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The Effect of Replacing Maize with Pap Waste on Productive Performance, Nutrient Digestibility and Carcass Characteristics of Broilers in Nigeria

[1]Obienyem, J.N., [5]Kwari, I.D., [5]Igwebuike, J.U. [2*]Ezebo, R.O., [3]Ozoh, C.N. and [4]Nwankwo, C.A.

[1]Department of Animal Health and Production Technology, Anambra State Polytechnic, P.M.B. 002, Mgbakwu, Anambra State, Nigeria.
[2]Department of Botany Faculty of Bioscience, Nnamdi Azikiwe University, P.M.B. 5025, Awka, Anambra State, Nigeria.
[3]Department of Applied Microbiology and Brewery, Faculty of Bioscience, Nnamdi Azikiwe University, P.M.B. 5025, Awka, Anambra State, Nigeria.
[4]Department of Animal Science and Technology, Nnamdi Azikiwe University, P.M.B. 5025, Awka, Anambra State, Nigeria.
[5]Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria.
[*]Correspondence: esau056@yahoo.com

ABSTRACT

A study was conducted to determine the productive performance, nutrient digestibility and carcass characteristics of broilers fed pap waste. A total of 150 broilers were used for the experiment. The birds were randomly assigned to five (5) dietary treatments in groups of 30, with each treatment consisting of three replicates of 10 chickens each. Pap waste replacing maize at 0, 25, 50, 75 and 100% levels in Diets 1(Control), 2, 3, 4 and 5. The experimental diets were fed *ad libitum* through out the experimental period. The daily feed intake (113.78g, 116.78g, 120.17g, 120.28g and 123.50g) were significantly (P<0.05) different amongst all the treatment groups. Diet 5(100%) was significantly (P< 0.05) higher than Diet 1(0%). However there were no significant (P>0.05) difference among Diets 1, 2, 3 and 4. The daily weight gain (44.05g, 51.03g, 50.73g, 52.26g and 54.10 g), and feed conversion ratio (2.77g, 2.49g, 2.57g, 2.55g and 2.63g) for Diets 1, 2, 3, 4 and 5 respectively were not significantly (P>0.05) different. There were significant (P<0.05) difference among the treatments for nutrient digestibility. The dry matter digestibility is significantly (P<0.05) higher in the control (0%) than the other treatments. With the exception of Diets 3 and 4, crude protein, ether extract, ash and nitrogen-free extract, the digestibility of the other diets were similar to the control (0%). Carcass characteristic values were not (P>0.05) significantly different among all treatments. Based on these, pap waste could replace maize in broiler chicken diets without adverse effect on performance.

Keywords: Replacing, Maize, Pap, Waste, Productive, Nutrient, Carcass, Broiler, Broilers, Nigeria

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INTRODUCTION

As the population of Nigeria continues to increase in a geometric pattern, food supply particularly, protein supply lags behind in arithmetic pattern. [1], have stated that one of the ways of increasing protein supply for the Nigerian population is through broiler production. Broilers are poultry birds used mainly for meat, and in recent years occupied a leading role in meeting the animal protein need of people worldwide [2]. The high price of conventional poultry feed ingredients in Nigeria has increased the feeding cost to about 80% of the total cost of production [3]; [4]. This is due to the stiff competition between human and monogastric animals for the already scarce conventional feed resources [5]; [1]. The resultant effects have been low production level, narrow profit margin and collapse of the once prosperous poultry farms. In the present time, the choice of feed is determined to a large extent by price rather than by quality of feed [6]. This development has also contributed to the indiscriminate appearance of new commercial feeds in the market, the quality of such commercial feeds being doubtful because no quality grading system is in place. Chickens have short generation interval and therefore are the choice animal species for achieving sustainable and rapid production of animal protein for human consumption [7]. Unlike other forms of animals (livestock) that have either or both cultural taboos and religious prohibitions attached to them, the chickens have neither restrictions in all parts of Nigeria [8]. [9], also reported that poultry, particularly broilers are fast growing birds, with high feed efficiency, reaching the required market weight of 2 kg within eight to twelve weeks (8-12 weeks) of age. In a world where malnutrition and starvation stare the entire human race at the face, it is amazing that there exist some agro-industrial by-products lying waste, which could be utilized for increased food production, especially livestock and poultry, to supply protein [5]. In cases where agricultural by-products are utilized, they are inappropriately or grossly under-utilized; not withstanding their favourable yield characteristics and relatively lower cost [10]. This study investigated the effect of maize with pap waste on productive performance, nutrient digestibility and carcass characteristics of broilers in Nigeria.

