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ORIGINAL RESEARCH ARTICLE

Effects of African nutmeg (*Monodora myristica*) seed water extract on performance, carcass and organ characteristics of broiler chickens

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ABSTRACT

The effect of Monodora myristica seed extract on growth performance, carcass and relative organ weights of broiler chickens fed corn-soyabean based diet were evaluated. Monodora myristica seed contains anti-microbial and anti-oxidant properties. Two hundred unsexed 1-day old Arbor Acre broiler chicks were randomly allotted into 5 groups of 4 replicates housing 10 chicks per replicate in a Completely Randomized Design. Monodora myristica seed was dried and milled into powder and then infused into the drinking water as follow: T1 - 0g/L of water (control); T2 - 0.25g/L of water; T3 - 0.50g/ L of water; T4 - 0.75g/L of water and T5-1.0g/L of water. Daily feed intake, weekly body weight changes and feed conversion ratio were recorded. On day 42, two birds per replicate were sacrificed to evaluate relative carcass and organ characteristics. Feed intake was not significantly different from birds fed T1, T4 and T5 diets. Body weight gain of 1.46kg was recorded for birds offered 0.50g/L which was significantly higher (P<0.05) than the rest of the groups. Birds offered 0.50g/L of test ingredient also had the best feed conversion ratio with least value of 2.18. Birds that consumed water containing 1g/L of the extract (T5) had higher absolute but non significant live weight, bled weight, defeathered weight, eviscerated weight and dressed weight across treatment levels. Birds fed 1.0g/L had the highest values of thigh, drumstick, wing, breast, shank and abdominal fat weights. Values of the relative organ weight; kidney, heart, lung, liver, spleen, full gizzard, GIT weight and colon were not significantly different (P>0.05), while pancreas, empty gizzard, proventiculus and caecum were not significantly different among the treatment groups. In conclusion infused Monodora myristica seed did not improve carcass dressed weight values in comparison to the birds given extract at 0.25g/L. This indicates that infused Monodora myristica can serve as possible alternative for antibiotics in broiler chickens production, however, the inclusion level should be within 0.75g/L-1.0g/L which is subjected to the production objectives.

Keywords: *Monodora myristica*, feed additive, antibiotics, body weights, broiler chickens

INTRODUCTION

Poultry is regarded as the fastest means of bridging the animal protein deficiency gap prevailing in the country (Atteh, 2002).Broiler chickens are selected for rapid weight gain and efficient utilization of feed (NRC, 1994, Madubuike and Ekenyem, 2001) and they are good converter of unconventional feedstuffs, by meeting a marketable size (Partmouth, 1991). Studies showed the efficiency of antibiotics as growth promoter (Ogle, 2013), microbial infection inhibitors (Christopher, 2012), its influence in maximizing poultry production efficiency (Budino *et al.*,2005), product quality and diseases controlling (Bedford, 2000andWhitehead, 2002).Antibiotics Growth Promoters (AGP) were introduced for sub-therapeutics purposes during the era of meat shortage when there was advocacy for stable supplies by the public to the US government (Ogle, 2013). The influence of antibiotics in improving poultry production may be due to its ability to inhibit growth of pathogenic bacteria (Norcia *et al.*, 1999), lowering of gas distension problems, improved digestion and absorption of essential nutrients(Gibson and Roberfroid, 1995; Jeurissen *et al.*, 2002). However, reports showed that prolonged usage of AGP in animal production caused resistance by microbiota through gradual genetic modifications (Pattanayak, 2017), antibiotic selections and/or spread of antibiotics resistance (Adjiri-Awere and Van Lunen, 2005). This has called for efforts to find potential replacements that could improve animals' growth performance with better carcass quality.

Monodora myristica is found to possess inhibitory effect similar to antibiotics (Ravindran and Kallupurackal, 2001). The antimicrobial effect is in its oil present in the

seed. *Monodora myristica* was used as antimicrobial agent against *Staphylococcus aureus, Substilis aureus* and *Escherichia coli in vitro* (Adewole *et al.*, 2013).Hence, this research was carried out to study the effect of *Monodora myristica seed* water extract as alternative to antibiotics on growth performance, carcass characteristics and organ weights in broiler chickens.

MATERIALS AND METHODS

The research was carried out at the poultry unit, teaching and research farm, University of Ibadan, Ibadan, Oyo State, Nigeria.

