Trakia Journal of Sciences, No 1, pp 17-23, 2026

Available online at:
https://trakia-uni.bg

ISSN 1313-3551 (online) doi:10.15547/tjs.2026.01.003

Original Contribution

CARCASS CHARACTERISTICS OF BROILER CHICKENS FED RAW AND TREATED *MORINGA OLEIFERA* SEED MEALS

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ABSTSRACT

PURPOSE: Effects of raw and treated Moringa oleifera seed meals (MOSM) on performance and carcass characteristics of broiler chickens was investigated using 180 day-old sexed male Arbor acre chickens. METHODS: Broilers were subjected to five dietary treatments as follows; Diet 1 served as the control and contained no Moringa oleifera seed meal (MOSM), diet 2 is raw MOSM, diets 3, 4, and 5 are ammonium hydroxide Moringa oleifera seed meals (AHMOSM) included at the same 5% level respectively in a Completely Randomized Design. Each treatment was replicated thrice with 12 birds per replicate in the experiment which lasted 35 days. RESULTS: Data analysis indicated that daily weight gain and daily feed intake were not significantly ($p>0.05$) affected by the inclusion of treated MOSM group and the control while daily weight gain, daily feed intake and feed conversion ratio were significantly ($p<0.05$) affected by the inclusion of raw MOSM. Birds fed a diet containing 30% AHMOSM showed the highest values for the daily weight gain (61.993 g), and daily feed intake (104.737 g), while feed conversion ratio favoured birds on 20% AHMOSM (1.677) among the treatment group. AHMOSM also showed a significant ($p<0.05$) effect on all the prime cut and organs of broilers. Birds fed control diet had significant ($p<0.05$) highest live weight, dressed weight and dressing percentage values followed by those fed 20% dietary doses of AHMOSM. CONCLUSIONS: MOSM can replace soya bean meal in broiler chick diets up to 5% without deleterious effect on the growth performance and carcass characteristics.

Key words: Moringa seed meal; broiler chickens; performance; Carcass characteristics.

INTRODUCTION

The major factor militating against the development of livestock industry in the developing countries is the scarcity and inadequate availability of conventional feedstuff throughout the year. Feed accounts for about 80% of the total cost of poultry operations, and recent hikes in the prices of conventional feed ingredients have negatively impacted profit margins. In order to meet the increasing demand of livestock and its products, there is the need for effective utilization of novel feed resources which do not compete with humans [1] One of these potential tree forages is *Moringa oleifera* Lam (syns. *Moringa pterygosperm*, family *Moringaceae*), which grows throughout the tropics [2] *Moringa oleifera* is a plant with multiple advantages. It is a small, graceful tree characterized by sparse foliage, white flowers, and elongated pods. In northern Nigeria, it is commonly planted on farms, in compounds, and used as live fencing due to its multipurpose nature. *Moringa oleifera* seed supplement have been included into the diets of poultry as means of reducing high cost conventional protein sources [3]. MOSM contains 30–38% crude protein, depending on

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processing method and dehulling. It also contains appreciable levels of lysine, methionine, threonine and valine — amino acids which makes it a good partial substitute for conventional protein sources.

According to [4], the leaves of *Moringa oleifera* possess antimicrobial properties and are a good source of fats, proteins, and minerals. Nigeria is one of the leading producers of moringa in Africa, with an estimated annual production of 1.5 million metric tons. This has positioned the country as a key player in the global moringa market, which is expected to grow at a CAGR of 9.3% from 2021 to 2028. According to a report by Grand View Research, the global moringa market size is expected to reach USD 10.65 billion by 2028.

Tannins, phytates, and protease inhibitors as meal constituents are the non-nutrient components that hinder the usage of seed cake. The constrain in the use of this present novel feed resources attributed to the ANFs existent in MOSM could be ameliorated using different processing methods including aqueous ammonium hydroxide for the removal of condensed tannin [5] Acid and alkali treatment were adopted to detoxify karanja cake.

[6] Ammonia reacts with the aflatoxin molecule by breaking an oxygen bond making the resulting products far less toxic [7].

The purpose of this study was to investigate the effects of *Moringa Oleifera* seed meal on the performance and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

20kg of *Moringa oleifera* seed cake used for this work was obtained from Moringa processing plant at Afe Babalola University, Ado-Ekiti, Nigeria. Raw (unprocessed) *Moringa oleifera* seed cake was divided into four equal portions of 3 kg each. A portion was left untreated, while each of the other three portions was treated by soaking in 5 litres of 10, 20 and 30% ammonium hydroxide solution respectively for 24 hours. The seed cake was later removed from solution and properly dried in the sun to a constant weight and milled for replacing soyabean in the diets.

