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Sustainable Use of High Quality Cassava Peels in Broiler Chicken Starter Diets

M. A. Akinsuyi *, K. A. Azeez and O. O. Abioye
*Department of Agricultural Technology, Ekiti State Polytechnic, Isan Ekiti.
*Email: maakinsuyi@ekspoly.edu.ng

Abstract

The rising cost of conventional feed ingredients is a major constraint to broiler chicken production in Nigeria. This study evaluated nutrient utilization, growth and economics of broiler chicken production with the use of high-quality cassava peels (HQCP) as sustainable, lower-cost feed alternatives. 150 day-old chicks of the Ross strain broiler chicken were randomly distributed to five dietary treatments of three replicates each in a 28-day trial. Each replicate consist of ten birds. HQCP replaced 25%, 50%, 75% and 100% maize in the control diet (T1) as T2, T3, T4 and T5 respectively. A 5-days digestibility trial was performed when birds were 21 days. Two birds of uniform body weight from each of the fifteen (15) replicates were picked at random and fed test diets in the digestibility cage. Body weight changes were recorded during the digestibility trial. Performance indices were measured. Results showed a significant *($P < 0.05$)* effect of HQCP on all growth parameters, digestibility coefficients and economic indices. The final body weight, daily weight gain and daily feed intake increased as HQCP in the diets increased up to 25% and decreased *($P < 0.05$)* between 50% and 100% of HQCP replacements. Digestibility of nutrients was affected *($P < 0.05$)* by inclusion of high-quality cassava peel in the diets. Cost of feed decreased *($P < 0.05$)* with increased HQCP inclusions in diets. The result of the study indicated that unit gain of weight was sacrificed on 75% and 100% HQCP diets. 50% HQCP replacement for maize with HQCP is hereby recommended in broiler starter diets.

Keywords: broiler, digestibility, growth, high-quality cassava peel, maize, utilization,

Introduction: **Sustainable poultry production** emphasizes not only economic efficiency but also environmental responsibility and animal health. Sustainable feeding practices contribute to reduced environmental impact. The cost of conventional livestock/poultry feed ingredients has continually be on the increase in recent times. Of particular importance is the cost of maize which contribute the largest portion of poultry rations as a major energy source. Major conventional poultry feed ingredients, particularly maize are expensive in the tropical countries as they are also in high demand for human consumption, and may be used for other industrial production (Morgan *et al.,* 2016, Chauynarong *et al.,* 2009. The increased demand for maize in most countries of the world has forced many poultry farmers to explore viable alternatives that can replace maize at a lower cost without significant deleterious impacts on the production and performance of birds. The shift toward using **lower-cost, sustainable feed ingredients** is a crucial strategy in making broiler production more resilient and accessible, particularly for small- and medium-scale poultry producers in resource-limited settings. Most non-ruminant animals especially Broiler chickens rely on highly digestible feedstuffs, such as maize being used as energy source (Mutayoba *et al.,* 2011, Swick *et al.,* 2013). Maize is the most commonly used energy source for poultry feeding worldwide Ngiki *et al.,* 2014) because it has a higher metabolizable energy (ME) content than other cereal grains (Okike *et al.,* 2015). The recent introduction of cassava products as energy feed ingredient in poultry diets is a welcome development that had helped to change the narrative. Several studies have suggested the use of cassava as a replacement for maize meal as an energy source in poultry diets because it is produced in great quantities and has high energy content (Buitrago *et al.,* 2002, Morgan *et al.,* 2016, Broch *et al*., 2017). These studies have demonstrated that cassava peels can be a good energy feed base in poultry feed because of the high metabolizable energy. Cassava's low protein content, imbalanced amino acid profile, dustiness, and presence of anti-nutritional elements, however, limit its utilization in chicken diets.

High-quality cassava peel (HQCP) was reported to have been used to replace maize up to a 30% level. Replacement of 20% maize with cassava peel did not have any detrimental effect on broiler chicken growth (Abu *et al.,* 2015). Several authors reported varied proximate values for cassava products. Cassava peel has 3.1–5% and 9–12% crude protein and crude fibre, respectively (Babatunde, 2013), low energy, protein and high in fibre (Ngiki *et al.*, 2014). This study was conducted to explore viable alternative in the name of high-quality cassava peel that can replace maize and be utilized at a lower cost without significant deleterious impacts on the production and performance of broiler chickens.

Materials and Methods: Animals and Experimental Design: The research work was conducted at the Poultry Unit of the Teaching and Research Farm of Ekiti State Polytechnic, Isan Ekiti. HQCP with fine particle size was used in this trial **(Table 1**). Proximate composition of high quality cassava peels was carried out as described by AOAC, (2005).

In a completely randomized design, one hundred and fifty-day-old Ross broiler chicks were randomly placed into five diets. A Control diet was formulated (T1). Four other diets (T2, T3, T4 and T5) were formulated with 25%, 50%, 75% and 100% replacement of maize in diet T1 with HQCP **(Table 2).** 0%, 25%, 50%, 75% and 100% HQCP translated to 0%, 14.75%, 29.50%, 44.50% and 59.00% inclusion level of HQCP in broiler starter diets on weight basis.

