



## Nutritive value of fermented cassava peel meal on growth performance and nutrient digestibility of broiler chickens

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### Abstract

A study was conducted to examine the effect of fermented cassava peel meal on the growth performance and nutrient digestibility of broiler chickens. One hundred and fifty (150) unsexed day-old chicks (arbor acre breed) were obtained from a reputable hatchery and used for the study. The chicks were randomly allocated to five treatments, each with three replicates and ten birds per replicate in a completely randomized design. Feed and water were given to the birds ad libitum and the experiment lasted for 8 weeks. The result of this study revealed that there was no significant difference ( $p < 0.05$ ) in total feed intake (TFI), average daily feed intake (ADFI) and feed conversion ratio (FCR). However, final weight gain (FWG). Total weight gain (TWG) and average daily weight gain (ADWG) were significantly affected ( $p > 0.05$ ) across the treatment groups. In the nutrient digestibility study, dry matter, ash and nitrogen-free extract (NFE) were not affected ( $p < 0.05$ ). Nevertheless, the digestibility of crude protein, crude fibre and ether extract was significantly influenced ( $p > 0.05$ ). The results obtained suggest that fermented cassava peel meal could be included in broiler chicken diets up to 20% without adverse effects on growth performance and nutrient digestibility.

**Keywords:** Broiler chicken, fermented cassava peel meal, growth performance, nutrient digestibility

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### Introduction

Poultry production, particularly broiler farming, is among the most efficient methods to address the animal protein deficit in developing countries. Broilers, known for their rapid growth rates, are a prime source of meat. Compared to ruminants, broiler production benefits from simpler management, higher turnover rates, and faster returns on investment (Ukorebi, 2022; Haruna and Hamidu, 2004) <sup>[29, 13]</sup>. To improve broiler production and mitigate the rising cost of feed ingredients, such as corn and soybean, which serve as the primary energy and protein sources in livestock diets, researchers advocate for the use of affordable, locally available, and nutritionally viable alternative feedstuffs that do not compete with human or industrial uses, thus reducing the reliance on conventional feedstuff for livestock production (Iyayi and Fayoyin, 2004; Ezihe and Uchendu 2019) <sup>[15, 10]</sup>. Cassava is a vital dietary staple food in many tropical regions, providing an average of 285 calories per person per day and feeding over 800 million people (FAO, 2000; FAO, 2007) <sup>[11, 12]</sup>. It serves as the main source of dietary energy for the majority of the population in the lowland and subhumid tropics of West and Central Africa (Oladunmoye *et al.*, 2014; Verma *et al.*, 2022) <sup>[20, 30]</sup>. Cassava peel is a promising by-product that is abundantly available in regions where cassava is grown and processed for food. Cassava peels are often discarded and left to decompose, creating a waste disposal problem, and posing a health hazard to humans (Ukorebi, 2022; Oboh, 2006) <sup>[29, 19]</sup>. The outer covering of the tuber, known as the peel, comprises 10-13% of the tuber's weight (Oladunjoye *et al.*, 2010) <sup>[21]</sup>. While cassava peels offer potential as a cost-effective feed for non-ruminant, their application is hampered by anti-nutritional factors like hydrocyanic acid and high non-starch polysaccharides (Aguihe *et al.*, 2015; Idahor, 2012; Egbunike *et al.*, 2009) <sup>[3, 14, 9]</sup>. Therefore, the processing of cassava peel is essential for improved utilization and acceptability by the animals.

Numerous processing methods have been reported and used by different authors to improve the nutritive value of cassava, such as sun drying, soaking in water and retting, oven drying, and enzymes (Akinfala *et al.*, 2007; Salami and Odunsi, 2003; Tewe and Kasali, 1986; Ukorebi, 2022) [4, 29, 26, 23].

According to Aro *et al.* (2008) [7], fermentation has been employed as a method to enhance the nutritional profile of cassava peel for livestock feeds, by mitigating anti-nutritional factors, lowering crude fiber, and enriching protein content. Furthermore, observed an enhanced crude protein content when fermented cassava peel was fed to broiler chickens. Also, Olaifa *et al.* (2015) [22] reported improved performance and carcass traits in broiler chickens fed cassava peel fermented with rumen filtrate. Therefore, this study was conducted to determine the effects of fermented cassava peel on the growth performance and nutrient digestibility of broiler chickens.

