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# Growth Performance, Nutrient Digestibility and Carcass Characteristics of Broiler Chickens Fed Moringa (*Moringa oleifera*) and Baobab (*Adansonia digitata*) Leaf Powders to Replace Synthetic Premix in North-East – Nigeria

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**Abstract** A total of one hundred and eighty (180) two weeks old broiler chickens were used for 49 days feeding trial to investigate the effects of Moringa leaf powder (MOLP and Baobab leaf powder (BLP) to replace commercial premix on growth performance, nutrient digestibility and carcass characteristics. Six (6) experimental diets designated as treatments 1, 2, 3, 4, 5 and 6 were formulated. T1 contained (0.30% synthetic premix), T2 (0.15% synthetic premix + 0.15% MOLP), T3 (0.15% synthetic premix + 0.15% BLP), T4 (0.15% MOLP + 0.15% BLP), T5 (0.30% MOLP) and T6 (0.30% BLP). The chickens were randomly allotted to the six (6) treatments and each treatment consisted of 30 chickens which were replicated thrice with 10 chickens per replicate in a Randomized Complete Block Design (RCBD). Result obtained revealed that, final live weight, total weight gain and total feed intake were significantly ($P<0.05$) different among treatment groups with the exception of feed conversion ratio. Highest final liveweight, total weight gain and total feed intake were observed in T3. Similarly, significant ($P<0.05$) differences were observed in nutrient digestibility's among all the treatments. Carcass and organs weight showed no significant ($P>0.05$) differences in all the treatment groups. Numerically however, final live weight, slaughter weight, plucked weight, dressed weight and dressing percentage were higher in T3. It can be concluded that MOLP and BLP can completely be used to replace commercial premix in broiler chickens diets without adverse effects on growth performance, nutrient digestibility and carcass components.

**Keywords** *Moringa* leaves, Baobab leaves, synthetic premix, digestibility, carcass, broiler chickens

## Introduction

Poultry production is a business that can flourish with a good care and understanding from farmers. Poultry industry occupies a unique position in the livestock sector because they are highly prolific and are good feed converters [1]. The acute shortage of animal protein in the diet of Nigerians requires a logical solution by increasing the production and consumption of poultry meat and eggs [2]. Production of quality and quantity of feed ingredients for feed formulation for poultry determinants is the major profitable production. It has been established that green vegetable leaves are the cheapest and most abundant source of proteins because of their ability to synthesize amino acids from wide range of available primary materials such as water, carbondioxide and atmospheric nitrogen [3].

*Moringa oleifera* is one of the plants whose leaves are used in poultry diets because; it contains good sources of nutrients [4]. *Moringa oleifera* leaf are good sources of proteins, vitamins A, B and C and minerals such as calcium and iron [5]. The protein content of *Moringa oleifera* leaf ranged between 20 to 23% on dry weight

basis and is of high quality [6]. *Moringa* plant known as "Miracle tree" has been reported to have many medicinal uses as it possesses hypo-cholesterolemic properties [7] and impaction of carotenoid compound into the poultry muscles and could as such substitute conventional feed stuffs [8].

Similarly, baobab leaf is rich in nutrients. It is high in vitamin C and it contains anti-oxidant capacity [9]. Baobab leaves contain 5 to 17% crude protein [10], fibre content ranged from 10 to 19% and calcium, 1 – 4%. However, the high tannin content of baobab leaves limit its usage as a major ingredient in poultry diets [6]. The objective of this study was to assess the growth performance, nutrient digestibility and carcass characteristics of broiler chickens fed *Moringa oleifera* and Baobab (*Adansonia digitata*) leaf powders as a replacement for synthetic premix.