Diets were formulated and compounded with no other feed additives. Birds were brooded on a floor pen in an open-sided wall building with heat provided from burning charcoal in pots. Nutrient digestibility studies were conducted in the fourth week of the trial and lasted five days. In a completely randomized design arrangement of five dietary treatment replicated thrice, two birds (2 per replicate) with total number of fifteen (15) birds were randomly selected, and placed in digestibility cages. Birds were fasted for 24 hours to empty the digestive tract after which they were fed the formulated diets. *Ad libitum* feeding and clean drinking water were provided. The standard technique of total fecal collection was followed. Faecal samples and data on feed intake were collected daily over a period of five days by placing feacal trays under each cage. The collected faecal samples were weighed on wet and dry basis to determine moisture and dry matter content. The final body weight was recorded at the end of the trial. Growth changes and feed consumed calculated.

Chemical Analyses: Proximate composition of high quality cassava peels, experimental diets and faecal samples were carried out as described by AOAC, (2005).

Statistical Analysis

Data generated were subjected to one-way analysis of variance (ANOVA) using the SAS (2008) package for Windows. To separate significant differences among means, Duncan multiple range test was used.

Results and Discussion: Calculated and Proximate composition of experimental diets.: Calculated and Proximate composition of experimental diets are presented in Table 3. Proximate data obtained were similar to the calculated values obtained.

Growth performance characteristics of Broiler Starter fed High Quality Cassava Peel: Table 4 shows the performance characteristics of broiler starter fed HQCP for the digestibility trial. There was a significant *(P < 0.05)* effect of HQCP on all growth parameters. The final body weight, daily weight gain and daily feed intake increased by the increase HQCP in the diets up to 25% and thereby decreased *(P < 0.05)* between 50% and 100% of HQCP. Performance characteristics were significantly similar for birds on 0%, 25% and 50% HQCP diets. The differences *(P < 0.05)* for feed intake was not consistent with HQCP increase across treatments. Birds on diet 2 (25% HQCP) replacement recorded the highest final body weight, daily weight gain and daily feed intake. The higher daily feed intake in 75% and 100% HQCP diets did not translate to improved weight gain. This could be attributed to higher fibre content which resulted in poor utilization of crude protein and metabolizable energy in the diet. The final body weight, daily weight gain, and FCR among birds fed diets with 25% and 50% were not *(P < 0.05)* different. Also, the deteriorating effect of feeding HQCP diets noticed in the final body weight, daily weight gain, and FCR for birds were not different *(P < 0.05)* on 75% and 100% HQCP. The low *(P < 0.05)* FCR values recorded for birds that were fed diets with higher levels of HQCP might be attributed to higher non-soluble starch component of HQCP (Adekeye *et al.*, 2021). Cost of feed decreased *(P < 0.05)* with increased HQCP inclusions in diets. The cost per unit weight gain were lower on 25% and 50% than on 0% HQCP diet. However, it is expensive to achieve a unit gain of weight when 75% and 100% of maize in diets was replaced with HQCP than on the other diets because the nutrient was not better utilized.

Nutrient Digestibility Parameters: Nutrient digestibility parameters of Broiler Starter fed High Quality Cassava Peel are shown in **table 5**. The digestibility of inherent nutrients of diets was influenced (P<0.05) by addition of high-quality cassava peel into the test diets. The utilization of crude protein, crude fibre, ether extract, and nitrogen-free extract were also affected (P<0.05). Crude protein digestibility increased (P<0.05) up to 25% HQCP inclusion level, which was then observed to reduce significantly from 50% to 100% HQCP inclusion. However, the utilization of Metabolizable energy, crude fibre and ether extract decreased (P<0.05) with increasing levels of HQCP in the diets. The result showed a drop in the digestibility of crude protein and ether extract after the 25% HQCP level The least metabolizable energy value (2894.08 kcal ME kg-1) recorded in this study are adequate for starting broiler in the tropics (Olomu, 2005). The attendant weight reduction recorded with HQCP increase in the diets could be attributed to the poor utilization of the crude protein, crude fibre, ether extract and metabolizable energy of the diets at higher levels of HQCP inclusion.

Conclusion and Application: High Quality Cassava Peel are poorly utilized by broiler chicken when added to diets at higher level. Broiler chicks can thrive well on diets in which up to 50% of maize is replaced with High Quality Cassava Peel without impairing performance. Thus, HQCP can be incorporated into broiler starter diets at 29.50% on weight basis. The use of HQCP as an alternate energy feed source in poultry feed will help to mitigate the ever increasing cost of broiler feed in Nigeria.