Materials and Methods

Location of Study

The study was carried out at the Livestock Teaching and Research Farm of the University of Maiduguri. Maiduguri is situated at latitude 11°51' North, longitude 30°09' East and on an altitude of 364m above sea level in the north-eastern part of Nigeria [11]. Maiduguri falls in the semi-arid zone characterized by a shorter rainy season (3 to 4 months), longer period of dry season (8 to 9 months), hot and dry climate, and has ambient temperatures that can be as high as 40°C and above by the months of April, May and June; and as low as 20°C during the months of November, December and January [12]; [13]. The area is therefore, prone to extreme weather conditions and variations [14].

Experimental Stock and Management

One hundred and fifty straight run day-old Anak – 2,000 broilers were used for this study. They were obtained from Obasanjo Farms Ltd, Otta, Ogun State, Nigeria. The birds were brooded together on a deep litter floor which was previously cleaned and disinfected. During the study, the birds received the conventional husbandry practices and necessary medications which included vaccinations and anti-stress drugs administration. They were vaccinated against Newcastle disease at first and third week, while Gumboro disease vaccine was administered at fourth week of age. Vita stress® and vitalyte extra® served as anti-stress drugs. Commercial broiler starter diet was given during brooding till the third week.

Preparation of Pap Waste

Pap waste is the left-over after processing maize grains into "akamu" or pap. During the preparation of pap, maize grains are soaked in plastic container with water for two days and allowed to ferment. On the third day, the grains are washed and ground after draining the water. The ground mass of maize is sieved using a nylon cloth. The chaff or by-product in the basket is the "Pap Waste" while the watery product below is the 'akamu' or pap. The watery product is further compressed in a bag, with water seeping out. The 'akamu' or pap may then be stored in a container or bag and kept in the fridge. In some communities, it may be sun-dried for some days and reconstituted when necessary, for pap production.

The chaff or by-product from the sieve was sun-dried for some days and used in the formulation of the diets.

Experimental Design and Diets

At the commencement of the study, the 3-week-old birds, numbering 150 were weighed individually and randomly assigned to five (5) treatments in a randomized complete block design (RCBD) and the test diets administered *ad libitum* to the experimental birds.

Each treatment contained thirty birds each replicated three times with ten birds per replicate. Data collection started at the third week, for the six-week trial. Five experimental diets were formulated using locally available feedstuffs viz: (pap waste, i.e. the test material), maize, groundnut cake, wheat offal, fish meal, bone meal and salt. The compositions of the experimental diets are shown in Tables 1 and 2. Maize was replaced with pap waste at 0%, 25%, 50%, 75% and 100% levels in diets 1(control), 2, 3, 4 and 5 respectively during the starter and finisher phases.

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Table 1: Ingredient composition of the experimental starter diets

Ingredient (%)	Levels of Replacement of Maize with Pap Waste (%)				
	0	25	50	75	100
Maize	55.00	42.40	35.00	14.40	0.00
Pap waste	0.00	12.60	20.00	40.60	55.00
Groundnut cake	30.00	30.00	30.00	30.00	30.00
Wheat offal	6.00	6.00	6.00	6.00	6.00
Fish meal	6.00	6.00	6.00	6.00	6.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.30	0.30	0.30	0.30	0.30
Salt	0.70	0.70	0.70	0.70	0.70
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 2: Ingredient composition of the experimental finisher diets

Ingredient (%)	Levels of Replacement of Maize with Pap Waste (%)				
	0	25	50	75	100
Maize	56.30	43.30	31.30	16.30	0.00
Pap waste	0.00	13.00	25.00	40.00	56.30
Groundnut cake	25.00	25.00	25.00	25.00	25.00
Wheat offal	9.00	9.00	9.00	9.00	9.00
Fish meal	7.00	7.00	7.00	7.00	7.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.30	0.30	0.30	0.30	0.30
Salt	0.40	0.40	0.40	0.40	0.40
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Data Collection

Feed Intake

A known quantity (1 kg) of feed was given to the birds daily and the left-over weighed every morning. The feed intake was obtained by subtracting the left over from the quantity supplied the previous day. The average feed intake per bird per day was determined by dividing the total feed consumed by the number of birds in each pen. At the end of each week, the mean daily feed consumption was calculated.