## Materials and Methods

### Study Area

The study was carried out at the University of Maiduguri Teaching and Research Livestock Farm, Department of Animal Science. Maiduguri is located between latitude 11°05' and 12° North and longitude 13°05' and 14° East and at an altitude of 354M above sea level [11]. The mean temperature is 34°C, the maximum being 40.6°C and minimum 25°C which is in April and December respectively [12]. The area falls within semi-arid zone of West Africa which is characterized by short duration of rainfall (3 to 4 months) which varies from minimum of 478mm to 500mm and maximum of 600 m to 621 mm with a long dry season of 8 to 9 months [13].

### Experimental Stock and Management

One hundred and eighty (180) two weeks old broiler chickens were used for the study. The chickens were weighed individually and allotted to six (6) experimental diets. The chickens were assigned to the six dietary treatments in groups of 30 birds per treatment and replicated thrice with 10 chickens per replicate in a randomized Complete Block Design (RCBD) six experimental diets were formulated and designed as treatment 1, 2, 3, 4, 5 and 6. T1 contained (0.30% synthetic premix) T2 (0.15% synthetic premix + 0.15% MOLP), T3 (0.15% synthetic premix + 0.15% BLP), T4 (0.15% MOLP + 0.15% BLP), T5 (0.30% MOLP) and T6 (0.30% BLP). The chickens were provided with the experimental diets and drinking water *ad libitum*. Other management practices such as vaccination against Gumboro and New Castle diseases were carried out. The study lasted for 49 days. The ingredients composition and calculated analysis of the experimental finisher diets is presented in Table 1.

**Table 1:** Ingredients Composition and Calculated Analysis of the Experimental Broiler Finisher Diets

| **Ingredient** | **Treatments / Diets** | | | | | |
|---|---|---|---|---|---|---|
| | **T1** | **T2** | **T3** | **T4** | **T5** | **T6** |
| Maize | 54.00 | 54.00 | 54.00 | 54.00 | 54.00 | 54.00 |
| Soyabean | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 |
| Wheat offal | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Fish meal | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Bone meal | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Premix | 0.30 | 0.15 | 0.15 | 0.00 | 0.00 | 0.00 |
| Moringa leaf meal | 0.00 | 0.15 | 0.15 | 0.00 | 0.00 | 0.00 |
| Baobab leaf meal | 0.00 | 0.00 | 0.15 | 0.15 | 0.00 | 0.30 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Lysine | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| **Total** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |
| **Calculated Analysis** | | | | | | |
| Crude protein (%) | 20.29 | 20.39 | 20.31 | 20.35 | 20.38 | 20.32 |
| Crude fibre (%) | 4.48 | 4.50 | 4.50 | 4.53 | 4.54 | 4.52 |
| Ether extract (%) | 8.27 | 8.28 | 8.28 | 4.28 | 4.28 | 4.29 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ash | 2.91 | 2.92 | 2.92 | 2.93 | 2.94 | 2.93 |
| Nitrogen free extract | 52.62 | 52.67 | 52.72 | 52.77 | 52.73 | 52.65 |
| Calcium (Ca) | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| Phosphorus (PH) | 0.44 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 |
| ME (kcal/kg) | 3179.50 | 3179.50 | 3179.50 | 3179.50 | 3179.50 | 3179.50 |

ME = Metabolizable Energy (Kcal/kg)

** Premix suppling the following per kg of feed. Vit. A = 50,000,000IU, Vit $D_2$ = 1,600,000IU, Thiamin = 2000Mg, Riboflabin = 5,000mg, Panthotenic acid = 10,000, Vit. B6 = 3000mg, Vit. $B_{12}$ = 20mg, Vit. K = 100mg, E = 20,000mg, Vit. C = 100,000mg, Nicotinic acid = 25,000mg, Folic acid = 600mg, biotin = 0.5mg, Manganese = 100,000mg, Iron = 80,000mg, Zinc = 49,000mg, Copper = 5,000mg, Iodine = 200mg, Cobalt = 250mg, Selenium = 125mg, Choline chloride 400,000mg, Zinc bacitracin = 15,000mg, Farmers UGF = 75,000mg*

**Data Collection:**

**Performance Data**

During the study, the data collected: were final Live weight, total weight gain, total feed intake and Feed conversion ratio (FCR).