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Proximate Composition of High Quality Cassava Peels HQCP

Table 1: Proximate composition of HQCP

Parameters	HQCP (Whole)	HQCP (Fine)	HQCP (Coarse)
Starch	66.70	69.00	55.00
Protein (%)	4.50	4.60	2.80
Fat (%)	1.40	1.20	1.20
Crude Fibre (%)	9.80	8.20	15.60
Crude Ash (%)	5.80	6.60	3.50
ME (kcal/kg)	2947	3039	2495

HQCP – High Quality Cassava Peels

Table 2: Gross Composition of Experimental diets of broilers starter fed High Quality Cassava Peels

	REPLACEMENT LEVELS				
Ingredients	0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP
Maize	59.00	44.25	29.50	14.75	0.00
HQCP	0.00	14.75	29.50	44.25	59.00
Soy Bean Meal	31.00	31.00	31.00	31.00	31.00
Wheat offal	4.19	4.19	4.19	4.19	4.19
Bone meal	2.20	2.20	2.20	2.20	2.20
Fish meal	3.00	3.00	3.00	3.00	3.00
Broiler premix	0.01	0.01	0.01	0.01	0.01
Table salt	0.50	0.50	0.50	0.50	0.50
Methionine	0.05	0.05	0.05	0.05	0.05
Lysine	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00

Note – ME- Metabolisable energy, HQCP – High Quality Cassava Peel

Table 3: Calculated and Proximate composition of experimental diets

Ingredients	REPLACEMENT LEVELS 0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP
Calculated nutrient values					
Crude protein (%)	21.93	21.82	21.78	20.86	19.77
ME (kcal/kg)	2903.32	2860.43	2814.52	2790.13	2765.73
Ether extract	2.96	2.45	2.26	1.90	1.55
Crude fibre	3.64	4.51	5.40	6.34	7.24
Analyzed Proximate values					
Crude Protein (%)	21.90	21.31	20.69	20.08	19.48
Crude Fibre (%)	5.85	6.55	8.32	9.10	11.48
Ether Extract (%)	5.89	4.01	4.94	3.69	3.43
Ash (%)	6.91	5.41	5.12	5.21	3.84
NFE (%)	59.45	62.72	60.93	61.92	61.77
ME (kcal/kg)	3097.87	3039.84	3028.69	2940.01	2891.43

Note – ME- Metabolisable energy, HQCP – High Quality Cassava Peel

Table 4: Growth Performance Characteristics of Broiler starter fed varying inclusion levels of HQCP

PARAMETERS	REPLACEMENT LEVELS OF HQCP FOR MAIZE						p-value
	0%	25%	50%	75%	100%	SEM	
Initial body weight (g/bird)	110.05	111.85	115.40	110.00	110.75	1.46	0.8434
Final body weight (g/bird)	669.95^{a}	691.95^{a}	611.55^{ab}	392.80^{b}	357.30^{b}	52.65	0.0525
Daily weight gain (g/bird)	111.98^{a}	116.02^{a}	99.23^{ab}	56.56^{b}	49.31^{b}	10.39	0.0442
Daily Feed Intake (g/bird)	70.80^{e}	82.83^{b}	77.53^{d}	91.36^{a}	79.41^{c}	2.25	<.0001
Feed Conversion Ratio	1.58^{a}	1.40^{a}	1.28^{ab}	0.62^{b}	0.62^{b}	0.15	0.0316
Fc/kg feed (₦)	368.18^{a}	346.05^{b}	323.92^{c}	301.80^{d}	279.68^{e}	10.43	<.0001
Fc/wg/b (₦)	3.41	3.02	3.29	5.52	5.96	0.49	0.1354

HQCP – High Quality Cassava Peel, Fc- Feed Cost, SEM: Standard Error of **Mean**

Table 5: Utilization of High Quality Cassava Peel Nutrient by Broiler starter

PARAMETERS	REPLACEMENT LEVELS					SEM	p-value
	0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP		
Moisture (%)	7.22^{a}	6.50^{ab}	5.54^{bc}	5.44^{bc}	5.10^{c}	0.2493	0.0415
Dry Matter (%)	92.79^{c}	93.50^{bc}	94.46^{ab}	94.56^{ab}	94.90^{a}	0.2492	0.0415
Crude Protein (%)	3.16^{bac}	4.39^{a}	3.42^{ab}	2.03^{bc}	1.72^{c}	0.3289	0.0249
Crude Fibre (%)	11.93^{a}	11.90^{b}	9.92^{b}	9.98^{c}	9.40^{c}	0.4760	0.0035
Ether Extract (%)	3.85^{a}	3.62^{ab}	2.77^{bc}	2.02^{cd}	1.35^{d}	0.3242	0.0029
ASH (%)	5.35^{c}	5.78^{c}	6.79^{b}	7.71^{a}	8.35^{a}	0.3803	0.0004
NFE (%)	75.71^{cd}	74.32^{d}	77.05^{bc}	78.85^{ab}	80.14^{a}	0.7281	0.0064
ME	3116.31^{a}	3093.33^{ab}	3085.91^{ab}	2948.98^{c}	2894.08^{d}	18.2015	0.0409

Note – NFE – Nitrogen Free Extract, ME- Metabolisable energy, HQCP – High Quality Cassava Peel