PERFORMANCE OF BROILER CHICKENS FED CASSAVA ROOT-LEAF-BASED DIETS SUPPLEMENTED WITH PROTEASE ENZYME

Binuyo, O. A.[1*], Jegede, A. V.[1], Oluwatosin, O. O.[1], Abioja, M. O.[2] and Ekunseitan, D. A.[3]
* Corresponding author (Email: olanrewajubinuyo@yahoo.com Tel: +234(0) 816 119 9448)
[1] Department of Animal Nutrition, College of Animal Science and Livestock Production, Federal University of Agriculture Abeokuta, PMB 2240, Ogun State, Nigeria
[2] Department of Animal Physiology, College of Animal Science and Livestock Production, Federal University of Agriculture Abeokuta, PMB 2240, Ogun State, Nigeria
[3] Department of Animal Sciences, North Carolina Agricultural and Technical State University, Greensboro, NC 27411, USA

Abstract
This study was conducted to evaluate the performance of broiler chickens fed cassava root-leaf-based diets supplemented with protease enzyme. Fresh cassava roots and leaves (TME 419) were harvested, sun-dried, and milled to create CRLM. Four experimental diets were formulated, with varying levels of maize replacement by CRLM (0%, 15%, 30%, and 45%), and supplemented with a protease enzyme (CIBENZA DP100). The performance of broiler chickens fed these diets was assessed over 21 days using 200-day old unsexed Ross broiler chicks. The birds were allotted into 4 dietary groups in a Completely Randomized Design (CRD). The final weight showed no significant (P>0.05) differences. Birds on CRLM+P diets showed reduced feed intake, particularly in the 45% CRLM+P group. Feed conversion ratios (FCR) improved in the CRLM+P diets compared to the control diet. In conclusion, replacing a portion of maize with up to 45% CRLM in broiler chicken diets, supplemented with protease enzyme, can be a viable strategy to reduce production costs without compromising performance.

Keywords: performance, cassava, enzymes, growth, digestibility

Description of Problem

Agriculture is a vital sector of Nigeria's economy, employing approximately two-thirds of the country's total labor force and contributing 40 percent to its GDP (1). Nigeria, despite its potential and being the world's largest producer of cassava, yam; remains a food-deficit nation and depends on imports of grains and livestock products (1). Poultry products remain expensive in developing countries mostly due to the high cost of production, resulting in the low daily intake of animal protein (2). Poultry production in Nigeria is affected by the high cost of feedstuffs (3) as there is competition between the feed industry and other channels in the food chain over conventional feed ingredients such as maize and soybean. Maize most often constitutes the highest proportion of ingredients in diet formulation of any poultry ration (4). Hence, the need to find sustainable alternatives like cassava that will not compromise the quality of finished feed (5) and can replace a certain proportion of energy and protein sources in the diets at a lower cost (6).

Cassava is an important food resource in Africa, and more specifically in Nigeria (7). Although cassava is a staple food for humans, there is increasing interest in its use as a substitute for maize in feeding livestock (8). Cassava is the highest supplier of carbohydrates among staple crops so there is thus the likelihood of its continued use in livestock feeding in the 21st century and beyond (9). Although, anti-nutritional factors like cyanide and its relatively low protein content, which is of poor quality limit its use (10). Available literature shows that cassava leaf meal could be successfully used as a protein, mineral, and vitamin source in poultry diets (1,12). Therefore, this study is conducted to evaluate growth performance characteristics of finisher broiler chickens fed cassava root-leaf-based diets supplemented with protease enzyme.

Materials and Methods

Experimental site

This study was carried out at the Poultry Unit of Teaching and Research Farms, Federal University of Agriculture, Abeokuta, Alabata road, Nigeria. Alabata is located in Odeda local government area of Ogun state. It is situated within the rainforest vegetation zone of southwest Nigeria on latitude 7 S 13' N and longitude 3 26'E (Google earth, 2017).

Collection and preparation of test materials
Fresh cassava roots and leaves (TME 419) were harvested from a reputable commercial farm in Ilora, Oyo State. The cassava roots were rinsed and cut into small pieces. The root and leaves were sun-dried separately on a concrete floor for about 5 days with regular turning. The chopped root and the leaves were milled separately using a hammer mill before mixing in the ratio of 80:20 respectively. Commercial protease enzyme (CIBENZA DP100) was sourced from Novus Inc (USA). CIBENZA DP100 is a Serine protease with enzyme classification number (EC) 3.4.21.62. of bacterial origin *Bacillus lincheniformis* PWD-1.

Experimental birds and management
Two hundred (200), 4 weeks old unsexed Ross broiler chicks were purchased from a reputable hatchery in Ibadan for the experiment. The pen was properly cleaned, washed, and disinfected before the arrival of the birds. Birds were reared intensively on a deep litter housing system. Feed and clean water were supplied *ad-libitum* all through the duration of the experiment (21 days). All birds were fed a control diet for 29-49 days. Conventional vaccination and medication schedules were strictly followed throughout the experimental duration.