Live Weight Gain

The total live weight gain for each treatment group was obtained by calculating the difference between the mean initial live weight and the final live weight.

Feed Conversion Ratio (FCR)

FCR for the 6-week period was calculated by dividing the total feed intake per treatment in grams by the live weight gain per treatment in grams.

$$\text{Feed Conversion Ratio} = \frac{\text{Feed intake (g)}}{\text{Live weight gain (g)}}$$

Digestibility Study

During week six of the experiment, three (3) birds from each treatment group (one bird per replicate) were placed in individual metabolism cages for the digestibility study. The birds were allowed two days adjustment period. A known quantity (100 g) of feed was fed to them. Faeces were collected from each bird for 5 days, using a nylon mesh as collection trays and sun-dried for few days. Faecal samples were ground and analyzed for proximate composition according to AOAC (1990) [15]. Apparent digestibility was calculated thus:

Apparent Digestibility (%) =

$$\frac{(\text{nutrient in feed x feed intake}) - (\text{nutrient in faeces x faeca output})}{(\text{nutrient in feed x feed intake})} \text{ x } 100$$

Carcass Evaluation

At the end of the experiment (9 weeks) three birds per treatment, one from each replicate, were selected randomly for carcass evaluation. They were deprived of feed overnight to empty their crops but water was provided. Their weights before and after slaughter and defeathering were recorded. The organs and body components (cut-up parts) which include the neck, thighs, wings, breast, shanks, head, drum sticks and back

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were weighed and expressed as percentage of the slaughter weight. The defeathered birds were eviscerated with the legs and head removed to obtain the dressing percentage.

$$\text{Dressing percentage} = \frac{\text{Dressed carcass wt (g)}}{\text{Slaughter weight (g)}} \times 100$$

Mortality

Mortality for each experimental group was recorded during the period. Causes of death were determined through post-mortem examination. Thirteen deaths recorded as shown in Table 3, were due to heat stress prevalent during the period of this study.

Chemical Analysis

The proximate analysis of the test ingredient and the diets were carried out according to the methods of the Association of Official Analytical Chemists (AOAC, 1990)[15].

Dry Matter Determination

About 2 g of the experimental diet was weighed into a Petri dish, using an electronic balance and fed into an oven. The sample was oven-dried at a temperature of 105°C for 24 hours to attain a constant weight. The difference between the original and final weight, which is the percent moisture (M) was calculated as:

$$\% MC = \frac{W_1 - W_2}{W} \times 100$$

Where: W_1 = weight of sample + Petri dish before drying

W_2 = weight of sample + Petri dish after drying

W = weight of sample

% MC = percentage moisture

The percent dry matter was then calculated by subtracting the %moisture from 100 as follows: %DM=100-%moisture.

Crude Protein (CP)

The crude protein was determined by Kjedahl method (AOAC, 1990) [15]. This involves three stages as follows:

Digestion

About 2 g of the prepared sample was placed in a digestion tube. Two digestion tablets and 20 ml of concentrated sulphuric acid were added. The tube was then placed in a digestion block and covered with the exhaustion cap. After being completely digested the sample was allowed to cool at room temperature and diluted with distilled water to a volume of 100 ml.

