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Growth performance, nutrient digestibility, carcass and economic characteristics of turkey poults fed millet-based diets as a replacement for maize

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Abstract

A nine (9) weeks feeding trial was conducted on seventy two (72) day-old Indigenous turkey poults raised on deep litter to determine their growth performance, carcass and economic characteristics when fed three dietary treatments (T_1, T_2, and T_3) containing 0 %, 25 % and 50 % replacement of maize with millet respectively. The birds were divided into three replicates of 8 birds per replicate; making a total of 24 birds per treatment. At the end of the 8th week, 4 birds per replicate were transferred to specially-designed metabolism cages for a digestibility study involving the collection of faecal droppings; while at the end of the 9th week of the experiments, two birds per replicate were randomly selected and slaughtered to determine their carcass characteristics. Turkey poults fed millet at 25 % replacement showed significantly ($p<0.05$) higher body weight gain, lower cost of feed per kg live weight gain and higher revenue generated per bird; but there were no significant ($p>0.05$) differences in the performance of birds on 0 % and 50 % replacements for those parameters. Also, there were no significant ($p>0.05$) differences in feed intake and mortality across the treatments. Similarly, there were no significant ($p>0.05$) differences in nutrient digestbilities and carcass characteristics of the birds among the various dietary treatments. Therefore, it can be concluded that millet can be used to replace maize up to 50 % in the diets of turkey poults at the starter phase with no detrimental effects on their performance.

Keywords: Turkey poults, growth performance, carcass, economic characteristics.

Introduction

According to Morgan (1991), the population of turkey (*Meleagris gallopavo)* in Nigeria had grown from 1.5 to 2.0 million. Therefore, turkey occupies an important position next to chicken, duck and guinea fowl in the poultry industry in Nigeria; but turkey production has largely remained at the smallholder level due to high cost of feed, inconsistency in feeding programmes, as well as lack of knowledge on the adequate levels of its nutrient requirements (Ojewola *et al.*, 2002). The tremendous increase in human population and high demand for animal feedstuffs, which caused rapid increase in cost of feed, has led to the search for alternative cheap energy sources for livestock animals by farmers. This is as a result of the fact that the increasing cost of feed has led to poor feeding of livestock, as feed cost is estimated to represent over 70 % of the total cost of producing poultry intensively (Oguntowora, 1984).

Durunna *et al.* (2000) reported that maize is the major source of energy in poultry feeds and constitutes about 50 % of poultry diets. Unfortunately, the rapid growth of human population has intensified the competition between man and livestock for this cereal grain, resulting in high cost of feeds and consequently high prices of poultry

products, leading to very low levels of protein intake in most developing countries (Abdulrashid and Agwunobi, 2009).

There is competing demands for maize worldwide; with emphasis being placed on export in Nigeria for ethanol production and for use in the brewery industry (Thornton, 2007). One important measure that can be taken to alleviate this situation is the use of alternative energy sources like millet and sorghum which are produced extensively in the semi-arid areas. Singh *et al.* (2000) exonerated millet from the anti-nutritional factors commonly found in sorghum (phytate and tannins); and that millet is superior to sorghum in protein content, protein efficiency and metabolizable energy. Also, millet has the ability to tolerate drought and can thrive on poor soils. Hence, the main objective of this research study is to determine the most optimum dietary inclusion level of millet in the diets of turkey poults at the starter phase (as a replacement for maize) that will produce optimal response in terms of growth performance, nutrient digestibility and carcass characteristics; with the least cost.

Materials and Methods

The Experimental Diets

Three isocaloric and isonitrogenous diets were formulated as treatment T_1, T_2 and T_3 representing 0 %, 25 % and 50 % replacement of maize with millet, respectively (Table 1). The feed ingredients used for this experiment were purchased from the Central Market, Minna, and from other commercial feed ingredients depots within Minna, Niger State.

The Experimental Animals and their Management

The experimental design used in the research work was a Completely Randomized Design (CRD) model. Seventy two (72) day-old Indigenous turkey poults obtained from Animal Care Centre, Minna, were used for this research study. They were purchased from Topmost Chicks, Ibadan, Oyo State. About two weeks before the arrival of the birds, the deep litter pens were thoroughly washed and disinfected. Few hours to their arrival, all equipments were put in place (feeders, drinkers, bulbs, heat source etc) and heated to a suitable temperature. On arrival, the birds were weighed and allocated randomly into three dietary treatment groups of twenty four (24) birds per treatment and three replicates per diet consisting of eight birds per replicate.

