment groups. Each group consisting of forty (40) chicks was replicated four times in a completely randomized design experiment. Feed and water were supplied ad - libitum, and uniform light was provided 24hr daily. The birds were vaccinated against Newcastle disease on the 28$^{th}$ day and gumboro (infectious bursal disease) on the 10$^{th}$ and 35$^{th}$ day respectively. Also, the birds were administered with medications against round worms and coccidiosis on the 39$^{th}$, 41$^{st}$ and 47$^{th}$ days of the experiment respectively. The experiment was terminated at the end of the

Table 1 : Percentage Composition of Broiler Starter Diets

| Ingredients | Control | 5% MOLM | 10%MOLM | 15%MOLM | 20%MOLM |
|---|---|---|---|---|---|
| Maize | 54.90 | 56.79 | 50.79 | 49.79 | 42.60 |
| Soybean meal | 20.00 | 13.00 | 13.00 | 12.00 | 12.00 |
| Groundnut cake | 10.00 | 12.00 | 14.00 | 12.00 | 10.00 |
| Moringa | - | 5.00 | 10.00 | 15.00 | 20.00 |
| Fish meal | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| Wheat offal | 4.00 | 3.00 | 2.00 | 2.00 | 3.00 |
| Brewer Dried grains | 2.70 | 3.00 | 3.00 | 1.75 | 2.00 |
| Palm oil | 1.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Bone meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Oyster shell | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Premix | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Methionine | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Lysine | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Calculated Crude protein (%) | 22.89 | 22.79 | 22.74 | 22.76 | 22.54 |
| Calculated Metabolizable Energy (Kcal/kg) | 3101.21 | 3054.12 | 3024.35 | 3011.71 | 3001.40 |

MOLM= Moringa leaf meal.

0.50 premix supplied, per kilogram of diet: vitamin A, 12,000 IU; vitamin D3, 2,000 IU; vitamin E, 50 IU; vitamin B1, 1 mg; vitamin B2, 3 mg; vitamin B6, 1 mg; vitamin B12, 10 µg; vitamin K, 2 mg; copper (cupric sulphate), 75 mg; nicotinic acid, 12 mg; pantothenic acid, 10 mg; iron, 200 mg; cobalt, 0.5 mg; manganese, 40mg; zinc, 90 mg, iodine, 1 mg; selenium, 0.2 mg; calcium, 31.25 g; sodium, 10 g

 

Table 2 : Proximate Composition of Finisher Diets

| Ingredients | Control | 5%MOLM | 10%MOLM | 15%MOLM | 20%MOLM |
|---|---|---|---|---|---|
| Maize | 59.90 | 61.79 | 55.79 | 53.79 | 46.60 |
| Soybean meal | 15.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Groundnut cake | 10.00 | 12.00 | 14.00 | 12.00 | 10.00 |
| Moringa | - | 5.00 | 10.00 | 15.00 | 20.00 |
| Fish meal | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| Wheat offal | 4.00 | 3.00 | 2.00 | 2.00 | 3.00 |
| Brewer Dried grains | 2.70 | 3.00 | 3.00 | 1.75 | 2.00 |
| Palm oil | 1.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Bone meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Oyster shell | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Premix | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Methionine | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Lysine | 0.10 | 0.1 | 0.1 | 0.1 | 0.1 |
| Calculated Crude protein (%) | 20.01 | 19.97 | 19.89 | 19.86 | 19.87 |
| Calculated Metabolizable Energy (Kcal/kg) | 2989.11 | 2967.16 | 2911.43 | 2904.37 | 2901.41 |

MOLM= Moringa leaf meal

0.50 premix supplied, per kilogram of diet: vitamin A, 12,000 IU; vitamin D3, 2,000 IU; vitamin E, 50 IU; vitamin B1, 1 mg; vitamin B2, 3 mg; vitamin B6, 1 mg; vitamin B12, 10 µg; vitamin K, 2 mg; copper (cupric sulphate), 75 mg; nicotinic acid, 12 mg; pantothenic acid, 10 mg; iron, 200 mg; cobalt, 0.5 mg; manganese, 40mg; zinc, 90 mg, iodine, 1 mg; selenium, 0.2 mg; calcium, 31.25 g; sodium, 10 g

eighth week..