**Chemical Analysis**

All feed samples collected were analyzed using [14] methods.

**Digestibility of Nutrients**

During the seventh week of the experiment, three (3) chickens from each treatment were randomly selected for digestibility study. The chickens were placed into metabolism cages for the study. A measured quantity of feed was provided and faecal samples collected for 5 days, oven-dried and preserved for proximate analyses. The proximate composition of the diets and faecal samples were determined. The digestibility (%) was calculated as follows:

$$\text{Digestibility (\%)} = \frac{(\text{Nutrient in feed} \times \text{FI}) - (\text{Nutrient in faeces} \times \text{FO})}{\%\ \text{Nutrient in feed} \times \text{FI}} \times \frac{100}{1}$$

Where: FI = Feed intake, FO = Faecal Output

**Carcass Analysis**

At the end of the experiment, six (6) chickens were randomly selected from each treatment and were deprived of feed for 12 hours before slaughter. The weight of the chickens were taken and slaughtered by cutting transversely across the trachea, esophagus, large carotid arteries and jugular veins to ensure maximum bleeding. This was in conformity with local practice. The liveweight, slaughter weight, dressed weight as well as the weights of head, neck, wings, thighs, shanks, abdominal fats and visceral organs such as heart, liver, lungs and gizzard were excised and weighed. The dressed weight was compared with the liveweight to obtain the dressing percentage.

$$\text{Dressing percentage} = \frac{\text{Dressed weight}}{\text{Liveweight weight}} \times \frac{100}{1}$$

All the cut-up parts and the organ weights were expressed as percentage of live weight.

**Statistical Analysis**

All data collected were subjected to analyses of variance (ANOVA) using the software Statistix 9.0 [15] and where significant, means were separated by least significant difference (LSD).

**Results and Discussion**

The chemical composition of broiler finisher experimental diets is presented in Table 2. The crude protein values ranged from 20.31 to 20.39%. These values were within the recommended values 19 to 21% reported by [16] for finishing broiler chickens. The crude fibre levels 4.48 to 4.50% were also within the accepted range 3 to

7% reported by [17] for finishing broiler chickens. The values for ether extract 4.29 to 8.28%, ash 2.91 to 2.94%, Nitrogen free extract (NFE) 52.62 to 52.77% and metabolizable energy (ME) 3179.50 (kcal/kg) were all within the recommended levels outlined by [16] for finishing broiler chickens.

**Table 2:** Chemical Composition of the Experimental Broiler Finisher Diets Fed to Broiler Chickens

| Constituents (%) | Treatments /Diets | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 |
| Dry matter | 97.60 | 99.20 | 98.20 | 99.00 | 98.90 | 99.40 |
| Crude protein (CP) | 20.29 | 20.39 | 20.31 | 20.35 | 20.38 | 20.32 |
| Crude fibre (CF) | 4.48 | 4.50 | 4.50 | 4.53 | 4.53 | 4.52 |
| Ether Extract (EE) | 8.27 | 8.28 | 8.28 | 4.58 | 4.29 | 4.30 |
| Ash | 2.91 | 2.92 | 2.29 | 2.93 | 2.94 | 2.93 |
| Nitrogen free extract (NFE) | 52.62 | 52.67 | 52.72 | 52.77 | 52.73 | 52.65 |
| ME (Kcal/kg) | 3179.50 | 3179.50 | 3179.50 | 3179.50 | 3179.50 | 3179.50 |