The birds were fed *ad libitum* with the experimental diets for nine weeks. Routine management operations such as daily removal of left-over (uneaten) feed, washing of drinkers, provision of clean drinking water and cleaning of the environment were carried out. A standard vaccination programme suitable to the environment was followed strictly, and medications such as antibiotics, coccidiostats and anti-stress were administered appropriately.

Parameters Determined

(i) Growth performance

This was determined using the procedures of Adesida *et al.* (2010). Average daily feed intake was obtained by subtracting the quantity of the left-over (uneaten) feed from the quantity of feed supplied to the birds per day. Weekly body weight gain was measured by subtracting the body weight of the birds the preceding week from the body weight of the birds the following week. Feed conversion ratio (FCR) was obtained by dividing the average feed intake per bird per week by the body weight gained per bird per week for each treatment.

Table 1: Composition of the experimental diets (%)

Ingredients	T_1 (Control diet)	T_2 (25 % replacement)	T_3 (50 % replacement)
Maize	42.00	31.50	21.00
Millet	0.00	10.50	21.00
Groundnut cake	45.00	43.60	43.00
Wheat offal	3.30	4.00	4.00
Fish meal	5.00	5.00	5.00
Palm oil	0.20	0.90	1.50
Lysine	0.50	0.50	0.50
Methionine	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00
Common salt	0.25	0.25	0.25
*Premix	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated composition			
Crude protein	28.75	28.50	28.52
Metabolizable energy (MJ/kg)	11.66	11.59	11.53
Analyzed composition			
Dry matter	97.40	95.20	93.40
Crude protein	28.40	28.35	28.88
Crude fibre	5.00	4.00	3.00
Ash	8.00	10.00	8.50
Ether extract	18.50	17.00	15.50
Nitrogen free extracts	34.80	35.85	37.52

*Each 2.5 kg premix contained: Vit. A-10,000IU; Vit.D_3-2,000,000 IU; Vit. K-2.250mg; Thiamine-1,750mg; Riboflavin-5,000mg; Pyridooxine-2,750mg; Niacin-27,500mg; Vit.B_{12}-15mg; Pantothenic acid-7,500mg; Folic Acid-7,500mg; Biotin-50mg; chloride-400g, Magnesium-80g; Zinc-50g; Iron- 20g; copper-5g; Iodine-1.5g, selenium-200g and cobalt-200mg.

(ii) Economic characteristics

The following parameters were determined using the procedures of Medugu *et al.* (2010).

(a) Total cost of feed consumed per bird (in): This was the cost per kg of feed (/kg) multiplied by the total feed intake per bird (kg).

(b) Cost of feed per kg live weight gain (in): This was obtained by dividing the total cost of feed consumed per bird by the total body weight gain (kg).

(c) Revenue generated per bird in (RG): This was obtained using the formula:

RG = (Weight of bird x Price /kg live weight) — (Cost of feed/kg x Total feed intake)

(iii)Carcass characteristics

At the end of the experimental period (9 weeks or 63 days), two birds per replicate were randomly selected, making a total of six birds per treatment, and deprived of food for 12 hours before slaughtering. After bleeding the birds, their feathers were removed after scalding in warm water (65^{0}C for 30 seconds). They were then eviscerated and various individual organs removed, weighed and computed as

percentage of live weight. Other carcass parameters determined include slaughter weight, de-feathered weight and dressed weight.

(iv) Digestibility trial

At the end of the 8th week of the experiment, 4 birds per replicate were randomly selected, removed from the floor and placed in the digestibility cages for 3 days acclimatization period (for them to adjust to the conditions in the cages). Before the commencement of the faecal sample collections, the birds were kept off feed for 12 hours and given only water. This was to evacuate the residual content of their gut. Fresh feed of known weight were then given to the birds; and faecal collection commenced the following day, using the total collection method, following the procedures of Lamidi *et al.* (2008). Collection lasted for 4 days. Faecal samples collected per day were oven dried at 80°C for 24 hours to get a constant weight. The oven dried droppings collected for 4 days were then pooled together, packaged in plastic containers and stored in the freezer until needed for analysis.

The samples were then separately analyzed for their proximate composition according to the procedures of AOAC (2000). From the data obtained, apparent digestibility of nutrients was calculated using the formula of Isikwenu *et al.* (2010).

$$\text{Apparent digestibility} = \frac{\text{Nutrient consumed} - \text{Nutrient in droppings}}{\text{Nutrient consumed}} \times 100\%$$

Total digestible nutrient (TDN) was calculated using the formula of Fonnesbeck (1981):

TDN = Digestible crude protein + Digestible NFE + 2.25 x Digestible ether extract.