Five experimental diets were formulated to meet [8] requirement for day old broiler chicks. A corn-soybean reference diet (diet 1) is devoid of *Moringa oleifera* seed meal (MOSM), diet 2 contained raw MOSM, while the other three diets contained processed *Moringa oleifera* seed meal using ammonium hydroxide before inclusion in the diet at the same 5% level of inclusion corresponding to diets 1, 2, 3, 4 and 5 respectively. Previous research conducted by [9, 10] reported poor performance of broiler chickens fed moringa oleifera seed based diets at higher inclusion level above 5%. One hundred and eighty day-old sexed male Arbor acre breed of broiler birds used for this experiment were obtained from Novic Farms, Ibadan, Oyo State Nigeria. The experiment was designed as a complete randomized design. The dietary treatments contained three replicates with 12 chicks per replicate. All the birds were raised under similar management practices throughout the five-week experimental period. The birds were given feed and water *ad-libitum* and weighed weekly. The composition of the experimental diets together with the calculated nutrient content for the broilers is presented on **(Table 1)**.

Diet Formulation

Five experimental diets were formulated for the study. Diet 1 served as the control and contained no *Moringa oleifera* seed meal (MOSM), diet 2 is raw MOSM, diets 3, 4, and 5 are MOSM soaked in 10, 20, and 30% representing ammonium hydroxide (AHMOSM) diet respectively. In these experimental diets, *M. oleifera* seed meal was used to partially replace soybean meal at the corresponding inclusion level.

Test Animals and Feeding Trial

A total of 180 sexed male Arbor Acre broiler chicks were utilized for this study. The experiment was arranged in a one-way classification design comprising five dietary treatments. Each treatment group consisted of three replicates, with twelve (12) chicks per replicate. Prior to the commencement of the feeding trial, all chicks were fed a conventional starter diet for one week to allow for acclimatization to the new environment. Following this period, the birds were provided with the respective experimental diets ***ad libitum*** for a duration of 35 days.

Carcass Evaluation

At the end of the experiment period, 2 chicks from each replicate within each treatment with weight closest to the average were selected from each dietary treatment. They were fasted for 12 hours and then weighed to obtain live body weight, then slaughtered and allowed to

bleed properly, immersed in boiling water for de-feathering. The cut parts (drumsticks, thigh, breast, back and wings) and organs such as liver, kidney, heart, gizzard and lungs were weighed on a sensitive digital scale. Prime cut parts were expressed as percentage of the carcass weight while organs weight was expressed in relative to percentage of the live body weight.

Data Analysis

The data obtained from the study were analysed using One-way ANOVA using the General Linear Model procedure of the Statistical Analysis System [11]. Differences between treatment means were separated using Duncan multiple range test as described by [12].

RESULTS

Five experimental diets were formulated to meet [8] requirement for day old broiler chicks. A Diet 1 is devoid of *Moringa oleifera* seed meal (MOSM), diet 2 contained raw MOSM, while the other three diets contained processed *Moringa oleifera* seed meal using ammonium hydroxide before inclusion in the diet. The composition of the experimental diets together with the calculated nutrient content for the broilers is presented on **(Table 1)**.

Table 1. *Composition (%) of the Experimental Diets (Starter)*

	Inclusion doses of AHMOSM (%)				
Ingredients	**0**	**Raw**	**10**	**20**	**30**
Maize	58.25	58.25	58.25	58.25	58.25
SBM	38.40	33.40	33.40	33.40	33.40
AHMOSM	0.00	5.00	5.00	5.00	5.00
Bone meal	1.50	1.50	1.50	1.50	1.50
Oyster shell	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Lysine	0.10	0.10	0.10	0.10	0.10
DL-methionine	0.25	0.25	0.25	0.25	0.25
*Vit/Min premix	0 .50	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
ME (Kcal/kg)	2954	2959	2943	2958	2946
Crude protein (%)	23	23	23	23	23
Crude fibre (%)	3.20	4.11	3.13	3.58	4.23
Crude fat (%)	4.65	9.13	5.85	6.23	4.67
Methionine (%)	0.49	0.58	0.35	0.48	0.45
Lysine (%)	1.25	1.50	1.10	1.45	1.10

SBM= soybean meal, AHMOSM= Ammonium hydroxide Moringa oleifera seed 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, 40 mg; zinc, 90 mg, iodine, 1 mg; selenium, 0.2 mg; calcium, 31.25 g; sodium,10g

(Table 2) presents the phytochemical constituents of the raw MOSC. There are notable phytochemicals in the seed, such as saponins, phytates, tannins, oxalates, alkaloids, flavonoids, phenols, glycosides and terpenoids.