Preparation of experimental material

Monodora myristica seeds were obtained from Bode Market in Ibadan, Oyo state. The seeds were de-husked and milled into powder and incorporated in diets for starter and finisher broilers. The diets were formulated to meet nutritional requirements of broilers as recommended by NRC (1994) (Tables 1). The birds were offered diets *ad libitum* and water in which *M. Myristica* seed extracts at varying of 0, 0.25, 0.50, 0.75 and 1.0 g per Litre for treatments 1, 2, 3, 4 and 5, respectively.

Table 1: Composition of experimental diet (%)

Ingredients	Starter	Finisher
Maize	55.40	60.00
Soya bean meal	38.00	33.20
Fish meal	2.50	2.00
Wheat offal	0.80	1.50
Dicalcium phosphate	1.50	1.50
Premix*	0.25	0.25
Limestone	0.80	0.80
DL- Methionine	0.25	0.25
L-lysine	0.25	0.25
Table salt	0.25	0.25
TOTAL	**100.00**	**100.00**

Vitamin & mineral premix contain the following per Kg diet. Vit. A 10,000 IU, D3 2,000 IU, E 15 IU, K3 1.5mg, B2 5mg, B6 2mg, B12 10µg, Pantothenic acid 12mg, Biotin 10µg, Niacin 25mg, Cholin Chloride 900mg, Folic acid 0.5mg, Cu 10mg, Mn 52.5mg, Zn 60mg, Fe 100mg, I 1.5mg, Co 0.25mg

Experimental diet and management of birds

Two hundred unsexed 1-day old Arbor Acre broiler chicks were procured from a reputable hatchery in Oyo State. The chicks were brooded for two weeks, before randomly allocated into 5 treatment groups containing 40 birds per treatment group. The treatment groups were further sub-divided into four replicates of 10 birds per replicate in a completely randomized design. Routine management and vaccination procedures were followed. Vaccinations were administered to the birds in all treatment groups, while no medication was given to treatments 2 to 5 except treatment 1 which was the control. The birds were fed starter diet *ad-libitum* from 0- 28 days and finisher diet from 29-56 days Tables 1 and 2 shows the feed compositions and calculated proximate analysis of the experimental diets.

Data collection

Feed intake was calculated as difference between amount of feed given and left over daily. The body weight gain was measured as the difference between the initial and final weight.Average body weight gain, feed intake, water intake were taken and Feed Conversion Ratio (FCR) calculated on weekly basis for 6 weeks.

The values obtained were used to compute the following parameters:

Average feed intake/bird/day (g) = (quantity of feed given – left overs)/bird/day

Weight gain (g) = final live weight – initial live weight

$$\text{FCR} = \frac{\text{Quantity of feed consumed (kg)}}{\text{Body weight gain (kg)}}$$

Carcass evaluation

When the birds were 56 days old, 2 birds per replicate were randomly selected for carcass and organ weight evaluation after fasting them over night, though water was provided. The birds were slaughtered at 56 days and allowed to bleed thoroughly according to the method recommended by Odunsi *et al.* (1999). The slaughtered birds were de-feathered, cleaned, eviscerated and dissected. Relative cut parts were recorded on thigh, drumstick, wing, breast, back, shank, neck, head, and abdominal fat. Also, kidney, heart, lung, bursa of fabricius, pancreas, liver, gizzard, ceca and colon were harvested and weighed.

Proximate analysis

The proximate compositions of starter and finisher diets were analyzed according to the methods of AOAC (2000).

Statistical analysis

Data obtained on performance, carcass and organ parameters were subjected to analysis of variance (ANOVA) using SAS (2005) software package and the means were separated using Duncan Multiple Range Test of the same statistical package as described by Steel and Torrie (1980).

RESULTS AND DISCUSION

Results of calculated nutrient composition and proximate composition are presented in Tables 2 and 3. Analysis of the diets for nutrient composition indicated that the diets are in reasonable agreement with the calculated values, for starter and finisher diets as shown in Table 2.

