The Journal of Poultry Science, 43 : 241–249, 2006

Potential of Breadfruit Meal as Alternative Energy Source to Maize in Diet of Broiler Chickens

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This study was conducted to investigate the response of broiler chickens to diets containing breadfruit meal (BFM). Two hundred and fifty-six (256) day-old unsexed Anak 2000 broiler chicks were randomly allotted to the eight dietary treatments consisting of four replicates of eight chicks each. The experimental layout was a 2×4 factorial arrangement with two types of breadfruit meal (raw and cooked breadfruit meal) and four levels (0, 10, 20, 30%) of each BFM (Table 2). The diets were balanced for energy and crude protein. Cooking of the BFM increased ($P<0.05$) daily weight gain of birds while it decreased ($P<0.05$) with increase in inclusion level of BFM. The interaction between processing and inclusion levels of BFM was significant ($P<0.05$) for daily weight gain, feed/gain and protein efficiency ratio. Crude fibre (CF), ash and nitrogen free extract (NFE) digestibility reduced ($P<0.05$) in cooked BFM diets while inclusion of BFM increased the NFE digestibility and reduced ash digestibility. Processing of BFM had no effect ($P>0.05$) on the measured serum metabolites except serum glutamate pyruvate transaminase (SGPT) which was reduced ($P<0.05$) with processing of BFM. Uric acid decreased ($P<0.05$) while globulin increased ($P<0.05$) with increased inclusion level of BFM. Relative weights of breast muscle, drumstick and thigh were higher in birds fed cooked BFM. Total cost of feed consumed per bird and cost of feed per kg weight gain decreased ($P<0.05$) in the BFM diets. Total cost of feed consumed per bird was higher ($P<0.05$) in cooked BFM but the cost of feed per kg weight gain decreased ($P<0.05$) in the cooked BFM.

Key words : breadfruit, broiler chicken, energy source

J. Poult. Sci., 43 : 241–249, 2006

Introduction

Livestock species require dietary source of energy, protein, minerals, and vitamins. Of all nutrients, energy is quantitatively the most important item in livestock rations especially poultry rations and all feeding standard are based on energy needs (Tewe, 1988). The need for energy varies from one environment to another and the requirement set the base for qualitative nutrients for the birds. In effect, energy sources constitute between 35–60% of finished feeds for different classes of livestock. The higher values are encountered in balanced rations for monogastric animals. Breadfruit (*Artocarpus altilis*) grows wild in southern parts of Nigeria (Achinewhu, 1982) and it is a tropical fruit-bearing tree, which store mainly carbohydrates on its fruit. Breadfruit pulp is made into various dishes that are relished by man but the consuming population is few and the bulk of the produce is consequently wasted. The crop fruits all the year round with its main season being May-August in Nigeria.

Ravindran and Sivakanesan (1995), Cochelim (1987) and Udoh (1981) reported that breadfruit

Received : January 4, 2006, Accepted : March 20, 2006
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could be processed into meal suitable for poultry. Quijano and Arango (1979) reported that the potential industrial uses of the breadfruit have not been sufficiently investigated other than attempt aimed at determining its chemical composition. There were no readily available information on the energy potential of breadfruit for broiler chickens.

Worrell and Carrington (1997) reported that breadfruit is as good nutritionally as tubers and root crops. It is in some cases superior especially in terms of mineral and vitamin content. The crude protein value of 19.96% was reported by Quijano and Arango (1979). Oladunjoye *et al.* (2004) have shown that bread fruit contains 86.27% DM ; 12.98% CP ; 4.22% CF ; 3.94% ash and 3870.30 kcal/kg gross energy. Traces of anti-nutritional factors like oxalate, tannin and phytate have been detected in breadfruit (Oladunjoye *et al.,* 2004). Some of these compounds provide agronomic advantages such as protecting the seed/fruit against attack by insects, birds and against pre-harvest germination. It is also likely that they protect the plant against diseases caused by fungi, bacteria and viruses. But they invariably interfere with the digestibility, absorption and utilization of nutrients (Bullard *et al.,* 1980 ; Harris and Burns, 1973).

However, there is dearth of information on the suitability of breadfruit as a source of energy in poultry diets. The present research effort is an attempt to explore the use of the fruit as energy source for feeding broiler chickens.