**Chemical analyses**

The proximate composition of the Moringa leaf meal was determined using the analytical methods of A.O.A.C (2012). The tannin, oxalate and phytate contents of the Moringa oleifera leaf meal were determined using the methods described by Apata (1990). In the 7$^{th}$ and 8$^{th}$ week of the experiment, droppings from each replicate group of birds were collected on four successive days at 24 hours interval in metabolic cages. Four birds with weights close to the average weight of each replicate group were used for this purpose. The droppings collected were weighed fresh, placed in aluminum foil, dried to constant weight at 100$^0$C and analyzed for apparent retention using the formula:

$$\frac{\text{Nutrient intake} - \text{Nutrient in Droppings}}{\text{Nutrient intake}} \times 100\%$$

**Carcass Characteristics**

At the end of the 8$^{th}$ week, eight (8) birds per group were fasted overnight and slaughtered for carcass characteristics. The following carcass characteristics of the broiler chickens were determined : (i) Dressed weight as percentage of live weight (ii)Eviscerated weight as percentage of live weight (iii) Eviscerated weight as percentage of dressed weight (iv) Weight of prime cuts (break, back, wings, thigh and drumstick as percentage of dressed weight

**Statistical analysis**

All data collected were analyzed using analysis of variance. Differences in means were separated using Duncan Multiple Range Test (Silva and Azevedo,2009)

**RESULTS**

The data obtained on the chemical composition of the fresh moringa leaves (FML) and Moringa leaf meal (MOLM) are shown in Table 3. Crude protein, crude fibre, ash, calcium, potassium, zinc, iron, tannin ,oxalate saponin and phytic acid contents were higher in MOLM than the FML .

The performance characteristics are shown in Table 4. Feed intake values were

 

Table 3. Chemical Composition Of Fresh Moringa Leaves And Moringa Leaf Meal

| Variable | FML (%) | MOLM (%) |
|---|---|---|
| Moisture Content(%) | 65.1 | 6.4 |
| Crude protein(%) | 6.7 | 22.6 |
| Crude fibre (%) | 1.2 | 10.1 |
| Ether extract (%) | 1.8 | 3.4 |
| Ash (%) | 3.8 | 7.9 |
| Nitrogen free extract (%) | 21.4 | 49.6 |
| Calcium (mg/100g) | 4.21 | 6.98 |
| Iron (mg/100g) | 1.76 | 2.98 |
| Potassium (mg/100g) | 5.45 | 7.09 |
| Zinc (mg/100g) | 4.42 | 5.89 |
| Tannin (mg/100g) | 2.34 | 2.92 |
| Phytic acid( mg/100g) | 41.34 | 42.68 |
| Oxalate (mg/100g) | 4.48 | 5.01 |
| Saponin (%) | 6.41 | 6.76 |

FML= Fresh moringa leaves; MOLM= Moringa leaf meal

Table 4 Performance Characteristics of Broilers fed with Moringa Leaf Meal

| Variable | Diets | | | | | SEM |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| STARTER PHASE | | | | | | |
| Average feed intake (g/bird/day) | 58.83$^{b}$ | 59.22$^{ab}$ | 61.62$^{a}$ | 61.59$^{a}$ | 62.95$^{b}$ | 2.08 |
| Average weight gain (g/bird/day) | 23.67 | 22.61 | 22.92 | 23.55 | 20.86 | 1.12 |
| Feed conversion ratio | 2.49 | 2.61 | 2.69 | 2.62 | 3.02 | 0.11 |
| Protein efficiency ratio | 2.94$^{a}$ | 2.57$^{c}$ | 2.59$^{c}$ | 2.87$^{b}$ | 2.48$^{d}$ | 0.07 |
| FINISHER PHASE | | | | | | |
| Average feed intake (g/bird/day) | 121.17 | 124.96 | 125.50 | 125.73 | 127.58 | 3.63 |
| Average weight gain (g/bird/day) | 49.03$^{b}$ | 47.98$^{b}$ | 47.33$^{b}$ | 52.43$^{a}$ | 40.86$^{c}$ | 3.15 |
| Feed conversion ratio | 2.47$^{c}$ | 2.67$^{b}$ | 2.74$^{b}$ | 2.47$^{c}$ | 3.16$^{a}$ | 2.29 |
| Protein efficiency ratio | 2.75$^{b}$ | 2.64$^{c}$ | 2.72$^{b}$ | 3.01$^{a}$ | 2.46$^{d}$ | 0.1 |