Distillation

About 50 ml of the digested sample was measured out and placed in a distillation flask along with 50 ml of NaOH which reacted with ammonium sulphate (resulting from protein + H_2SO_4 to give NH_4OH + Na_2SO_4). The steam from water that heated in the machine passed through the digested sample + NaOH to "carry over" the NH_4OH that was condensed into a receiver flask containing boric acid + bromo-cresol green and methyl red indicators. The NH_4OH in boric acid changed the initial reddish colour of boric acid to green, indicating the presence of a base (NH_3)

Titration

The green distillate was then titrated with 0.1 normal HCL. This then changed it to its original reddish colour. The crude protein (CP) was then calculated as follows:

$$CP = \frac{(A - B) \times N \times F \times 14.007}{\text{Weight (g) of sample used}} \times \frac{100}{1}$$

Where

A = Ml of acid used in titrating the sample

B = Ml of base used in titrating the blank

N = Normality of the acid used in titration

F = Conversion factor (6.25)

Crude Fibre (CF)

About 1 g of each of the feed samples was digested with 100 ml of the digestion reagent (20 g trichloroacetic acid, 500 ml glacial acetic acid and 50 ml NHO_3 and 450 ml of distilled water).The flask containing the sample and reagent was boiled and refluxed for 40 mins. The digested sample was then removed and allowed to cool to room temperature and then filtered through an ash-less filter paper of known weight. The filtered sample was washed six times with hot distilled water to remove carbohydrate and protein, then once with petroleum spirit to remove fat. The paper was then placed in a oven at 80°C overnight to remove all the moisture and then weighed. The residue (paper + fibre) after drying was ashed in a muffle furnace at 550°C for 3 hours and the ash, so formed, weighed. Percent crude fibre (CF) was then calculated according to Van-Soest and Wine (1967) as follows:

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% CF = (Oven dried weight – weight of ash + paper) x 100

Ether Extract (EE)

About 2 g of each sample was placed in a thimble (filter paper – like container) and the mouth closed with cotton wool. The thimble was then placed into an extraction chamber of a Soxhlet system. The chamber was fixed to an extraction flask (round bottom flask of 250ml capacity) in which 200 ml of petroleum ether was fed. The two units were fixed to a heating mantle and a condenser placed on the top of the unit. The heating mantle was turned on to a temperature of 60°C. After about 5 hours the ether coming down was received in a beaker leaving the flask with only the extracted fat. The flask was then oven-dried at 100°C for one hour, cooled in a desiccator and weighed. The ether extract was then calculated as follows:

$$EE = \frac{\text{Weight of oil flask after extraction} - \text{Weight of empty oil flask}}{\text{Weight of dried material taken}} \times 100$$

Ash

About 1 g of each of the samples was fed into a crucible of known weight and then incinerated at 600°C for 3 hours in a furnace. The resultant ash was cooled in desiccators and then weighed. Percent ash was calculated as follows:

$$\%\ Ash = \frac{\text{Weight of ash}}{\text{Weight of dried sample}} \times 100$$

Nitrogen-Free Extract (NFE)

This was calculated by difference. The summation of CP, CF, EE and Ash was subtracted from 100 as follows:
Nitrogen-Free Extract (NFE)
%NFE = 100 -%(CP + CF + EE + Ash)

Metabolizable energy (ME)

Metabolizable energy per kg feed was calculated according to Pauzenga (1985) as follows:
ME (kcal/kg) = 37 (% CP) + 81 (% EE) + 35.5 (% NFE)
Where: ME is metabolizable Energy, CP is crude protein, EE is ether extract and NFE is nitrogen- free extract.

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using Randomized Complete Block Design (RCBD) and treatment means were compared using Duncan's Multiple Range Test [16].

Results and Discussion

Proximate Composition of Pap Waste

The proximate composition of the test ingredient is presented in Tables 3. The dry matter (DM) is 93.75% for pap waste. The dry matter value was higher than the 90.15% reported by [17] but lower than the 96.43% level given by [18] for the same product. The crude protein (CP) content obtained for the test ingredient is 12.66%. The value is similar to the 12.93% obtained by [18] but slightly lower than the 13.97% reported by [17]. The feeding value of pap waste is supposed to have improved since it had undergone soaking, fermentation and fine grinding as explained by [8]. The values of ether extract (EE), crude fibre (CF), ash and nitrogen-free extract (NFE) were 2.45%, 12.70%, 2.50% and 63.45% respectively and were similar to the values reported by [19]. The metabolizable energy of the test ingredient was 2919.35 kcal/kg. The nutrient composition of pap waste suggests that it could be used as a replacement for maize in broiler diets.