Experimental design
Two hundred (200), 44 weeks old Ross broiler chicks were randomly allocated into 4 dietary groups in a completely randomized design (CRD). Each dietary group consisted of five (5) replicates with ten (10) birds each.

Experimental diets
A basal diet was formulated to meet the requirement of broiler chickens according to the recommendation of NRC (1994). The diets were formulated such that the maize component of the basal diet was replaced by whole cassava root and leaf mixture (CRLM). Whole cassava roots of 80% mixed with 20% cassava leaves. Diet 1 was a control diet with maize as the main energy source while diets 2, 3, and 4 consisted of 15, 30, and 45% replacement of maize in basal diet with CRLM and 250 g/ton protease enzyme respectively as shown in Table 1.

Table 1: Gross composition of the experimental diets (29-49days) (g/kg)

	Control	15% CRLM	30% CRLM	45% CRLM
Maize	580.00	493.00	406.00	319.00
Soya bean meal	250.00	250.00	250.00	250.00
Fish meal (72%)	15.00	20.00	20.00	20.00
Groundnut cake	78.00	77.00	75.00	75.00
Wheat offal	27.00	8.00	5.00	5.00
Bone meal	21.00	21.00	21.00	21.00
Cassava root-leaf meal	00.00	87.00	174.00	261.00
Soya oil	00.00	15.00	20.00	20.00
Limestone	20.00	20.00	20.00	20.00
Lysine	2.00	2.00	2.00	2.00
Methionine	2.00	2.00	2.00	2.00
Salt (NaCl)	2.50	2.50	2.50	2.50
*Premix	2.50	2.50	2.50	2.50
TOTAL	1000	1000	1000	1000
Protease enzyme	0.00	0.25	0.25	0.25
Determined analysis (g/kg)				
Metabolisable energy (kcal/kg)	2992.14	2913.38	2939.73	2955.87
Crude protein (%)	21.10	20.96	20.97	20.93
Fat (%)	4.07	4.22	3.63	3.78
Fibre (%)	7.08	7.40	8.65	8.68
Ash (%)	5.60	3.93	3.76	6.88
Calcium(%)	0.85	0.89	0.89	0.88
Phosphorus (%)	0.76	0.74	0.71	0.68

*Premix provided per kg of diet (mg): vitamin A (as all-trans retinol), 3.6 mg; cholecalciferol, 0.09 mg; vitamin E (as d-αtocopherol), 44.7 mg; vitamin K3, 2 mg; thiamine, 2 mg; riboflavin, 6 mg; pyridoxine hydrochloride, 5 mg; vitamin B12, 0.2 mg; biotin, 0.1 mg; niacin, 50 mg; D- calcium pantothenate, 12 mg ; folic acid, 2 mg; Mn, 80mg; Fe, 60 mg; Cu, 8 mg; I, 1 mg; Co, 0.3 mg and Mo, 1 mg. *Protease enzyme (- indicates 0, + indicates 0.25kg/1000kg inclusion).

Data Collection

Performance characteristics

The broiler birds were weighed before being allocated into various replicates before the start of the experiment and subsequent weighing was done weekly. The gain in weight was estimated by the difference in body weights of two consecutive weighing periods.

$$Average\ Weight\ Gain(g) = \frac{(Final\ Weight - Initial\ Weight)g}{Total\ Number\ of\ Birds\ in\ the\ Group}$$

Feed intake was calculated by subtracting the left-over feed from the initial feed given to the birds daily

$$Average\ Feed\ Consumption\ (g) = \frac{(Feed\ given - Feed\ leftover)g}{Total\ Number\ of\ birds\ in\ the\ group}$$

Feed conversion ratio was calculated using the following formulae;

$$Feed\ Conversion\ Ratio = \frac{(Feed\ intake\ within\ a\ specific\ period\ )g}{(Weight\ gain\ within\ a\ specific\ period)g}$$

Results and Discussion

Table 2 shows the performance characteristics of broiler chickens fed diets containing cassava root-leaf meal supplemented with protease enzyme. The result showed that the final weight recorded was not significantly (P>0.05) different across the treatments. The average daily feed intake (ADFI), feed cost per weight gain (FCWG), and feed conversion ratio (FCR) were significantly (P<0.05) influenced by the dietary treatments. Birds fed control diet consumed more feed to gain a kilogram of weight and the cost of feed to gain weight were highest for birds fed control diet while birds on 45% CRLM were lowest (P<0.05). Birds on 15% and 30% CRLM diets were similar in average daily feed intake, feed conversion ratio, and feed cost per weight gain. The average daily weight gain (ADWG) and mortality were not affected by the diets. The trend at finisher phase explains the significant (P<0.05) decrease (74.66 – 85.50 g/d) daily feed intake at finisher phase (29 to 49 days) of birds on CRLM+P dietary treatment compared to birds on control (99.20g/d). Although CRLM+P – based diets had lower energy density compared to those on control. Birds on 45% CRLM+P recorded the lowest (74.66 g/d) feed intake during the finisher phase. This is in agreement with the report of (13) who reported a lower feed intake as the CRLM supplementation increased but disagrees with the work of (14) who reported a significant (P<0.05) increase in feed intake with an increase in the level of composite cassava meal in the diets. However, the study of (15) reported that increased fiber content in the diet would probably stimulate higher feed intake since birds eat to satisfy their energy requirement, hence the increase in feed intake of the birds.