Chemical Analysis

The experimental diets and the droppings obtained from the digestibility studies were analyzed for moisture, crude protein, crude fibre, ether extract, ash and nitrogen free extracts using the procedures of AOAC (2000).

Statistical Analysis

The data obtained from this research study was subjected to a one-way analysis of variance (ANOVA) according to the Completely Randomized Design (CRD) model using the SPSS Package (Statistical Package for the Social Sciences, Version 2000). Where treatment means were significant, they were separated using the Duncan Multiple Range Test using the procedures of Steel and Torrie (1980).

Results and Discussion

The results of growth performance are shown in Table 2.

Feed intake was not significantly ($p>0.05$) different among the different treatment groups but total body weight gain was significantly ($p<0.05$) higher for birds on 25 % replacement of maize (807g) than those on 50 % replacement (731g) and those on the control diet (740g). This is contrary to the result obtained by Tornekar *et al.* (2009) when pearl millet was used to replace maize in the diets of broiler chicks from 0-42 days old. The authors found that birds on 50 % replacement showed higher ($p<0.01$) final live weights than birds on 25 % and 0 % replacement. For feed conversion ratio (FCR), values obtained were not significant ($p<0.05$) among the treatment groups. Whereas, in the research work by Tornekar *et al.* (2009), FCR was significantly ($p<0.01$) superior in the Control Diet (T_1, with 0 % replacement, followed by diets with 25 % and 50 % replacement respectively. Despite these differences, however, it can be seen that in this research work, there were no significant ($p>0.05$) differences in weight

Table 2: Growth performance of turkey poults fed millet as a replacement for maize at the starter phase

Parameters	Diet T_1 (Control Diet)	Diet T_2 (25 % Replacement)	Diet T_3 (50 % Replacement)	SEM
Initial body weight (g/bird)	35.94	36.98	36.46	0.27
Final body weight (g/bird)	776.14[b] 844.18[a]	767.71[b]	16.70	
Total body weight gain (g/bird)	740.20[b] 807.20[a]	731.25[b]	16.52	
Daily body weight gain (g/bird)	11.75[b]	12.81[a]	11.61[b]	0.26
Total feed intake (g/bird)	2033.102036.36	1998.95	18.69	
Feed conversion ratio (FCR)	2.75	2.53	2.74	0.05
Mortality (%)	8.30	4.15	16.65	3.35

[a,b] Means in the same row with different superscripts were significantly ($p<0.05$) different
SEM = Standard error of means

gain and FCR between the 0 % and 50 % replacement of maize by millet. Hence, it can be deduced that millet can replace up to 50 % maize in turkey poults diets with no detrimental effect on weight gain and FCR. This agrees with the conclusion of Tornekar *et al.* (2009) that pearl millet (Bajra) can replace between 25-50 % maize in broiler ration without significantly affecting their performance; thus authenticating the work by Venkata Reddy *et al.* (2008) that 50 % replacement of corn with either finger millet or sorghum or both did not impair body weight and FCR when compared to the corn-based diet for broilers..

There were no significant ($p>0.05$) differences in mortality and total cost of feed consumed per bird across the treatments, but T_2 had the lowest cost per kg live weight gain (□287/kg) and the highest revenue generated per bird (□401) while there were no significant ($p>0.05$) differences in cost of feed per kg live weight gain and revenue generated per bird between 0 % and 50 % replacement of maize by millet (Table 3). This result is similar to the result obtained by Medugu *et al.* (2010) when they investigated the effects of replacing maize with sorghum or millet on the performance and economics of production of broiler chickens in a 42-day feeding trial. They found that the cost per kg feed and cost of feed per unit weight gain

able 3: Economic characteristics of turkey poults fed millet as a replacement for maize at the starter phase

Parameters	Diet T_1 (Control Diet)	Diet T_2 (25 % Replacement)	Diet T_3 (50 % Replacement)	SEM
Cost per kg of feed (? /kg)	114.48	113.82	113.05	
Total cost of feed consumed per bird (?)	232.75	231.78	225.98	2.36
Cost of feed per kg live weight gain (? /kg)	314.42[a]	287.26[b]	308.99[a]	5.45
Revenue generated per bird (?)	349.35[b]	401.36[a]	349.80[b]	11.51

[a,b] Means in the same row with different superscripts were significantly ($p<0.05$) different

were lowest in millet followed by high-tannin sorghum, low-tannin sorghum and maize-based diets respectively; showing that replacement of maize by these materials would be economical and cost-effective. They then concluded that based on weight gain of the birds and the feed cost per weight gain, millet can completely replace maize in broiler chicken diets without adverse effects on their performance.