Proximate Composition of the Experimental Diets

Composition of the Starter Diets

The proximate composition of the experimental starter diets is presented in Table 3. The dry matter (DM) contents of the diets were 97.10%, 97.20%, 97.20%, 97.40% and 97.10% for 0%, 25%, 50%, 75% and 100% diets respectively. The crude protein (CP) levels were 21.44%, 22.48%, 22.35%, 22.05% and 22.40%. They were within the range (21 – 22% CP) recommended for starting broiler chickens [20] but lower than the recommended CP level (23 – 24% CP) for starting broilers by [21] and NEP (1979). The crude protein (CP) levels of the diets can support broiler growth and development. The ether extract (EE) values were 5.35%, 5.40%, 4.07%, 4.45% and 4.40% respectively for diets 1,2,3,4 and 5 which indicates that the fat contents would provide enough essential fatty acids and energy for the broilers [22]. The values 3,518.87 kcal/kg, 3,300.12 kcal/kg, 3,415.49 kcal/kg, 3,440.14 kcal/kg and 3,116.40 kcal/kg of metabolizable energy (ME) respectively for treatments 1, 2, 3, 4, and 5 recorded in the experimental diets were higher than the 3,000kcal/kg recommended by [22] for broilers at 0 – 6 weeks of age. The energy levels obtained in the starter diets are adequate for broiler growth. The crude fibre (CF) levels were 4.24, 5.11, 6.15, 6.13 and 7.90% for treatments 1(0%), 2 (25%), 3(50%), 4 (75%) and 5 (100%) respectively. The CF values were higher in diets 3(6.15%), 4 (6.13%) and 5(7.90%) than diets 1 (4.24%) and 2 (5.11%). The crude fibre levels increased with increasing levels of pap waste in the diets. With the exception of treatment 1 (control), all the other treatments had higher fibre levels than the 5% maximum crude fibre level recommended by [21] for broiler chickens. The ash content of the starter diets were 1.50%, 1.70%, 1.00%, 1.00% and 1.80% for treatments 1(0%), 2 (25%), 3 (50%), 4(75%) and 5 (100%) respectively while the nitrogen-free extract values were 64.57%, 57.21%, 63.63%, 63.77% and 54.40% for T1, T2, T3, T4 and

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T5 respectively. [22], recommended 2.70 to 3.00% level of ash and 66.20 to 75.80% nitrogen-free extract for chickens. Ash provides the minerals required by animals.

Table 3: Proximate composition of the experimental starter diets and pap waste

Nutrient (%)*	Level of Replacement of Maize with Pap Waste (%)					
	0	25	50	75	100	Pap Waste
Dry Matter (DM)	97.10	97.20	97.20	97.40	97.10	93.75
Crude Protein (CP)	21.44	22.48	22.35	22.05	22.40	12.66
Ether Extract (EE) Crude Fibre (CF)	5.35	5.40	4.07	4.45	4.40	2.45
Ash	4.24	5.11	6.15	6.13	7.90	12.70
Nitrogen-Free Extract (NFE)	1.50	1.70	1.00	1.00	1.80	2.50
Metabolizable Energy (ME) Kcal/Kg	64.57	57.21	63.63	63.77	54.40	63.45
	3518.87	3300.12	3415.49	3440.14	3116.40	2919.35