Diet 1= Control diet; Diet 2= 5% MOLM; Diet 3 = 10% MOLM; Diet 4= 15% MOLM; Diet 5= 20% MOLM

significantly (P<0.05) higher in birds fed 5%,10%, 15% and 20% MOLM based diets than those fed control diet at the starter phase, but similar (P>0.05) at the finisher phase across all the groups of birds.

The values of the weight gain of the birds fed with the varying levels of MOLM were similar (P>0.05) during the starter phase but significantly (P<0.05) differed at the finisher phase. Birds fed 15% MOLM at the finisher phase had the highest significant (P<0.05) weight gain, while the lowest was obtained in birds fed 20% MOLM.

The feed conversion ratio (FCR) followed a similar trend as that of weight gain in the birds at the starter phase. However, at the finisher phase, the FCR was similar (P>0.05) between birds fed 15% MOLM and control diet, but significantly (P<0.05) higher in birds fed 5%, 10% and 20%MOLM respectively. The protein efficiency ratio (PER) was higher (P<0.05) in birds fed the control diet and 15%MOLM both at the starter phase and finisher phase

Results on the nutrient digestibility of the birds are shown in Table 5. Higher significant (P<0.05) values of crude protein (CP) digestibility were obtained in birds fed control diet and 15% MOLM based diet. The CP digestibility was similar (P>0.05) in birds fed 5% and 10% MOLM, while the lowest was obtained in birds fed 20% MOLM. The ether extract digestibility was higher (P<0.05) in birds fed control diet and 15% MOLM, while the crude fibre digestibility was similar (P>0.05) across the groups of birds

Table 5. Nutrient Digestibility of Broilers fed with Moringa Leaf Meal

| Variable | Diets | | | | | SEM |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| Crude Protein(%) | 64.44[a] | 60.39[b] | 61.41[b] | 64.33[a] | 58.06[c] | 1.63 |
| Ether Extract(%) | 68.71[a] | 66.13[b] | 66.36[b] | 67.92[ab] | 61.48[c] | 1.74 |
| Crude Fibre(%) | 22.15 | 23.10 | 23.59 | 22.88 | 23.10 | 1.86 |
| Nitrogen Feed Extract(%) | 66.77[a] | 60.47[c] | 59.55[c] | 64. 51[b] | 57.09[d] | 1.63 |

Diet 1= Control diet; Diet 2= 5% MOLM; Diet 3 = 10% MOLM; Diet 4= 15% MOLM; Diet 5= 20% MOLM, SEM= Standard error of mean