## Materials Methods

### Experimental site

The experiment was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Joseph Sarwan Tarka University Makurdi Benue state. Makurdi is located at Latitude 7°14' North and Longitude 8°24' East and lies within the Southern Guinea Savannah Region of Nigeria. The annual temperature ranges from 22.43 to 33.41°C. High temperature is experienced between late February and April. The annual rainfall is between 1270mm-1397mm (Abu, 2002) [1].

### Experimental Animals, Management and Design

One hundred and fifty (150) unsexed day-old chicks (arbor acre breed) were obtained from a reputable hatchery and used for the study. The chicks were randomly distributed into five treatments, each with three replicates and ten birds per replicate in a completely randomized design. The chicks were housed in cages constructed with wood and wire mesh. The chicks were weighed at the beginning of the experiment and weekly thereafter to determine weight gain. The birds were vaccinated adequately. Feed and water was provided *ad libitum*. Starter diet was offered from 1-4 weeks while the finisher diet was provided from 5-8 weeks of age.

### Collection and preparation of cassava peel

Fresh cassava peel was collected from garri processing factory within Makurdi metropolis. Fresh rumen content was obtained from the abattoir at Northbank Cattle Market Makurdi, water was added to the rumen content at 1:1, thoroughly mixed, and sieved. 1 kg of fresh cassava peel was mixed with rumen filtrate, placed in a polythene bag, sealed, and left for 48 hours under shade to ferment. The fermented cassava peel was then sun-dried, crushed and mixed with other feed ingredients to form a complete diet. The cassava peel meal was supplemented in the diet at 0%, 5%, 10%, 15% and 20%.

## Data Collection

### Growth Performance

The chickens were weighed at the beginning of the experiment and weekly thereafter to determine the weight gain. Feed intake was measured by subtracting unconsumed feed from the total feed offered. The feed conversion ratio (FCR) was determined using the formula below.

$$FCR = \frac{\text{Feed intake}}{\text{Weight gain}}$$

### Digestibility study

During the last week of the study, a 5-day digestibility trial was carried out using six birds per treatment. Before faecal collection, the birds were deprived of feed for 12 hours to clear the gastrointestinal tract, the birds were however allowed free access to drinking water. A clean polythene bag was placed under the cage for daily faecal collection. The collected faecal samples from each replicate were ovum-dried, bulked, thoroughly mixed, grind, and used for further analysis. Nutrient digestibility was determined using the formula below.

$$\text{Nutrient digestibility} = \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times 100$$

### Laboratory analysis

The Proximate analysis of fermented cassava peel meal was determined according to the method described by AOAC, (2006) [6].

### Statistical Analysis

The data collected were subjected to a one-way analysis of variance (ANOVA) using SPSS Version 20 (2011). Duncan's Multiple Range Test (DMRT) was used to compare the mean at  $p < 0.05$  level of significance.

## Results and Discussion

The proximate composition of the cassava peel meal is presented in Table 3. The results revealed that the cassava peel contained 9.04% crude protein, 12.95% crude fiber, 1.45% ether extract, 10.03% ash, and 66.17% nitrogen-free extract (NFE). The crude protein content of 9.04% recorded in this study is higher than the 5.46%, 5.70%, and 5.75% reported by Udoyong *et al.* (2010) [28], Malik *et al.* (2018) [16], and Aguihe *et al.* (2015) [3], respectively. Additionally, the crude fiber content of 12.95% in this study is lower than the 14.83% reported by Malik *et al.* (2018) [16] and Aguihe *et al.* (2015) [3], and 15.5% reported by Idahor (2012) [14]. The ether extract of 1.45% observed in this study is similar to the value reported by Aguihe *et al.* (2015) [3]. The ash content of 10.03% is also comparable to the value obtained by Tonukari *et al.* (2023) [27]. The observed differences in the proximate analysis could be attributed to variations in cassava varieties, processing methods, and storage conditions employed by the different researchers.

The growth performance of broiler chickens offered diets containing fermented cassava peel is shown in Table 4. The results indicate that final weight (FW), total weight gain (TWG), and average daily weight gain (ADWG) were significantly affected ( $P < 0.05$ ) by the dietary treatments. In contrast, feed conversion ratio (FCR), average daily feed intake (ADFI), and total feed intake (TFI) were not significantly different ( $P > 0.05$ ) across the treatment groups. Broiler chickens offered diets T2, T3, and T4 had statistically similar ( $P < 0.05$ ) final weights and total weight gains compared to the control group (T1). Additionally, the birds fed diets T2, T3, and T4 recorded substantially higher ( $P < 0.05$ ) average daily feed intakes compared to the control. Although FCR was not significantly affected ( $P > 0.05$ ) by

the inclusion of cassava peel, broilers on diet T3 exhibited the best FCR compared to the other dietary treatments.