* The values are means of three determinations

Proximate Composition of the Finisher Diets

The proximate composition of the experimental diets at finisher phase is presented in Table 4. The dry matter values were 97.00, 96.60, 96.80, 97.10 and 97.00% for treatments 1 (0%), 2 (25%), 3 (50%), 4 (75%) and 5 (100%) respectively. The DM values were similar for all the experimental diets. The crude protein (CP) range (18.43 to 20.44%) was close to the recommended CP levels (19 to 21%) for broiler finishers [22]. Ether extract (EE) values (3.35 to 4.45%) obtained in this study (Table 4) were within the recommended values (3.0 to 5.0%) for broiler finishers [21] and (3.13 to 3.73%) recommended by [22]. The EE values obtained can favourably meet the fatty acid requirements of broiler finishers. The crude fibre (CF) range (4.10 to 7.16%) was close to the 5.0% level reported by Olomu (1979) and 3.13 to 3.73% recorded by [22]. The ash values were 4.00% for T1(0%), 8.00% for T2(25%), 4.00% for T3 (50%), 5.00% for T4 (75%) and 6.00% for T5 (100%) while the nitrogen –free extract values were 65.24%, 60.51%, 64.77%, 62.05% and 62.01% for T1 (0%), T2 (25%), T3 (50%), T4 (75%) and T5 (100%) respectively. The values were ideal for broiler finishers [23]. The metabolizable energy (ME) values of the experimental diets at the finisher phase ranged from 3158.67 to 3387.24 kcal/kg. The values were higher than the requirement recommended by [21] who reported that broiler chickens need about 3,000 kcal/kg of ME at 0 – 9 weeks of age. [22], reported 2,975.26 kcal/kg level as adequate when they fed broiler chickens with maize-based diets. The ME values obtained in this study can therefore adequately meet the energy requirements of broiler chickens [23].

Table 4: Proximate composition of the experimental finisher diets

Nutrient (%)*	Level of Replacement of Maize with Pap Waste(%)				
	0	25	50	75	100
Dry Matter (DM)	97.00	96.60	96.80	97.10	97.00
Crude Protein (CP)	19.21	18.54	18.56	20.44	18.43
Ether Extract (EE)	4.45	4.45	3.35	3.45	3.40
Crude Fibre (CF)	4.10	5.10	6.12	6.16	7.16
Ash	4.00	8.00	4.00	5.00	6.00
Nitrogen-Free Extract (NFE)	65.24	60.51	64.77	62.05	62.01
Metabolizable Energy (ME) Kcal/Kg	3387.24	3194.54	3257.41	3238.51	3158.67

* The values are means of three determinations.

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Productive Performance Parameters

Final Body Weight

Data on the final body weight are presented in Table 5. There were no significant (P>0.05) treatment effect on final body weight amongst treatments. The values for final weights were 2153.33 g, 2370.00 g, 2483.33 g, 2510.00 g and 2583.33 g for treatments 1 (0%), 2 (25%), 3 (50%), 4 (50%) and 5 (100%) respectively. There were no significant (P > 0.05) differences in the final body weight among all the treatment groups. The final body weights obtained in this experiment(2153.33 to 2583.33 g/bird) were close to the value 2,495 g reported by [21] for broiler chickens at nine weeks of age. Data on daily weight gain are presented in Table 5. The daily weight gain values of 44.05 g, 51.03 g, 50.73 g, 52.26 g and 54.10 g, for the control, 25, 50,75 and 100% replacement diets respectively showed no significant (P >0.05) differences among all the treatments. This reflects the similar levels of crude protein and ether extract of both the starter and finisher diets and followed the pattern of the final live weights. The values (44.05g-54.10g) reported here are higher than the values (26.10g-37.79g) reported by [22] for broilers fed different cereal grains as energy sources.

Daily Feed Intake

The daily feed intake values are presented in Table 5. The values are 113.78, 116.78, 120.17, 120.28 and 123.50g for treatments 1 (0%), 2 (25%), 3 (50%), 4 (75%) and 5 (100%) respectively. The values show significant (P<0.05) differences in daily feed intake among treatments. Feed intake in the 100% fed group is significantly (p<0.05) higher than in the control (0%) group. There were no significant (p>0.05) differences in feed intake amongst the pap waste fed birds as well as amongst the control, 25, 50 and 75% replacement groups. The daily feed intake values (113.78g to 123.50g) recorded in this study were similar to the values (110.54g to 120.46g) reported by [24]. This result however disagrees with report of [21] who stated that average feed intake by broilers should be around 160g/day/bird. The lower values in feed intake observed in this study could be attributed to the elevated ambient temperature (38.6 to 41.7^{0}C) during the study period. This is above the comfort zone (11 to 26.7^{0}C) specified by [25] for broiler chickens beyond which feed intake is bound to be lowered. [26], also reported that ambient temperature exerts strong influence on efficiency of feed utilization in broiler chicken. The daily feed intake values were close to the values (173.83g to 187.67g) of [27] who reported a steady increase in feed intake with increasing level of maize bran in broiler diets. [28], also indicated that increased fibre inclusion in diets caused a dilution of the nutrient content of the rations and since chickens eat to meet their energy needs, more feed would be consumed to meet this requirement as the fibre levels increased.