Table 2*. Phytochemical composition of Raw MOSC*

Chemical	**Amount**
Saponins (%)	36.10
Phytates (mg/100g)	173.20
Tannins (mg/100g)	132.16
Oxalates (mg/100g)	109.40
Alkaloids (mg/100g)	283.58
Flavonoids (%)	86.42
Phenols	38.16
Glycosides (%)	0.00
Terpenoid (%)	72.44

Table 3 presents data on performance characteristic of broilers fed ammonium hydroxide treated *Moringa oleifera* seed meal (AHMOSM). There was a comparable result obtained for the average daily weight gains and the feed intake of the birds that were not significantly ($p>0.05$) affected by the dietary inclusion of the graded doses of ammonium hydroxide treated MOSM and the control group while significant difference ($p<0.05$) exist between the raw (treatment 2) and the control group. The feed conversion ratio favoured birds on the 20% ammonium hydroxide treated *Moringa oleifera* seed meal (MOSM) having the least mean (1.67) compared with the control. There was no mortality recorded during the course of this trial.

Table 3. *Performance Characteristics of Broiler Chickens Fed ammonium hydroxide treated Moringa oleifera seed meal*

Parameters	**0(control)**	**0(Raw)**	**10**	**20**	**30**	**SEM**
Daily weight gains (g/bird/day)	59.993^{a}	42.340^{b}	61.763^{a}	61.873^{a}	61.993^{a}	1.366
Feed intake (g/bird/day)	102.507^{a}	92.307^{b}	104.477^{a}	103.747^{a}	104.737^{a}	3.972
Feed conversion ratio	1.707^{b}	2.180^{a}	1.693^{b}	1.677^{b}	1.687^{b}	0.045

SEM= Standard error of mean*=P<0.05Means with different superscript along the same rows are significantly (P<0.05), MOSM=*Moringa oleifera* seed meal

Table 4. *Carcass characteristics of broiler birds fed ammonium hydroxide Moringa oleifera seed meal.*

Inclusion doses of ammonium hydroxide treated MOSC (%)						
(%)	**1**	**2**	**3**	**4**	**5**	**SEM**
Parameters	**(control)**	**0(Raw)**	**10**	**20**	**30**	
Live weight (g/bird)	1,952.00^{a}	1,255.00^{c}	1,890.00^{b}	1,900.02^{b}	1,889.50^{b}	5.91
Carcass weights (g/bird)	1,275.00^{a}	760.00^{b}	1213.00^{b}	1223.00^{b}	1212.00^{b}	3.37
Dressing percentage (%)	66.79^{a}	60.55^{c}	64.17^{b}	64.36^{b}	64.14^{b}	2.53
Prime cut and Organ weights Expressed as % of live weight						
Head	2.97^{c}	4.51^{a}	3.05^{b}	4.29^{a}	3.09^{b}	0.37
Thigh	12.74^{a}	7.68^{c}	9.39^{b}	7.82^{c}	11.42^{a}	0.53
Breast	17.07^{a}	13.11^{c}	14.31^{ab}	15.32^{ab}	16.60^{a}	0.77
Wings	9.45^{a}	8.84^{ab}	7.48^{d}	8.68^{abc}	9.42^{a}	0.43
Shank	5.46^{a}	4.55^{b}	3.96^{cd}	4.11^{bc}	5.07^{a}	0.37
Neck	6.23^{ab}	5.68^{abc}	4.67^{c}	5.54^{abc}	5.54^{abc}	0.54
Drumstick	10.91^{a}	9.22^{ab}	7.45^{bc}	7.58^{bc}	7.71^{abc}	0.81
Back	11.64^{a}	9.94^{ab}	11.54^{a}	6.99^{c}	11.46^{a}	0.69
Heart	0.49	0.39	0.45	0.50	0.47	0.22
Lungs	0.53	0.40	0.45	0.57	0.48	0.23
Liver	2.02	2.22	1.87	1.96	2.01	0.48
Kidney	0.52	0.29	0.40	0.47	0.44	0.23
Proventriculus	0.38	0.48	0.42	0.50	0.50	0.25
Gizzard	2.11^{c}	3.68^{a}	2.95^{abc}	3.11^{abc}	2.25^{bc}	0.46

SEM= Standard error of mean *=P<0.05 a,b,c Means with different superscript along the same rows are significantly (P<0.05) different, Prime cut and Organ weights Expressed as % of live weight

The carcass characteristics of broilers fed ammonium hydroxide treated *Moringa oleifera* seed meal is presented on **(Table 4)**.

The carcass characteristics of the birds fed ammonium hydroxide treated diets were better than the group fed with the raw diet. The differences in the live weights, carcass weights and the dressing percentage were significantly ($p<0.05$) affected across the treatment groups on the test feed ingredient. There was a corresponding decrease in the live weights, carcass weights, and the dressing percentage of the birds fed with raw diet (treatment 2) and a comparable live weights, carcass weights and the dressing percentage of the birds on control diet and those with ammonium hydroxide treated *Moringa oleifera* seed meal. The weights of the carcass components like the neck, wings, thigh, drumstick, breast, shank, back expressed as percentages of the live weight were lower in all the dietary groups fed the treated feedstuff compare with the control group. The observed inconsistencies in the weights of the internal organs of the birds fed with the raw and treated groups and inclusion of ammonium hydroxide treated *Moringa oleifera* seed meal could not be said to have either or not enhanced the weights of the organs. The weights of the lung, heart, kidney, proventriculus were not significantly ($P>0.05$) affected except the gizzard.

