Performance and carcass characteristics of broiler chickens fed graded levels of cassava peel meal based diets

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Abstract

A total of 96 unsexed day-old broiler chicks (Arbor Acre breed) were used in a 28-day feeding trial to evaluate the effect of inclusion levels of rumen filtrate fermented cassava peal meal (RFFCPM) on the performance and carcass characteristics of finishing broiler chickens. The birds were randomly allotted to four dietary treatments formulated with the ratios of 100:0, 75:25, 50:50 and 25:75 maize:RFFCPM, respectively. Each treatment was sub-divided into four replicates comprising 6 birds each. The results showed that the inclusion of RFFCPM affected ($p<0.05$) the final weight, weight gain, feed intake, feed conversion ratio and carcass characteristics which decreased with increasing levels of RFFCPM in the diets of broiler chickens among the treatments. Birds fed 25% RFFCPM competed favourably with those on control diet (0% RFFCPM) for most of the performance and carcass characteristics measured. However, feeding RFFCPM at 25% inclusion level in the diet resulted in best economy of production as this produced similar body weight gain with those fed control diet. Conclusively, finishing broiler chickens effectively utilized up to 25% RFFCPM as substitute for maize in their diet as they were superior in performance and carcass characteristics when compared with those fed 50% and 75% inclusion levels of RFFCPM.

Keywords: Performance, carcass characteristics, rumen filtrate fermented cassava peel meal, broiler chickens

Introduction

Feed is of utmost importance in broiler chicken production (Alikwe and Nodu, 2013); it amounts to about 60-75 % of the total cost of production for intensively reared stocks (Enyenihi *et al*., 2013). This has been attributed to the trend of competition between humans and livestock as a result of high cost of conventional feed stuff which in turn affects animal protein intake by man (Ewa *et al*., 2012). In an attempt to combat the challenges of feed, researchers have stressed the need for utilization of cheaper, locally available and nutritionally viable alternative feedstuffs far removed from human and industrial interests, thereby limiting the dependence on maize for livestock (Iyayi and Fayoyin, 2004; Okah, 2004).

Cassava (*Manihot esculenta Crantz*) is a tuber crop widely cultivated in Nigeria with an average annual production estimate of 45 million tonnes (FAO, 2002). It is the highest supplier of carbohydrate among energy staple food stuff (FAO, 2003).

Also, it offers a great potential as cheap, alternative energy feedstuff in rations for livestock (Eruvbetine *et al*., 2003). Cassava peel is an abundant and less expensive agroindustrial by-product, farm waste or crop residue resulting from the processing of cassava roots for human consumption which can be exploited as alternative feed resource in the diets of monogastric stocks to high energy cereals particularly maize (Fajemisin *et al*., 2012). However, the use of cassava peel has largely remained under utilized as livestock feed due to its high cyanide and fibre content, poorer protein quality and powdery nature of its meal compared to cereal grains. As a cyanide-bearing waste, fresh cassava peel has to be processed in order to reduce its cyanide level which is deleterious to growth and development of poultry (Tewe, 2004) and promote its acceptability and utilization in finished feeds. As a result, several processing methods such as sun-drying, ensiling and fermentation have been reported to effectively reduce the concentration of the anti-nutritional factors in cassava meal to tolerable levels (Aro *et al.*, 2008a). Fermentation technology has been used as a method of improving the nutritional value of cassava peel meal by reducing the anti-nutritional factors, high crude fibre content and enriching the protein content in livestock feeds (Oboh and Akindahunsi, 2003; Aro *et al*., 2008b). An improvement was also reported in the crude protein concentration of cassava root meal when fermented with fresh rumen filtrate with source of nitrogen (Adeyemi, 2007 and Dairo *et al*., 2011).This study was therefore conducted to evaluate the effect of varying levels of RFFCPM on the performance and carcass characteristics of finishing broiler chickens.

Materials and Methods

Experimental site

The experiment was conducted at the Poultry Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The location falls within the rainforest zone of South-Western Nigeria at longitude 7^{o} 10', 37'N, latitude 3^{o} 26' 58'E and altitude 173m above sea level. The climate is humid with a mean annual rainfall of 1,037mm. The mean annual temperature and humidity are 34.7^{o}C and 82%, respectively (Google Earth, 2013).