Feed Conversion Ratio (FCR)

Data on the feed conversion ratio is presented in Table 5. The values are 2.77, 2.49, 2.57, 2.55 and 2.63 for the control, 0%, 25%, 50%, 75% and 100% respectively. There were no significant (P>0.05) differences among all the treatment groups. The values however, fall within the range (1.75 – 3.41) reported by [29] for broiler chickens. Feed conversion ratio is the feed consumed per unit weight gain and therefore measures how efficiently the birds convert or utilize the feed consumed to meat. The value of feed conversion ratio recorded in this study are close to the value (2.50) reported by [21]. Similarly, [22], who used different energy sources (maize, millet and guinea corn) at graded levels in diets of broiler chickens reported FCR of 2.56 to 3.64.. The FCR in this study followed the same pattern with the daily weight gain and final live weight.

Mortality

A total of thirteen (13) deaths (4, 3, 1, 4, and 1 birds on the control, 25, 50, 75 and 100% diets respectively) were recorded. This trend of mortality was not traceable to any dietary effect.

Table 5: Performance of broiler chickens fed graded levels of pap waste daily weight gain

Parameters	Level of Replacement of Maize with Pap Waste (%)					
	0	25	50	75	100	SEM
Initial weight (g)	303.33	293.33	353.00	315.67	311.67	25.45^{NS}
Final weight (g)	2153.33	2370.00	2483.33	2510.00	2583.33	184.49^{NS}
Daily weight gain (g)	44.05	51.03	50.73	52.26	54.10	4.46^{NS}
Daily Feed Intake (g)	113.78^{b}	116.78^{ab}	120.17^{ab}	120.28^{ab}	123.50^{a}	2.58*
Feed Conversion Ratio	2.77	2.49	2.57	2.55	2.63	0.15^{NS}
Mortality (Number)	4	3	1	4	1	NAS
% Mortality	13.79	10.35	3.45	13.79	3.45	NAS

SEM = Standard Error of the Means

a, b, c …. , Means in the same row bearing the same superscripts are not significantly (P > 0.05) different.

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* = Significant (P<0.05)
NAS = Not analyzed statistically
NS = Not significant (P>0.05)

Nutrient Digestibility

Data on the nutrient digestibility are presented in Table 6. The dry matter digestibility is significantly (P<0.05) higher in the control (0%) than the other treatments. With the exception of treatments 3 (50%) and 4 (75%) which were inferior, crude protein, ether extract, ash and nitrogen-free extract digestibility of the other treatments were similar to the control (0%). [30] had reported that different chemical and physical composition influenced differently the utilization of nutrients. [31], noted that increasing fibre level had significant negative effect on growth, feed utilization and daily weight gain of birds. Increased fibre inclusion in poultry diets brings about decrease in digestibility and utilization of nutrients. Also, it often results in dilution of the total nutrient available for body building and growth of birds [28] and [8]. Furthermore, high fibre content lowers digestibility and utilization of the dietary nutrients [32]. Increased feed intake caused by the inclusion of fibre is responsible for decreased efficiency of feed utilization [33], and [28]. Birds are monogastrics, and cannot effectively digest crude fibre content of the diets. This is confirmed by the proportionate general decline in percentage digestibility and overall poor nutrient utilization observed in this study as the level of fibre increased. [34], also corroborated that non-starch polysaccharides (NSP) depressed metabolizable energy and crude protein utilization resulting in lower weight gain and poor feed conversion ratio of birds.