Table 6. Carcass Characteristics of Broilers fed with Moringa Leaf Meal

| Variable | Diets | | | | | SEM |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| Live weight (LW) g | 1951.33 | 1870.00 | 1832.33 | 2065.67 | 1814.67 | 70.99 |
| Dressed weight (% of LW) | 69.69[a] | 63.87[b] | 61.02[c] | 69.43[a] | 60.09[c] | 0.91 |
| Breast (% of LW) | 22.30[a] | 21.26[b] | 21.06[b] | 23.89[a] | 20.15[c] | 0.94 |
| Wings (% of LW) | 9.11[a] | 9.18[a] | 8.18[bc] | 8.74[b] | 8.02[c] | 0.18 |
| Thigh (% of LW) | 11.92 | 12.07 | 11.45 | 11.61 | 11.52 | 0.25 |
| Drum stick (% of LW) | 11.36 | 11.18 | 10.76 | 10.86 | 11.05 | 0.34 |
| Back (% of LW) | 14.53[ab] | 14.96[ab] | 15.47[a] | 14.24[bc] | 13.9[8c] | 0.30 |
| Heart (% of LW) | 0.49[a] | 0.46[ab] | 0.34[c] | 0.39[ab] | 0.37[bc] | 0.04 |
| Liver (% of LW) | 1.93 | 2.12 | 2.05 | 1.83 | 1.89 | 0.13 |
| Gizzard (% of LW) | 2.10[b] | 2.05[b] | 2.49[a] | 2.11[b] | 2.03b | 0.08 |
| Neck (% of LW) | 3.42[ab] | 3.05[bc] | 2.96[c] | 3.68[a] | 3.54[a] | 0.14 |
| Leg colour | 1.00 | 1.00 | 1.33 | 5.33 | 5.67 | 0.86 |
| Fat (% of LW) | 0.44[a] | 0.36[a] | 0.38[a] | 0.39[b] | 0.21[b] | 0.03 |
| Spleen (% of LW) | 0.14[a] | 0.07[b] | 0.09[ab] | 0.10[ab] | 0.09[ab] | 0.02 |

Diet 1= Control diet; Diet 2= 5% MOLM; Diet 3 = 10% MOLM; Diet 4= 15% MOLM; Diet 5= 20% MOLM, LW= live weight

The carcass characteristics of broilers fed with the varying levels of MOLM are shown in Table 6. The average live weight of the birds were similar (P>0.05) across the groups . Higher significant (P<0.05) values of dressing percentage were obtained in birds fed control diet and 15% MOLM. Lower values of breast, wings, and abdominal fat were obtained in birds fed with 10% and 20%% MOLM. Similar (P>0.05) values of thigh and drum stick were obtained across groups of birds. Higher significant (P<0.05) values of back and gizzard expressed as percentage of the live weight were obtained in birds fed with 10% MOLM while the lowest was in those in 20% MOLM. The spleen and fat contents of broiler birds fed diets containing MOLM were lower than the control

**DISCUSSION**

The chemical composition obtained in the MOLM and FMLare similar to the findings of Aye and Adegun (2013). Aregheore, (2002) reported that Moringa leaf is an outstanding indigenous source of highly digestible protein, calcium, iron, vitamin C, and carotenoids suitable for utilization either in man or animals. The tannin, phytate and oxalate contents were marginally increased in MOLM when compared to the FML. These three anti-nutritional factors have been reported to form complexes with dietary protein and divalent minerals (Permaul, 2009). According to Maga (1982), the main nutritional concern associated with phytate lies in its interaction with several minerals and proteins, and that it binds up certain metal ions, such as calcium, magnesium, zinc, copper and iron to form insoluble phytate metal complexes that are not readily broken down, thus rendering them unavailable or only partially available for absorption in the intestinal tract of an animal. According to Akanji (2002), excess oxalate ingestion causes some gastrointestinal irritation, renal damage, precipitation of blood calcium and production of a hypocalcaemc syndrome of muscular weakness and paralysis. Tannins when ingested in high amounts are also known to exert adverse effects on growth or egg production

On the performance characteristics, the higher feed intake of birds fed with diets containing MOLM at the starter phase might be as a result of the relatively low energy value of the diets as reflected in their metabolizable energy values. Birds have been reported to consume more of low energy feed to satisfy their physiological requirement (Shurlock and Forbes, 1981; Ferket and Gernat, 2006). According to Onu and Aniebo, (2011), increasing levels of MOLM in broiler diets increased their feed consumption