Experimental animals and management

A total of 96 unsexed day-old broiler chicks (Arbor Acre breed) were procured from a reputable hatchery in Abeokuta area of Ogun State. The chicks were subject to standard brooding for 2 wk in a deep litter pen and fed commercial broiler starter diet during the starter phase (0-4 wk). Weekly data such as feed intake and body weight gain were recorded accordingly, while feed conversion ratio and economic indices were calculated. The birds were distributed into 4 groups of 24 chicks each and each group was further subdivided into four replicates comprising 6 birds and housed in 1.5m x 1.5m deep litter pen with dry wood shavings as the litter material. The birds were served feed and clean cool water *ad libitum* throughout the 4-wk feeding trial.

Collection of test ingredients and preparation of experimental diets

Aliquots of rumen content of freshly disemboweled cattle carcasses were collected from Abeokuta central abattoir. The mass of rumen content was squeezed and the liquid portion filtered through a sieve into a clean plastic container to obtain rumen filtrate. Freshly dried cassava peels collected from 'gari' processing unit of the University farm was mixed with dried poultry manure as the nitrogenous source at 75g/kg. Thereafter, the mixture was thoroughly mixed with rumen filtrate (1 litre/5kg), and fermented in sealed polythene bags for 7 d. Other feed ingredients were sourced locally from a reputable commercial feed mill near a retail market in Abeokuta and added at fixed amount (Table 1). The fermented mixture was then sun-dried, milled before been incorporated to formulate experimental diets at 0, 25, 50 and 75% levels of inclusion. The chicks were fed the experimental diets from 4 – 8 wk of age.

Carcass yield evaluation

At the end of the feeding trial, 2 birds weighing close to average of birds from each replicate were selected and fasted for 12 h for carcass analysis. The birds were tagged and sacrificed humanely by severing the carotid arteries with subsequent exsanguination. They were scalded, de-feathered, eviscerated and dissected to obtain carcass weights. Dressed carcasses, retail cuts and visceral organs were weighed using an electronic weighing scale. Carcass parameters taken were carcass yield, retail cuts and organ weights. The retail cuts and organs were expressed as percentages of the live weight of birds.

Cost analysis

The prevailing market prices of feed ingredients at the time of the experiment were used to estimate the unit cost of the diets. Cost per kg feed and cost per kg weight gain were calculated.

Chemical analysis

Samples of fermented cassava peel meal and experimental diets were analyzed for proximate fractions according to the procedures of AOAC (2006).

Statistical analysis

Quantitative data generated were subject to one-way analysis of variance using SAS (2006) package. Differences between treatment means were tested using Duncan's Multiple Range Test as contained in the statistical software.

Results and Discussion

The proximate composition of rumen filtrate fermented cassava peel meal was determined as: 7.62% crude protein, 9.88% crude fibre, 3.55% ether extract, 2.98% ash and 3225.05Kcal/kg metabolizable energy (Table 1). The crude protein (7.62%) observed in this study was higher than 5.46% reported by Udoyong *et al*. (2010) and Midau *et al*. (2011). The result is also similar with the findings of Adeyemi *et al*. (2004) and Adeyemi *et al*. (2007) who also observed an increase in crude protein content of cassava root meal fermented with rumen filtrate and nitrogenous source. Moreover, the increase in crude fibre content of RFFCPM contradicted the findings of Adeyemi *et al*. (2007) and Dairo *et al*. (2011) who observed a decline in crude fibre after fermentation of cassava root meal. These differences could be as a result of differences in the varieties of cassava and peeling methods used.