**Table 1:** Nutrient Composition of Starter Diets

Ingredients	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
Maize	50.60	48.07	45.54	43.01	40.48
BCPM	0.00	2.53	5.06	7.59	10.12
Maize offal	5.00	5.00	5.00	5.00	5.00
Brewers Dry Grain	4.00	4.00	4.00	4.00	4.00
SBM	34.60	34.60	34.60	34.60	34.60
Blood meal	1.80	1.80	1.80	1.80	1.80
Limestone	1.00	1.00	1.00	1.00	1.00
Bone ash	2.00	2.00	2.00	2.00	2.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Remix	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition					
ME (Kcal/kg)	2947.52	2939.63	2923.98	2908.33	2892.68
Crude Protein	23.18	22.96	22.73	22.51	22.28
Crude Fibre	4.70	4.63	4.56	4.49	4.42
Calcium	1.01	1.01	1.01	1.01	1.01
Avail. Phosphorus	0.59	0.58	0.58	0.57	0.56

SBM = Soybean meal, ME = Metabolizable energy, BDG = Brewer dried grain, BCMP = Biodegraded cassava peel meal, Premix supplied per kilogram, Vit A: 10000000IU, Vit D3: 2000000 mg, VitK3: 2000 mg, VitB1: 3000 mg, VitB2: 5000 mg, Niacin:45000 mg, Calcium panthothenate:10000 mg VitB6:4000 mg, Choline chloride:300000 mg, Folic acid:1000 mg, Biotin:50 mg, Manganese:300000 mg, Iron:120000 mg, Zinc:80000 mg, Copper:8500 mg, Iodine:1500 mg, Cobalt:300 mg, Selenium:120 mg, Antioxidant:120000 mg.

**Table 2:** Nutrient Composition of Finisher Diets

Ingredients	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
Maize	55.50	52.73	49.95	47.18	44.40
BCPM	0.00	2.78	5.55	8.88	11.10
Maize Offal	6.00	6.00	6.00	6.00	6.00
BDG	5.50	5.50	5.50	5.50	5.50
SBMS	28.00	28.00	28.00	28.00	28.00
Blood meal	1.00	1.00	1.00	1.00	1.00
Limestone	0.50	0.50	0.50	0.50	0.50
Bone Ash	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition					
ME(Kcal/kg)	2982.29	2943.49	2904.70	2865.90	2827.44
Crude protein	20.53	20.42	20.32	20.21	20.10
Crude fibre	4.70	3.99	5.25	4.46	3.29
Calcium	1.00	1.00	1.00	1.00	1.00
Avail. Phosphorus	0.22	0.22	0.21	0.28	0.19

SBM = Soybean meal, ME = Metabolizable energy, BDG = Brewer dried grain, BCMP = Biodegraded cassava peel meal. Premix supplied per kilogram VitA.; 10,000,000IU, VitD3:20,000,000 mg, VitK3:2000 mg. VitB1:3000 mg., VitB2:5000 mg, Niacin:45000 mg., Calcium panthothenate:10000 mg., VitB6:4000 mg., Choline chloride: 300,000 mg., Folic acid: 1000 mg. Biotin:50 mg, Manganese: 300,000 mg., Copper:8500 mg. Iodine: 1500 mg., Cobalt:300 mg., Selenium:120 mg., Antioxidant: 120000 mg. Iron: 120000 mg., Zinc:8000 mg

The results of this study are consistent with the findings of Aguihe *et al.* (2015) [3], which demonstrated that supplementing broiler chicken diets with cassava peel meal enhances growth performance. Our findings suggest that the inclusion of cassava peel meal in the diet positively affects the growth parameters of chickens. This improvement is likely due to the fermentation of cassava peel, which enhances performance and improves the absorption, digestion, and utilization of nutrients (Malik *et al.*, 2018) [16]. The fermentation process reduces fiber content, degrades non-starch polysaccharides (NSPs), and mitigates anti-nutritional factors. These results support the findings of

Ukorebi (2022) [29], Aguihe *et al.* (2015) [3], Ademola *et al.* (2013) [2], who reported that enzyme-treated cassava peel meal improves feed utilization efficiency, lowers fiber content and enhances performance.