Table 2: Calculated nutrient values of the starter and finisher diets

Ingredients (%)	Starter	Finisher
Crude protein	23.13	21.40
Crude fat	3.69	3.78
crude fibre	3.96	3.76
Calcium	0.87	0.83
Total phosphorus	0.73	0.70
Non-phytate P, %	0.39	0.38
Ca: NPP	0.22	0.21
Ca: total P	0.12	0.11
Energy ME, Kcal/kg	3014.90	3042.05

Table 3: Proximate composition of the experimental diets

Nutrient %	Starter	Finisher
Dry matter	88.95	87.55
Crude protein	22.53	20.04
Ether extract	4.38	3.96
Crude fibre	3.66	3.82
Ash	5.41	6.38

Table 4 shows the performance characteristics of broiler chicken fed *Monodora myristica*. Significant differences ($P<0.05$) were observed in the feed intake, final body weight, weight gain, feed conversion ratio and water intake. Birds on 0.25g/L consumed the highest feed with average daily intake of 36.74g/b/d which was significantly ($P<0.05$) different from the birds fed 0.5g/L of the test ingredient with average daily intake of 31.82g/b/d but had not significantly different from the control (0g/L). This result showed that low inclusion level of infused *Monodora myristica* seed water extract could stimulate higher feed consumption (36.74g/b/d) by poultry. This is assumed to have occurred due to spicy nature of the test ingredient which correlates with the report by Enwereuzoh *et al.* (2015) that used *Monodora myristica* extract as flavoring agent to improve popcorn palatability. Also, Esmail, (2004) reported improved level of voluntary feed consumption by bird fed flavored diets, which could be a result of essential oil that serves as stimulant to the secretion of digestive fluids (Wenk, 2000). Birds fed 0.5g of *Monodora myristica* per Liter of water had superior final body weight and weight gain of 1.58kg and 1.46kg which are significantly ($P<0.05$) different from values of birds fed the control diet (T1 = 0g/L of water; 1.34kg and 1.23kg), 0.25g/L (1.39kg and 1.28kg), 0.75g/L (1.42kg and 1.31kg) and 1.0g/L (1.36kg and 1.25kg) respectively. These birds fed 0.5g/L of test ingredient consumed the highest water intake and gave the best FCR value of 2.18(with least feed consumption level). The reduced feed intake might have occurred due to better feed utilization of dietary nutrient as reflected in the FCR value, a result of increase in the quantities of test ingredient consumed which may contain some factors that reduced the feed intake of the birds. This record of better feed efficiency by birds fed on 0.50g/L is in line with Herawati (2010) who reported that birds fed 1.5 – 2% dried ginger meal had significantly lower feed intake than those fed his control diet. The weight gain results evidently showed that moderate consumption of *Monodora myristica* improved weight gain performance of broiler chickens which resulted from the efficient utilization of the feed. as efficiently stimulated by the test ingredient. These results directly relate with Ukoha *et al.* (2016) experiment where they used 0.25% and 1.25% of *Monodora myristica* seed meal and *Zingiber officinale* seed meal respectively as mixed spice to obtained improved mean weight gain (54.19g/b/d) compare to the control diet (49.90g/b/d). Onunkwo and Ugwuene (2015) also used (2%) each of *Monodora myristica seed* meal and poultryzyme as feed constituents and the experiment results showed better average daily weight gain records (24.40g and 29.17g) by the feed additives in relations to the control diet (23.21g).

Table 4: Performance of broilers offered *Monodora myristica* water extract (g/L)

Parameters	T1(0g/L)	T2 (0.25g/L)	T3 (0.50g/L)	T4 (0.75g/L)	T5(1.0g/L)	SEM
Initial Bd Wt (g)	113±0.03	114±0.06	112±0.04	118±0.09	109±0.03	0.003
Final Bd Wt (kg)	1.34±1.03^{b}	1.39±0.83^{b}	1.58±1.05^{a}	1.42±1.39^{ab}	1.36±0.75^{b}	0.095
Wt Gain (kg)	1.23±1.01^{b}	1.28±0.84^{b}	1.46±1.08^{a}	1.31±1.37^{b}	1.25±0.73^{b}	0.094
Feed Intake (g/b/d)	34.93±3.02^{ab}	36.74±1.99^{a}	31.82±1.18^{b}	33.58±1.16^{ab}	35.52±2.99^{a}	0.189
Water Intake (L)	15.99±0.45^{ab}	14.95±0.83^{b}	16.09±0.66^{a}	15.23±0.59^{ab}	15.43±0.63^{ab}	0.049
FCR	2.86±0.06^{a}	2.88±0.07^{a}	2.18±0.12^{c}	2.58±0.18^{b}	2.85±0.13^{a}	0.030