Growth performance of broiler chickens fed MOLP and BLP replacing synthetic premix is presented in Table 3. The final live weight, total weight gain and total feed intake were significantly (<0.05) different among treatment groups with the exception of feed conversion ratio. Highest final live weight, total weight gain and total feed intake were obtained in T3 (0.15% synthetic premix + 0.15% BLP) and lowest values of final weight gain and total weight were observed in T2 (0.15% synthetic premix + 0.15% MOLP). Lowest total feed intake was obtained in T4 (0.15% MOLP + 0.15% BLP). Results obtained, revealed higher final liveweight and total weight gain in T3 (0.15% synthetic premix + 0.15% BLP) and this agreed with [18] who reported that birds on 50% baobab leaf meal had better performance. [18] reported that 20% inclusion level of MOLP enhanced final live weight. Chickens fed 15 to 20% MOLP inclusion level had the highest feed intake. Numerically, the poorer feed conversion ratio observed in T4 (0.15% MOLP + 0.15% BLP) could probably be due to the tannin and other antinutritional contents in *Moringa* and baobab leaves as reported by [19], which depressed growth and feed utilization [20].

**Table 3:** Growth Performance of Broiler Chickens Fed *Moringa oleifera* and Baobab leaf Powders Replacing Synthetic Premix

| Constituents (%) | Treatments /Diets | | | | | | |
|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | SEM |
| Initial live weight (g) | 576.25 | 552.00 | 560.65 | 555.00 | 570.80 | 555.80 | $9.20^{NS}$ |
| Final live weight (g) | $1628.80^{ab}$ | $1456.40^{b}$ | $1775.90^{a}$ | $1511.20^{ab}$ | $1635.10^{ab}$ | $1681.20^{ab}$ | $98.20^{*}$ |
| Total weight gain (g) | $1052.50^{ab}$ | $904.40^{b}$ | $1215.50^{a}$ | $956.20^{ab}$ | $1064.30^{ab}$ | $1125.40^{ab}$ | $97.40^{*}$ |
| Total feed intake (g) | $4393.40^{ab}$ | $4598.80^{ab}$ | $4882.90^{a}$ | $4257.00^{b}$ | $4572.80^{ab}$ | $4773.40^{ab}$ | $149.74^{*}$ |
| Feed Conversion Ratio | 4.20 | 4.80 | 3.90 | 4.90 | 4.50 | 4.30 | $0.39^{NS}$ |

a,b = Means bearing different superscripts within the same differ significantly (P<0.05), NS = Not significant (P>0.05), SEM = Standard Error of Means

The result for nutrient digestibility is presented in Table 4. The dry matter, crude protein, ether extract, ash and nitrogen free extract digstibilities were significantly (P<0.05) different among all the treatment groups. The dry matter digestibility showed that T6 (0.30% BLP) had the highest and the lowest was in T4 (0.15% MOLP + 0.15% BLP). The similarities observed in T1, T2, T3 and T5 agreed with the report of [21 who revealed that inclusion of *Moringa oleifera* leaf in broiler chickens diets improved digestibility of the diets. Crude protein digestibility was highest in T1 (0.30% synthetic premix) and the lowest was in T4 (0.15% MOLP + 0.15% BLP). The ether extract digestibility was highest in T1 and the lowest was in T4. The crude protein digestibility recorded in this study (81.71 to 88.27%) was close to the values (86.42 to 92.72%) recorded by [18] when broiler chickens were fed baobab pulp and seed based diets. They further stated that inclusion of baobab meal especially at 40% in the diet of broiler chickens gave optimum digestibility and feed conversion. The ether extract digestibility was highest (83.24%) in T1 and the lowest (66.46%) was in T4. These values were lower than the values (87.99% to 96.03%) reported by [18]. Ash availability and nitrogen free extract digestibility

were higher in T6 (0.30% BLP). These results were also similar to the values obtained by [18]. The higher value of Ash in T6 indicated that minerals in the diets were readily available.