Table 5 shows the effect of nutrient digestibility of broiler chickens fed fermented cassava peel. There were no significant differences ( $p>0.05$ ) in the digestibility of dry matter, crude ash, and nitrogen-free extract among the treatment groups. However, significant differences ( $p<0.05$ ) were observed for crude protein, fiber, and ether extract digestibility. Birds in the T2 and T3 groups exhibited higher crude protein digestibility compared to other treatment

groups and the control. Additionally, broiler chickens in the T3 group showed improved crude fiber digestibility relative to the control group. The result of this study aligned with Aguihe *et al.* (2015) [3], who reported enhanced nutrient digestibility in birds fed enzyme-treated cassava peel meal. Conversely, Ndelekwute *et al.* (2020) [18] found that cassava peel meal does not improve nutrient digestibility in broiler chickens. The improved nutrient digestibility observed in our study can be attributed to the beneficial effects of fermented

cassava peel on gastrointestinal tract health. These benefits include lowering gastric pH, enhancing nutrient absorption, reducing pathogenic microbial activity, and improving the gut lining structure (Akinola *et al.*, 2015; Scholten *et al.*, 1999) [5, 24]. Additionally, treated cassava peel may reduce antinutritional and fiber components, releasing trapped nutrients and making them more accessible for the chickens' utilization (Aguihe *et al.*, 2015; Sekoni *et al.*, 2008) [3, 25].

**Table 4:** Effect of Biodegraded Cassava Peel Meal on Growth Performance of Broiler Chicken

Parameters	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	SEM
Initial weight (g)	35.00	35.00	35.00	35.00	35.00	-
Final weight (g)	1790.00 <sup>c</sup>	1940.00 <sup>ab</sup>	2026.67 <sup>a</sup>	1883.33 <sup>ab</sup>	1840.00 <sup>b</sup>	42.35*
TWG (g)	1755.00 <sup>c</sup>	1905.00 <sup>ab</sup>	1991.67 <sup>a</sup>	1848.33 <sup>ab</sup>	1805.00 <sup>b</sup>	42.35*
ADWG (g)	35.82 <sup>b</sup>	38.88 <sup>a</sup>	40.65 <sup>a</sup>	37.72 <sup>ab</sup>	36.84 <sup>b</sup>	0.76*
TFI (g)	3523.16	3739.66	3509.81	3394.97	3489.57	42.96 <sup>ns</sup>
ADFI (g)	71.90	76.32	71.63	69.29	71.22	0.88 <sup>ns</sup>
FCR	1.95	1.96	1.76	1.84	1.93	0.05 <sup>ns</sup>

<sup>abc</sup> Means with different superscripts within the row indicate significant differences ( $p < 0.05$ ).

TWG = Total weight gain, ADWG = Average daily weight gain, TFI = Total feed intake, ADFI = Average daily feed intake, FCR = Feed conversion ratio

**Table 5:** Effect of biodegraded cassava peel meal on nutrient digestibility of broiler chickens

Parameter	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	SEM
Dry matter	85.61	82.86	82.72	79.09	78.00	1.71
Crude protein	83.59 <sup>b</sup>	86.77 <sup>a</sup>	85.03 <sup>a</sup>	78.48 <sup>c</sup>	82.31 <sup>b</sup>	1.64*
Crude fibre	43.30 <sup>c</sup>	44.76 <sup>b</sup>	47.69 <sup>a</sup>	45.83 <sup>b</sup>	43.39 <sup>bc</sup>	4.64*
Ether Extract	65.93 <sup>b</sup>	72.94 <sup>a</sup>	69.95 <sup>ab</sup>	64.94 <sup>bc</sup>	62.72 <sup>c</sup>	5.08*
Ash	65.54	67.44	65.04	68.61	68.57	5.20
NFE	90.43	88.66	88.94	87.43	85.31	1.12

<sup>abc</sup> Means with different superscripts within the row indicate significant differences ( $p < 0.05$ )

## Conclusion

The result of this current study demonstrated that fermented cassava peel meal could be supplemented up to 20% in broiler chickens without adverse effects on growth performance and nutrient digestibility. This supplementation level is recommended to poultry farmers due to its cost-effectiveness and availability.

**Table 3:** Proximate analysis of fermented cassava peel meal

Parameter	FCPM
Dry matter	93.05
Crude protein (%)	9.04
Crude fibre (%)	12.95
Ether extract (%)	1.45
Ash (%)	10.03
Nitrogen free extract (%)	66.17

FCPM = Fermented cassava peel meal

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