^{abc}Mean along the row with the same superscript are not significantly (P>0.05) different from each other. **T1-** Control (no additive in water) **T2-** 0.25g of *Monodora myristica/* L of *water* **T3**– 0.50g of *Monodora myristica*/L of water **T4-** 0.75g of *Monodora myristica/* L of water, **T5** – 1.0 g of *Monodora myristica*/L of water

Table 5: Slaughtering performance of broiler chicken offered *Monodora myristica* water extract (g/L)

Parameters	T1(0g/L)	T2 (0.25g/L)	T3 (0.50g/L)	T4 (0.75g/L)	T5(1.0g/L)	SEM	P-value
Live Wt (g)	1565.00 ±101.28^{a}	1378.75 ±169.99^{b}	1518.88 ±175.41^{ab}	1588.75 ±111.67^{a}	1622.50 ±128.03^{a}	6.719	0.0137
Bled Wt (g)	1374.21 ±85.33^{a}	1206.46 ±154.69^{b}	1388.47 ±173.90^{a}	1419.52 ±60.17^{a}	1473.00 ±50.69^{a}	7.083	0.0009
DefeatheredWt(g)	1312.24 ±85.41^{a}	1161.41 ±149.58^{b}	1318.30 ±158.50^{a}	1361.01 ±62.53^{a}	1402.01 ±53.54^{a}	6.444	0.0017
Eviscerated Wt (g)	1134.33 ±89.55^{a}	975.37 ±132.67^{b}	1082.34 ±154.72^{ab}	1135.93 ±104.45^{a}	1199.04 ±129.68^{a}	5.914	0.0143
Dressed Wt (g)	945.80 ±70.06^{a}	800.15 ±92.79^{b}	922.85 ±133.53^{a}	948.45 ±87.52^{a}	991.98 ±121.10^{a}	5.125	0.0099

^{abc}Mean along the row with the same superscript are no significantly (P>0.05) different from each other

Results on Table 5 show the live weight, bled weight, defeathered weight, eviscerated weight, and dressed weight of broiler carcass which was significantly affected by the test ingredient. The parameters were not significantly (P>0.5) different across the treatment groups as the absolute slaughtering weight increased numerically for birds fed on 0.75g/L and 1.0g/L respectively against the control treatment (0g/L of test ingredient). These results were not line with the report of Alabi *et al.* (2017) that used aqueous *Moringa oleifera* leaf extract fed to Hubbard broiler chickens. But dressed weights were same except for birds fed the extract at 0.25g/L. The influence of bioactive compounds present in the extracts of *Monodora myristica* seeds have been reported to improve body weights as reported by Stephen *et al.* (2014) and supported by (Okwu, 2001) that the use of spices as natural growth promoter as supplement in poultry diets are due to their phytochemicals composition.

Table 6 shows relative primal cuts of broiler chickens offered *Monodora myristica* seed water extract No significance differences were obtained in the primal cuts. A similar report by Alabi *et al.* (2017) revealed that there was no significant difference in the relative weight of the breast meat, thigh, wings and drumstick data of broilers fed aqueous *Moringa oleifera* leaf extract. The similarities across the treatment levels of relative carcass parameters (%) indicate the fact that infused *Monodora myristica* seeds have relative potential as the control treatment. Table 7 shows the relative organ weights parameters of broiler chickens fed *Monodora myristica* seed extracts. In the data results of relative weight of pancreas, empty gizzard, proventiculus and caecum showed significant differences across the treatments group (P<0.05). Birds fed 0.75g/L of *Monodora myristica* seed extracts had the highest value (0.29%) of relative pancreas weight and those fed the control with no additive had the least relative pancreas weight value of 0.22%. The