Table 6: Nutrient digestibility of broiler chickens fed graded levels of pap waste (%)

Parameters	Level of Replacement of Maize with Pap Waste (%)					
	0	25	50	75	100	SEM
Dry Matter	69.10[a]	65.14[b]	63.60[b]	61.62[b]	64.55[b]	1.29*
Crude Protein	71.35[a]	67.88[ab]	65.73[b]	67.98[ab]	69.38[ab]	1.37*
Ether Extract	68.67[a]	66.35[ab]	60.06[c]	59.09[c]	63.14[bc]	1.59*
Crude Fibre	45.69[ab]	42.02[b]	44.73[b]	44.68[b]	51.55[a]	2.23*
Ash	55.80[a]	60.75[a]	48.04[b]	39.61[c]	54.86[a]	2.14*
Nitrogen-Free Extract (NFE)	73.09[ab]	73.74[ab]	71.54[b]	70.54[b]	6.67[a]	1.34*

SEM = Standard Error of the Means
a,b,c = Means in the same row bearing the same superscripts are not significantly (P>0.05) different.
* = Significant (P<0.05)
NS = Not significant (P>0.05)

Carcass Analysis

Data on the carcass characteristics are presented in Table 7. There were no significant (P>0.05) differences in slaughter weight, dressed weight and dressing percentage among all the treatment groups. The dressed weight followed a similar trend with the slaughter weight of the birds. The weight of cut-up parts (head, neck, shanks, breast, thorax, back, wings, thighs and drum sticks) expressed as percentage of slaughter weight, did not also differ significantly (P > 0.05) among all the treatments. Organ weights (liver, heart, gizzard, proventriculus, empty crop) and abdominal fats were also expressed as percentage of slaughter weight. The values obtained for liver, heart, gizzard, proventiculus, empty crop and abdominal fats showed no significant (P > 0.05) differences among treatment groups.

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Table 7: Carcass data of broiler chickens fed graded levels of pap waste

Parameters	Level of Replacement of Maize with Pap Waste (%)					
	0	25	50	75	100	SEM
Slaughter weight (g)	2153.33	2370.00	2483.33	2510.00	2583.33	184.49^{NS}
Dressed weight (g)	1487.00	1635.33	1747.00	1794.00	1894.00	142.99^{NS}
Dressing percentage (%)	69.04	69.00	70.34	71.69	73.29	2.96^{NS}
Body components/ organs (%)	2.51	2.41	2.35	2.29	2.48	0.21^{NS}
Head	5.70	6.22	6.17	5.86	6.29	0.26^{NS}
Neck	4.51	4.38	4.23	4.21	3.84	0.46^{NS}
Shanks	17.21	17.32	18.72	18.35	19.17	1.04^{NS}
Breast	6.00	5.49	5.35	5.46	6.24	0.49^{NS}
Thorax	9.33	9.29	9.67	9.17	9.83	0.47^{NS}
Back	8.77	8.85	8.98	8.90	9.20	0.44^{NS}
Wings	11.39	11.08	10.90	10.85	11.55	0.26^{NS}
Thighs	10.31	9.94	10.34	10.20	10.93	0.39^{NS}
Drum sticks	1.73	1.85	1.80	1.86	1.79	0.09^{NS}
Liver	0.57	0.63	0.44	0.48	0.51	0.07^{NS}
Heart	2.97	3.32	2.78	2.64	2.84	0.33^{NS}
Gizzard (Ventriculus)						
Proventriculus	0.60	0.55	0.47	0.49	0.48	0.07^{NS}
Empty crop	0.36	0.29	0.34	0.39	0.35	0.06^{NS}
Abdominal fat	2.33	1.42	1.43	1.54	1.73	0.52^{NS}

SEM = Standard Error Mean
a, b, c …. Means in the same row bearing the same superscripts are not significantly ($P > 0.05$) different.
NS = Not significant ($P>0.05$)

CONCLUSION

The results of this study showed that maize could be substituted completely with pap waste in broiler chicken diets as an energy source without adverse effects on their productive performance, nutrient digestibility and carcass components. Pap waste is cheaper than whole maize and locally available since pap (akamu) is a popular breakfast staple in both rural and urban communities in Nigeria. The feeding value (nutrient value) for broilers is quite acceptable having undergone soaking, fermentation and fine grinding during processing which are known to improve the utilization of many cereal grain residues. The results obtained from the study indicated that pap waste can replace 100% of the maize in the diets of broiler chicken. Therefore total substitution of maize with pap waste is suitable in broiler chicken diets.

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