**Table 4:** Nutrient Digestibility (%) of broiler chickens fed *Moringa oleifera* leaf powder (MOLP) and baobab leaf powder (BLP) replacing synthetic premix

| Nutrients Digestibility (%) | Treatment / Diets | | | | | | |
|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | SEM |
| Dry matter | $74.84^{b}$ | $73.04^{bc}$ | $73.55^{bc}$ | $66.26^{c}$ | $73.05^{bc}$ | $79.66^{a}$ | $1.73^{*}$ |
| Crude protein | $88.27^{a}$ | $87.94^{a}$ | $86.90^{a}$ | $81.71^{b}$ | $82.28^{b}$ | $85.86^{ab}$ | $1.22^{*}$ |
| Ether extract | $83.24^{a}$ | $77.85^{ab}$ | $81.15^{a}$ | $66.46^{c}$ | $71.84^{bc}$ | $73.90^{b}$ | $1.87^{*}$ |
| Ash | $54.69^{b}$ | $48.76^{bc}$ | $20.22^{d}$ | $20.03^{d}$ | $38.56^{c}$ | $63.92^{a}$ | $4.09^{*}$ |
| Nitrogen free extract | $73.79^{c}$ | $75.40^{c}$ | $78.79^{ab}$ | $79.98^{b}$ | $78.95^{ab}$ | $84.29^{a}$ | $2.73^{*}$ |

a,b,c, = Means within the same row bearing different superscripts differs significantly (P<0.05), SEM = Standard Error of Means, T1 = 0.30% synthetic premix, T2 = 0.15% synthetic premix + 0.15% MOLP, T3 = 0.15% synthetic premix + 0.15% BLP, T4 = 0.15% MOLP + 0.15% BLP, T5 = 0.30% MOLP, T6 = 0.30% BLP

Results for carcass parameters of broiler chickens fed *Moringa oleifera* and baobab leaf powders replacing synthetic premix is presented in Table 5. Carcass parameters showed no significant (P>0.05) differences among treatment groups. Numerically, slaughter weight, plucked weight, dressed weight and dressing percentage were higher in T3 (0.15% synthetic premix + 0.15% BLP). All the parameters were close to the values reported by [17] for broiler chickens at nine weeks of age. However, the final liveweight (1890.00 to 2160.00g) obtained in this study were lower than the value (2495g) reported by [17]. The dressing percentage (71.65 to 76.75%) obtained in this study were higher than (70.75%) reported by [20] as the ideal dressing percentage for well finished broiler chickens. The higher values recorded signifies that inclusion of *Moringa oleifera* or baobab leaf powders in broiler chickens diets provide adequate nutrients to be utilized.

The cut-up parts expressed as percentage of live weight showed no significant (P>0.05) differences among all the treatments. The breast weight (19.10 to 21.23%) obtained in this study were within the range reported by [23]. The weight of drum stick (9.13 to 10.25%) recorded was however, lower than the range (13.29 to 14.14%) reported by [18] who fed diets containing *Moringa oleifera* inclusion levels of 0.5, 1.0, 1.5 and 2.0% as supplements to broiler chickens. This variation could be as a result of age, because [20] terminated their experiment at nine weeks of age, while this experiment was terminated at seven weeks of age.

The weight of the visceral organs and abdominal fats showed no significant (P>0.05) differences among treatment groups. The percentage of abdominal fat obtained in this study (1.83 to 3.09%) agreed with the findings of [20] who reported that fats in broiler chickens at 43 days of age accounts for as much as 10 to 15% of the total carcass weight which is by for higher than the values recorded in this study. The non significant differences observed in this study indicated that the diets provided adequately all the needed nutrients for broiler chickens. The diets containing *Moringa oleifera* and baobab leaf powders replacing synthetic premix did not have adverse effects on growth performance, nutrient digestibility and carcass characteristics of broiler chickens.