significant increase in the relative pancreas weight showed indication of higher digestive enzyme secretion by the birds fed *Monodora myristica* seed extracts which eventually leads to better digestion of feeds. It correlates with a previous study by Jang *et al.* (2007) that reported increase in secretion of digestive enzymes with the supplementation of essential oils extracted from herbs. Also, in the proventriculus results, both birds fed 0.75g/L and 1.0g/L had the highest values of relative proventriculus weight of 0.67%, while the control group had the least relative value of 0.50%. The increase in the relative proventiculus weights as the *Monodora myristica* seed extracts increases is an indication of stimulated secretion of hydrochloric acid by the proventiculus which influence decrease in the gizzard $_{p}$H (Engberg *et al*., 2002). However, the relative caecum weight of birds fed 0.75g/L recorded the lowest value of 0.91% which is significantly (P<0.05) different from the other treatment groups. This result does not correlate with the result of Alabi *et al.* (2017) that reported no significant difference in the relative caecum weight of Hubbard broiler fed aqueous extracts of *Moringa oleifera* leaves. The variations could arise as a result of difference in the test ingredients used in the studies. The data obtained for the relative organ weight results of kidney, heart, lung, liver, GIT weight, spleen and colon revealed no difference across the test ingredients fed to the birds (P>0.05). Woyengo *et al*., 2011 reported increase in liver weights when canola meal was fed to broiler but however such observation was not reported in our study

Table 6: Relative carcass indices of broiler chickens offered *Monodora myristica* seed water extract (g/L)

Parameters (%)	T1(0g/L)	T2 (0.25g/L)	T3 (0.50g/L)	T4 (0.75g/L)	T5(1.0g/L)	**SEM**	**P-value**
Thigh	10.26±0.66a	9.96±0.41a	9.67±0.87b	9.70±1.23b	10.55±1.32a	0.029	0.32
Drumstick	9.92±0.87	9.61±0.73	9.53±1.17	9.68±1.21	10.08±1.54	0.016	0.86
Wing	7.92±0.27b	8.63±0.94a	8.43±1.18a	7.69±0.98b	8.36±1.29a	0.028	0.32
Breast	17.96±1.64	17.24±1.90	18.25±1.79	18.52±1.48	18.67±2.50	0.040	0.59
Back	13.35±1.66	12.63±1.64	12.44±1.72	13.09±1.46	12.52±1.54	0.028	0.75
Shank	4.64±0.41a	4.69±0.24a	4.50±0.59a	4.30±0.43b	4.57±0.49b	0.011	0.46
Abdominal fat	0.67±0.36c	0.63±0.45c	0.77±0.32b	0.93±0.40a	1.00±0.47a	0.012	0.28

[abc:]Mean along the row with the same superscript are not significantly (P>0.05) different from each other

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Table 7: Relative Organ Weight parameters of Broiler Chickens offered *Monodora myristica seed* extracts (g/L)

Parameters (%)	T1(0g/L)	T2 (0.25g/L)	T3 (0.50g/L)	T4 (0.75g/L)	T5(1.0g/L)	SEM	P-value
Kidneys	0.35	0.40	0.35	0.43	0.32	0.003	0.410
Heart	0.45	0.41	0.45	0.48	0.46	0.002	0.819
Lung	0.50	0.45	0.46	0.51	0.49	0.002	0.753
Liver	2.12	2.07	2.08	2.42	2.25	0.011	0.003
Pancreas	0.22^{b}	0.26^{ab}	0.23^{ab}	0.29^{a}	0.27^{ab}	0.002	0.153
Spleen	0.15	0.13	0.12	0.14	0.11	0.021	0.154
Full gizzard	2.82	3.01	2.96	2.97	2.76	0.008	0.539
Empty gizzard	2.10^{ab}	2.00^{ab}	2.12^{ab}	2.14^{a}	1.85^{b}	0.008	0.037
GIT weight	5.22	5.73	5.81	5.61	5.77	0.063	0.560
Proventiculus	0.50^{b}	0.62^{ab}	0.65^{ab}	0.67^{a}	0.67^{a}	0.005	0.124
Caecum	1.08^{a}	1.14^{a}	1.07^{a}	0.91^{b}	1.10^{a}	0.006	0.053
Colon	0.60	0.55	0.58	0.55	0.61	0.002	0.948

[abc:]Mean along the row with the same superscript are not significantly (P>0.05) different from each other.

CONCLUSION AND RECOMMENDATION

This study results show that infused *Monodora myristica* seeds had better performance in the feed conversion ratio, higher primal cut percentage and overall performance. Therefore, *Monodora myristica* seed water extract at an inclusion level ranging from 750mg/L to 1000mg/L is recommended for broiler production in the tropic. However, the production objectives should also be put into consideration when administering.

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