The weight gain was higher in birds fed 15% MOLM at the finisher phase but lowered in those fed 20% MOLM. This observation is similar to the findings of Ayssiwede *et al*. (2011) who assessed the effects of MOLM inclusion in poultry diets on growth performances, carcass and organs' characteristics of growing indigenous Senegal chickens. However, the similar values of weight gain at the starter phase across the groups of birds are at variance to the reports of Limcangco-Lopez and Devendra, (1989) who said that moringa fed in high quantities (7.5 and 10%) to one-week old chicks reduced growth. The high weight gain in birds fed 15% MOLM at the finisher phase can be attributed to the availability of essential amino acids .According to Melesse *et al.,* (2009), concentration of most essential amino acids in Moringa stenopetala leaf is comparatively higher than those found in soybean meal Hossain and Becker,(2001) reported that Moringa is notably rich in methionine compared to soybean meal. Chickens fed 20% MOLM diet in this study showed depressed performance compared with those fed other treatment diets and this observation is in agreement with the results of Olugbemi *et al.,* (2010) who reported a depressed growth in birds fed with Moringa oleifera leaf meal at higher levels of inclusion without affecting the dry matter intake. The depressed weight gain of birds fed 20% MOLM might be attributed to increased intake of tannin, phytate and oxalae thereby causing nutrient imbalance and poor metabolism on the birds ( Esonu. 2000; Iheukwumere *et al*., 2008).

The FCR was similar between birds fed 15% MOLM and control diet. However, in birds fed 20% MOLM, the FCR was higher especially at the finisher stage. The increase in the FCR in birds fed 20% MOLM suggests low utilization of the feed for meat production. This increase in FCR can be partly attributed to increased intake of tannin, oxalate and phytate. These anti-nutritional factors have been reported to reduce conversion of feed to meat or eggs in chickens especially when fed at high levels. (Akanji 2002). According to Vaithyanathan and Kumar, (1993) tannins can form complexes with dietary proteins and enzymes. The proteins bound with tannins are most unlikely to undergo normal metabolism. Akanji (2002) reported tannin-enzyme interaction which then inhibits the enzyme activity. The increase in FCR in birds fed 20% FCR is also consistent with the findings of Emiola *et al.,* (2003) when kidney beans -based diets containing some amounts of haemagglutinin were fed to broiler chickens. Phytate was reported by Apata (1990) to form complexes with many divalent metals, and even phosphorus thereby making them unavailable for use in poultry chickens. However, according to Fuglie (2009), the nutrient value of Moringa leaves can be increased for chickens through the addition of phytase to break down phytate leading to increased absorption of phosphorus. Phytase should be simply mixed with the leaves without heating.

The digestibility of crude protein, crude fibre, ether extract and nitrogen free extract in birds fed 20% MOLM are in agreement with the reports of Lorenzon and Olsen,

 

(1992) that raw plant seeds rich in toxic factors enhanced shedding of the brush border membranes and decrease in villus length in rats with a conspicuous effect on nutrient absorption. Kim *et al.,* (1976) reported that anti – nutritional factors can have *in vivo* inhibition of brush border dipeptidases which interfere with the transport of nitrogen through the absorptive cells of the gut and contribute to faecal – nitrogen losses. Nuhu, (2010) noticed that offering weaned rabbits a diet containing moringa leaf meal increased dry matter and protein digestibility.

The differences in the carcass quality in birds fed 5%, 10%, 15% and 20% MOLM are in contrast with the findings of Ayesiwede *et al.,* (2011) and Odetola *et al.,* (2012) who reported that MOLM did not significantly influence the carcass characteristics livestock and poultry

However, the lower spleen and fat contents obtained in birds fed diets containing MOLM might be attributed to the relatively lower energy value of the diets when compared to the control diet. Body fat deposit has been reported to correlate positively with energy intake (Cha and Jones 1998; Artkin and Davies 2000).

## CONCLUSION

Performance characteristics and nutrient digestibility were better enhanced in birds fed 15% Moringa leaf meal. At 20% dietary inclusion of MOLM in diet of the birds, the growth indices were reduced thus suggesting maximized negative effects of tannin, oxalate and phytate in the MOLM on the birds. The nutrient digestibility in birds fed 15% MOLM also compared favourably with those fed control diet. It is therefore recommended that Moringa oleifera leaf meal can be included into the diets of broiler chickens up to 15% level. Addition of the leaf meal above this level could show lower response indices.

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