The results of nutrient digestibility of turkey poults fed varying levels of millet in replacement for maize is shown in Table 4. There were no significant ($p>0.05$) differences in dry matter, crude protein, ether extract, crude fibre, ash and nitrogen free extract digestibility as well as total digestible nutrient (TDN) across the dietary treatments. This agrees with the results obtained by Ijaiya *et al.* (2009) while working with Japanese quails (*Coturnix coturnix japonica*). The authors found that millet can be used to replace up to 100 % maize in practical diets fed to Japanese quails with no deleterious effects on their growth performance and nutrient digestibility. This is because, millet, unlike sorghum, does not contain any polyphenol compounds such as condensed tannins that can interfere with or slow down digestibility when fed to poultry (Singh *et al.*, 2000).

The results of carcass characteristics are shown in Table 5. From the Table, there were no significant ($p>0.05$) differences in slaughter weight, de-feathered weight, eviscerated weight and dressed weight among the dietary treatments. Also, there were no significant ($p>0.05$) differences in weight of cut-up parts and weight of internal organs (expressed as % of live weight) among the dietary treatments. This is in agreement with the result obtained by Davies *et al.* (2003) who found no significant ($p>0.05$) differences in carcass yield of broilers (both male and female birds) fed diets containing up to 50 % pearl millet compared to those fed typical corn-soybean diets.

Conclusion

Though the result of this research work shows that turkey poults fed millet at 25 % replacement for maize performed better ($P<0.05$) than those fed 0 % and 50 %

Table 4: Nutrient digestibility of turkey poults fed millet as a replacement for maize at the starter phase

Parameters (%)	Diet T_1 (Control Diet)	Diet T_2 (25 % replacement	Diet T_3 (50 % replacement)	SEM[1,2]
Dry matter	80.10	81.13	77.6	1.47
Crude protein	69.32	71.20	68.79	1.68
Crude fibre	51.86	49.59	48.26	1.47
Ether extract	91.49	88.00	89.70	1.57
Ash	53.40	60.74	57.51	2.09
Nitrogen free extracts (NFE)	94.27	93.18	93.76	1.03
Total digestible nutrient (TDN)	88.38	89.16	86.30	1.06

[1]SEM = Standard error of mean;
[2]Differences between treatment means on the same row were not statistically significant ($p>0.05$)

Table 5: Carcass characteristics of turkey poults fed millet as a replacement for maize

Carcass characteristics	Diet T_1 (Control Diet)	Diet T_2 (25 % replacement	Diet T_3 (50 % replacement)	SEM[1,2]
Live weight (g)	968.75	1018.75	862.50	37.50
Slaughter weight (%)	92.25	93.85	95.65	0.73
De-feathered weight (%)	86.85	89.60	88.95	1.02
Eviscerated weight (%)	81.19	83.56	83.14	0.92
Dressed weight (%)	61.35	64.45	62.10	1.15
Weight of cut-up-parts (as % of live weight)				
Wing	9.99	10.48	10.78	0.21
Head	4.07	3.77	3.82	0.09
Thing	9.26	9.20	8.57	0.20
Drum stick	8.51	9.81	10.28	0.44
Fore leg	3.90	4.15	3.99	0.12
Neck	6.93	7.60	6.65	0.24
Breast	13.00	13.25	13.53	0.36
Weight of internal organs (as % of live weight)				
Proventiculus	0.45	0.46	0.43	0.02
Crop	0.51	0.52	0.51	0.01
Gizzard	3.94	3.97	3.43	0.13
Intestine	5.71	6.01	5.85	0.18
Heart	0.70	0.60	0.61	0.03
Lung	0.99	0.90	0.86	0.04
Liver	2.01	2.02	2.00	0.01
Kidney	0.20	0.20	0.13	0.02

[1]SEM = Standard error of means

[2]Differences between treatment means on the same row were not statistically significant ($p>0.05$)

replacement in terms of body weight gain, feed conversion ratio, cost of feed per kg live weight gain and revenue generated per bird, but there were no significant ($p>0.05$) differences in the performance of birds on 0 % and 50 % replacements for those parameters. Also, there were no significant ($p>0.05$) differences in nutrient digestibility, total digestible nutrient and carcass characteristics among the different dietary treatments. Hence, it can be concluded that millet can be used to replace up to 50 % maize in the diet of turkey poults at the starter phase, with no detrimental effects on their performance.

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