In the current study, the feed intake (FI) was reduced when birds were fed high fiber CRLM+P-based diets. This could be due to the inability of the birds to digest the fiber, which would then create a gut fill sensation and subsequent depression of appetite (11).

Table 2: Performance characteristics of broiler chickens fed diets containing cassava root-leaf meal supplemented with protease enzyme (29-49day)

Parameter	T1 0% CRLM	T2 15%CRLM	T3 30%CRLM	T4 45%CRLM	SEM	P-value
Initial weight(g)	1071.40	1063.60	1016.20	1025.30	15.72	0.539
Final weight(g)	1935.20	1897.00	1914.80	1860.00	17.66	0.463
Daily weight gain(g/bird/day)	41.13	39.69	42.80	39.75	21.82	0.092
Daily feed intake(g/bird/day)	99.20^{a}	85.50^{ab}	88.94^{b}	74.66^{c}	49.33	0.040
FCR(g)	2.42^{a}	2.19^{ab}	2.09^{ab}	1.90^{b}	0.067	0.032
Feed cost/kg (₦)	148.39	157.18	152.80	148.70	NA	-
Feed cost/ weight gain	359.10^{a}	344.22^{ab}	319.35^{ab}	282.53^{b}	16.74	0.026
Mortality %	4.0	2.0	2.0	4.0	1.05	0.848

^{ab}Means in the same row with different superscripts are significantly different P<0.05, NA: Not analyzed,

Conclusion and Application

Based on the findings of this work, it is concluded that diets with 45% CRLM+P inclusion improved feed conversion ratio in broiler chickens between 29-49 days. It was therefore recommended that broiler chickens could be fed diets with CRLM+P at 45% to improve growth performance and CRLM+P can replace up to 40% maize in diets of broiler chickens.

References

1. ILCA, (1980).International Livestock Centre for Africa.Livestock Production in Africa. In ILCA: The First Year. Addis Ababa. Ethiopia.
2. Okoye, F. (2002). Substitution of cassava with Maize with cassava peel leaf meal as energy source in the diet of broiler finishers. *Proceedings of the 17th Annual Conference University of Agriculture, Abeokuta, Nigeria.*
3. Amaefule, K. U and Obioha, F. C. (2005). Performance of Pullets Chicks fed raw or processed pigeon pea (*Cajanus Cajan*) seed meal diets. LRRD 19, 33.htt://www.cipar.org.co /rrd/rrd17/03/amec17033htm.Accessed: December, 2017.
4. Sogunle, O. M., Fanimo, A. O., Abiola, S. S. and Bamgbose, A. M. (2009). Performance of growing pullets fed cassava peel meal diet supplemented with cashew nut meal, *Archives Zootechnology*. 58 (221): 23 – 31.
5. Food and Agriculture Organization of the United Nations (FAO, 2008).Food Outlook Global Market Analysis. http://www.fao.org/docrep/011/ai474e/ai474e06.htm.
6. Khajarern, S. and Khajarern, J. (2007).Use of Cassava products in poultry feeding, Roots, Tubers, Plantains and Bananas in animal feeding. *International Journal of Agricultural Science*. 18(3): 143-149.
7 Food and Agriculture Organization of the United Nations. (1995). Commodity review and outlook, 1994-95. Economic and Social Development Series. Food and Agriculture Organization. Rome, Italy.
8. Adeyemi, O. A., Eruvbetine, D., Oguntona, T. O., Dipeolu, M. A. and Agunbiade. J. A. (2008). Feeding broiler chickens with diet containing whole cassava root meal fermented with rumen filtrate, *Archivos de Zootehcnia* 57 (218): 247-258.
9. Ravindran, (1992). Cassava Leaves as Animal Feed: Potential and Limitations. *Journal of Science Food Agriculture*. 61, 141-150.
10. Babiker, S.A.; H. M. Mousa and H. Muawia. (1991). Cassava root meal as an alternative source of energy to grain sorghum in broiler feeding. *Sudan Journal of Animal Production*. 4: 11-22.
11. Bhuiyan, M.M and Iji, P. A. (2015). Energy Value of Cassava Products in Broiler Chicken Diets with or without Enzyme Supplementation. *Asian Australia Journal of Animal Science*. 12(2): 49-55.