**Table 5:** Carcass Characteristics and Organ Measurements of Broiler Chickens Fed *Moringa oleifera* leaf powder (MOLP) and Baobab Leaf Powder (BLP) replacing Synthetic Premix

| Parameters | T1 | T2 | T3 | T4 | T5 | T6 | SEM |
|---|---|---|---|---|---|---|---|
| Final liveweight (g) | 2042.50 | 1937.50 | 2161.00 | 1890.00 | 1953.80 | 2107.50 | $203.72^{NS}$ |
| Slaughter weight (g) | 1996.30 | 1878.80 | 2106.30 | 1775.00 | 1885.00 | 2018.70 | $194.35^{NS}$ |
| Plucked weight (g) | 1853.00 | 1797.50 | 2025.00 | 1725.00 | 1830.00 | 1920.00 | $202.40^{NS}$ |
| Dressed weight (g) | 1511.30 | 1437.50 | 1575.00 | 1350.00 | 1400.00 | 1460.00 | $155.95^{NS}$ |
| Dressing percentage (%) | 71.65 | 76.50 | 76.75 | 72.75 | 75.50 | 75.50 | $3.56^{NS}$ |
| **Cut-up Parts as Percentage of Live Weights** | | | | | | | |
| Head (%) | 2.13 | 2.37 | 2.28 | 2.42 | 2.27 | 2.39 | $0.22^{NS}$ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Shank (%) | 3.04 | 3.69 | 3.55 | 3.37 | 3.38 | 3.37 | $0.37^{NS}$ |
| Wing (%) | 7.96 | 8.11 | 7.66 | 7.40 | 7.47 | 7.71 | $0.42^{NS}$ |
| Neck (g) | 5.08 | 5.13 | 5.07 | 5.36 | 4.96 | 4.34 | $0.48^{NS}$ |
| Thigh (%) | 11.49 | 11.31 | 11.77 | 11.30 | 10.87 | 10.90 | $0.44^{NS}$ |
| Drum stick (%) | 9.52 | 10.25 | 9.19 | 9.13 | 9.35 | 10.14 | $1.10^{NS}$ |
| Back (%) | 14.71 | 14.81 | 15.23 | 14.84 | 15.10 | 14.10 | $1.10^{NS}$ |
| Breast (%) | 20.60 | 19.10 | 21.23 | 19.73 | 19.10 | 20.08 | $1.09^{NS}$ |
| **Organs and Viceral Content Weight as % Live weight** | | | | | | | |
| Gizzard (%) | 2.72 | 2.73 | 2.53 | 2.88 | 2.99 | 2.86 | $0.36^{NS}$ |
| Proventriculus (%) | 0.54 | 0.59 | 0.59 | 0.52 | 0.66 | 0.69 | $0.11^{NS}$ |
| Liver (%) | 2.45 | 2.09 | 2.17 | 2.17 | 2.39 | 2.14 | $0.22^{NS}$ |
| Heart (%) | 0.47 | 0.54 | 0.50 | 0.48 | 0.57 | 0.50 | $0.06^{NS}$ |
| Abdominal fats (%) | 2.94 | 2.06 | 3.04 | 3.09 | 2.30 | 1.83 | $0.54^{NS}$ |
| Intestine (%) | 5.34 | 5.86 | 5.52 | 5.40 | 6.27 | 5.79 | $0.81^{NS}$ |
| Caeca (%) | 0.64 | 0.83 | 0.79 | 0.80 | 0.85 | 1.05 | $0.16^{NS}$ |

MOLP = *Moringa oleifera* leaf powder, BLP = Baobab leaf powder, T1 = 0.30% synthetic, T2 premix, T2 = 0.15% synthetic premix + 0.15% MOLP, T3 = 0.15% synthetic premix + 0.15% BLP, T4 = 0.15% MOLP + 0.15% BLP, T5 = 0.30% MOLP, T6 = 0.30% BLP.

## Conclusion

Based on these results, it can be concluded that, Moringa (*Moringa oleifera)* and Baobab (*Adansonia digitata*) leaf powders are suitable replacement for synthetic premix in broiler chickens diets without adverse effects on growth performance, nutrient digestibility and carcass characteristics. Therefore, poultry producers can use *Moringa* and/or baobab leaf powders to replace synthetic premix in broiler chickens diets. However, further studies should be carried out to evaluate the effects of both *Moringa* and baobab leaf powders in the diet of other classes of poultry.

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