DISCUSSION

Growth performance characteristics: The observed improved growth performance of birds with the ammonium hydroxide treated diets indicate the efficiency of the processing method to reduce the various anti-nutrients inherent in MOSM thereby enhancing its better utilization by the birds. This present study agrees with the findings of [13] that reported reduction in toxicity in mustard meal after alkali heating in broilers.

The significant increase in the feed intake of the animals fed ammonium hydroxide treated MOSM when compared to those on the raw MOSM may be an indication of reduction in the level of anti-nutrients in the treated feed sample. Tannins are known to cause reduction in feed intake (probably by irritating the gut) due to their astringency or bitter taste, thereby reducing the palatability of the feed [14].

The average daily weight gains of the birds was a reflection of their daily feed intake as the birds on the treated groups (treatments 3, 4 and 5) had the highest average daily weight gains due to the highest feed intake while there was a corresponding decrease in the average daily weight gain in treatments 2 containing raw MOSM which caused decreased feed intake. [15] reported that higher levels of 7.5 and 10.0 g/kg moringa seed meal supplementation depressed intake, growth rate and live weights of the chickens.

The authors suggested that the depressions in intake, growth rate and live weights of the chickens were due to the effects of anti-nutritional factors contained in moringa seed meal, for example, hydrogen cyanide. [16] reported that moringa seed kernel and seed meal have high levels of anti-nutrients. The significantly ($P<0.05$) low feed intake and poor feed conversion ratio observed with birds on raw diet could be as a result of poor acceptability of the MOSM based diets or due to the unpleasant taste of the diets. This observation is in consonance with the report by [17, 18] who reported that chickens have an acute sense of taste.

Also, the significant improvement observed in the feed conversion ratio of the birds placed on ammonium hydroxide treated MOSM based diet, when compared with those on the raw MOSM is indicative of a better utilization of the feed. Feed conversion ratio is the amount of feed consumed per unit weight gain [19]. It showed that the animals reared on the field, gained more weight with little amount of the feed consumed.

There was an indication that birds fed the control diet and the treated groups had better feed conversion ratios. The best FCR observed in birds on the control diet and the treated groups was due to the absence of anti-nutritional factors (ANFs) in the control diet and subsequent reduction in the ANFs present in MOSM by the adopted processed method.

This was a result of better utilization of the nutrients in the control diet with no anti-nutritional factors and 30% ammonium hydroxide based diet with lower contents of ANFs than 10% and 20% ammonium hydroxide based diets. This result confirms earlier findings of [20] that reduced ANFs as a result of improved processing techniques enhanced birds performance.

Absence of mortality in this study is an

indication that most of the anti- nutrients in the treated MOSM diets have been eliminated or significantly reduced. Some of these anti-nutrients are known to cause death in animals.
Carcass Characteristics: The observed improvement in live weights, carcass weight, dressing percentage as well as increased head weight of the birds on AHMOSM that compared favourably with birds on control diet may be due to antioxidant activities of some components of *Moringa oleifera* like vitamins C and E [21] and phenols especially flavonoids [22].

These results agree with [23; 24] who discovered that germinated moringa seed meal supplementation increased gizzard weight of quail chickens.

Moringa seed meal had a significant ($p<0.05$) effect on all the prime cut and organs of broiler chickens. Birds fed control diet had significant ($p<0.05$) highest live weight, dressed weight and dressing percentage values followed by those fed 20% dietary doses of AHMOSM. However, birds fed 10, 20% and 30% dietary doses of AHMOSM were statistically similar in terms of live weight, dressed weight and dressing percentage. The size of the gizzard and proventriculus were observed to increase progressively with inclusion doses of the AHMOSM. This may be as a results of underlying health challenges or due to ant nutritional factors that might be present in the MOSM which the liver was unable to detoxify.

CONCLUSION AND RECOMMENDATIONS

From this study, treated MOSM can be included in the diets of broiler chickens up to 5% for improved growth performance without hampering the carcass characteristics of the chicks. It is recommended that further study be carried out on other processing methods to remove the effect of anti-nutritional factors inherent in moringa seed meal at higher inclusion level.

CONFLICT OF INTEREST

The authors declare no conflict of interest

ACKNOWLEDGEMENT

The authors are grateful and thankful to the staffers of Moringa Plantation at the Afe Babalola University (ABUAD), for supplying the *M. oleifera* seed cake used in this study.

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