Table 1: Proximate composition of rumen filtrate fermented cassava peel meal

Component	Composition
Crude protein (%)	7.62
Crude fibre (%)	9.88
Ether extract (%)	3.55
Ash (%)	2.98
Metabolizable energy (Kcal/kg)	3,225.05

The final weight, weight gain and feed intake decreased with increasing levels of RFFCPM (Table 3). Broiler chickens fed control diet had the highest final weight and weight gain (2100.03gand 45.52g/bird), closely followed by those fed 25% RFFCPM (1980.22g and 43.78g/bird). However, the reduction in feed intake observed in broiler chickens fed 50% and 75% RFFCPM(137.21 g/bird and 133.00 g/bird, respectively) might be due to the presence of residual hydrocyanic acid which probably reached an intolerable level in the diets, and this naturally reduced feed intake (Banjoko *et al*., 2008).Also, the lowest body weight gain (36.80g/bird) recorded in birds fed 75% RFFCPM could be attributed to high dietary fibre(4.01%) emanating from higher concentration of cassava peel meal in the diet (Table 2). This corroborates the report of Zaczek *et al*. (2003) which stated that an increase in concentration of fibre in the diet of broiler chickens had a negative linear effect on body weight. The feed conversion ratio of birds fed 0% RFFCPM was best (3.13) followed by those fed 25% RFFCPM (3.20) when compared with broiler chickens fed 50% and 75% inclusion levels. This implied that diets 1 and 2 were effectively utilized, thus resulted in increased body weight gain. This observation agreed with the findings of Ogbonna *et al*. (2000) and Akinmutimi (2004) whose reports stated that the lower the feed:gain, the better the diet. The result further revealed that mortality was not affected (p>0.05) by the dietary treatments. The reduction observed in the unit cost of cassava peel meal based diets compared with the control diet could be attributed to high cost of maize compared to cassava peel meal. The control treatment group was highest in cost per kg of feed (#85.73) and cost per kg of weight gain (#268.33), while treatments 2, 3 and 4 showed reduction with increasing levels of RFFCPM. The cost of producing a kg of meat from broiler chickens fed 75% RFFCPM was cheaper than the control diet. However, production result was not comparable with the control; reduction in feed cost was only justifiable when production result is comparable with the standard (control). Thus, the inclusion of RFFCPM at 25% level resulted in the best economy of production as this produced broiler chickens with similar body weight gain with those fed control diet. This result agrees with the report of Obikaonu and Udedibie (2008) that the inclusion of cassava peel meal in the diet of poultry resulted in significant economic benefits.

Table 2: Composition of experimental diets fed to broiler chickens

	Dietary levels of RFFCPM (%)			
Ingredients (%)	0	25	50	75
Maize	47.00	35.25	23.50	11.75
RFFCPM	-	11.75	23.50	35.25
Wheat offal (<7% fibre)	7.00	7.00	7.00	7.00
Fish meal (72% crude protein)	2.00	2.00	2.00	2.00
Soybean meal	28.00	28.00	28.00	28.00
Groundnut cake	10.00	10.00	10.00	10.00
Palm oil	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Determined analysis				
Crude protein (%)	22.10	22.59	23.30	23.65
Crude fibre (%)	3.57	3.65	3.77	4.01
ME (Kcal/kg)	2866.12	2850.65	2892.46	2909.00

RFFCPM- Rumen filtrate fermented cassava peel meal, ME- Metabolizable energy
*Vitamin/Mineral Premix contains Vitamin A, 10 000 000iu; E, 12 500iu; K, 1.3g; $B_{1,}$ 1.30; $B_{2,}$ 4.00g; D Calcium-Pantothenate, 1.30g; $B_{6,}$ 1.30g; $B_{12,}$ 0.01g; nicotinic acid, 15.00g; folic acid, 0.05g; biotin, 0.02g; Co, 0.20g; Cu, 5.00g; Fe, 25.00g; I, 0.06g; Mn, 48.00g; Se, 0.10g; Zn, 45.00g; choline chloride, 200.00g; BHT, 50.00

Table 3: Effect of dietary inclusion of RFFCPM on growth performance of broiler chickens

	Inclusion levels of RFFCPM (%)				
Parameter	0	25	50	75	SEM
Initial weight (g)	783.21	786.57	789.26	790.45	15.25
Final weight (g)	2100.03[a]	1980.22[b]	1800.62[c]	1600.36[d]	20.87
Weight gain (g/bird)	45.52[a]	43.78[b]	40.57[c]	36.80[d]	2.92
Feed intake (g/bird)	142.60[a]	139.96[b]	137.21[c]	133.00[d]	6.53
Feed conversion ratio	3.13[d]	3.20[c]	3.38[b]	3.61[a]	0.58
Mortality (%)	0.00	0.00	0.00	0.00	0.00
Cost/kg feed (#)	85.73[a]	79.26[b]	72.80[c]	66.34[d]	3.72
Cost/kg weight gain (#)	268.33[a]	253.63[b]	246.06[c]	239.76[d]	7.83

[abcd] Means in the same row with different superscripts are significantly different ($p<0.05$)
SEM: Standard Error of Mean
RFFCPM- Rumen filtrate fermented cassava peel meal
All costs were computed in Naira (#158.70 = US$ 1.00)

Table 4 showed the varying inclusion levels of RFFCPM in the diets of broiler chickens affected ($p<0.05$) carcass parameters measured which decreased with increasing inclusion levels. Broiler chickens fed 25% inclusion level of RFFCPM in the diet had highest de-feathered weight (1700.11g), eviscerated weight (1495.06g), and dressing percent (77.85%) compared to those fed 50% and 75% inclusion levels. Also, broiler chickens fed 25% RFFCPM were superior in retail cuts, giblets and organs than those fed 50% and 75% inclusion levels. This was probably due to better utilization of nutrients which reflected in their body weights and in turn resulted in higher degree of carcass meatiness (Bartov, 1998 and Agunbiade, 2000). The decreasing trend observed in the organs and giblets of broiler chickens fed RFFCPM agrees with the findings of Esonu *et al.* (2008) who reported that organ weights were index of nutrients retained. The gizzard was also affected ($p<0.05$) and this confirmed the observation of Onimisi *et al*. (2008) that the difference in gizzard weight seemed to correlate with feed consumption. The increase in feed consumption of birds fed 0% and 25% RFFCPM tended to enlarge the gizzard capacity to enable birds to cope with higher volume of feed, hence better live weight. However, the dietary treatments had no effect ($p>0.05$) on the lungs and liver of broiler chickens.

Table 4: Effect of dietary inclusion of RFFCPM on carcass characteristics of broiler chickens

	Inclusion levels of RFFCPM (%)				
Parameter	0	25	50	75	SEM
Live weight (g)	2050.51[a]	1920.45[b]	1775.27[c]	1552.65[d]	30.83
Carcass yield					
De-feathered weight (g)	1845.00[a]	1700.11[b]	1570.56[c]	1350.20[d]	23.89
Eviscerated weight (g)	1600.77[a]	1495.06[b]	1300.92[c]	1098.17[d]	19.20
Dressing percentage	78.07[a]	77.85[b]	73.28[c]	70.73[d]	1.26
Retail cuts[1]					
Breast	23.76[a]	21.51[b]	20.07[c]	15.18[d]	1.07
Thigh	12.25[a]	11.30[b]	10.95[c]	7.99[d]	0.25
Drumstick	12.78[a]	11.23[b]	10.63[c]	6.85[d]	0.34
Back	13.49[a]	12.05[b]	10.88[b]	7.03[c]	0.30
Wings	8.99[a]	8.72[b]	7.90[c]	6.40[d]	0.21
Giblets[2]					
Gizzard	3.47[a]	3.22[b]	2.28[c]	2.00[c]	0.16
Heart	0.55[a]	0.49[b]	0.51[a]	0.40[c]	0.68
Liver	2.09	2.03	1.85	1.52	0.21
Neck	4.57[a]	4.56[a]	4.10[b]	3.56[c]	0.23
Organs[3]					
Lungs	0.71[a]	0.62[b]	0.58[b]	0.52[c]	0.05
Spleen	0.14	0.12	0.10	0.10	0.01
Intestine	5.02[a]	4.55[b]	4.32[c]	3.53[c]	0.20

[abcd]Means in the same row with different superscripts are significantly different ($p<0.05$)

SEM: Standard Error of Mean

[123] Expressed as percentages of the live weight

Conclusion

It is evident from this study that broiler chickens fed 25% RFFCPM competed favourably with those on 0% inclusion level (maize-based diet), but were superior when compared with those fed 50and 75% dietary levels in terms of performance and carcass characteristics. Therefore, for effective utilization of RFFCPM as substitute for maize, it is recommended that 25% inclusion level is most appropriate for optimum growth performance without any deleterious effect but also with significant economic benefits.

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