Materials and Methods

Experimental Site

The study was conducted at the poultry unit of the Teaching and Research Farm, University of Agriculture, Abeokuta, Nigeria. The farm is 7.6 m above sea level and falls within latitude 7°15′N and longitude 3°21′E. It receives a mean precipitation of 1,038 mm with a mean annual temperature of 34.7℃ and relative humidity of 82% throughout the year.

Processing of Test Ingredient

The test ingredient, breadfruit was purchased from a farm in Ile-Ife, Nigeria. The fruits were washed thoroughly and sliced. They were divided into two parts. A part was parboiled (100℃ for 3 minutes) and sun dried while the second part was sun dried raw. The drying took 10 days under intense sunshine. The dried samples were milled and packaged and later used along with other feed ingredients to compound the experimental diets.

Animals and their Management

Two hundred and fifty-six (256) unsexed day-old Anak 2000 broiler chicks obtained from a commercial hatchery were used. They were randomly allotted to the eight dietary treatments consisting of four replicates of eight chicks each. Feed and water were supplied *ad libitum.* The birds were reared on deep litter house with wood shavings as litter.

Dietary Treatments

The experimental layout was a 2×4 factorial arrangement with two types of breadfruit meal (raw and cooked breadfruit meal) and four levels (0, 10, 20, 30%) of each BFM (Table 2). The diets were balanced for energy and crude protein. A straight diet was used in this experiment for both the starter and finisher phases of the broiler birds.

Chemical Analysis

Feed, test ingredient and droppings samples were dried at 60℃ for 24 h and milled (1 mm screen) before analyses and all analyses were performed on dried samples, except for nitrogen (N) of droppings which was determined in fresh samples. Dry matter (DM), ash, CP (N×6.25), ether extract (EE) and crude fibre (CF) were determined on dry samples according to the methods of A.O.A.C. (2000). Gross energy (GE) was determined using an adiabatic bomb calorimeter. All analyses were performed in triplicate and are presented on a DM basis.

Data Collection

Feed intake and body weight of birds were measured weekly. A record of mortality was kept as it occurred. At the 56th day of the experiment, blood samples (3 ml) were collected from each of the 8 birds per treatment randomly selected and slaughtered by cervical dislocation for carcass analysis. The blood samples were thereafter analyzed for serum total protein, albumin, globulin, creatinine, cholesterol, urea, serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyrurate transaminase (SGPT) levels. The serum biochemical indices were carried out using routine standard clinical chemistry procedures (Olorede *et al.,* 1996 ; Onifade *et al.,* 1999). Birds for carcass analysis were defeathered after scalding in warm water (Oluyemi and Roberts, 2000). They were then cut into retail parts and weighed. Weights of parts were expressed as percentage of the live weight.

Statistical Analysis

All data were subjected to analysis of variance using 2×4 factorial arrangements in a completely randomized design. Duncan's Multiple Range Test was used to separate significant differences among the means. All the analyses were carried out using Minitab Analytical Computer Package (Minitab Inc., 1991).

Results and Discussion

Chemical Composition of Breadfruits

The chemical composition of unpeeled raw breadfruits (URBF) and unpeeled cooked breadfruit (UCBF) are shown in Table 1. The gross energy of 16.54–16.88 MJ/kg and crude protein of 17.73–18.26% obtained for breadfruit used in this study confirmed that the feedstuff is a good source of dietary energy. The gross energy of breadfruit meal in this study is very close to the value of 17.66 MJ/kg reported by Ravindran and Sivakanesan (1995). The gross energy of breadfruit meal is close to that of maize-a universal energy feed resource for poultry.

Trace of oxalate, phytic acid and tannin were found in the breadfruit used. The oxalate contents ranged between 2.1×10^{-6} and 4.0×10^{-6} which are lower than 39 mg/kg reported for maize (Ravindran *et al.,* 1996).The tannin level ranged between 6.0×10^{-5} and 6.9×10^{-5} percent ; which are lower than 0.5% found to depress growth in chicks (Chang and Fuller, 1964). The phytic acid was between 0.69 and 1.09%, this level is considered to be high and to have effect on feed utilization of birds (Ologhobo and Fetuga, 1982).

Growth Performance and Apparent Nutrient Utilization

The growth performance of the birds is shown in Table 3. There was an increase ($P<0.05$) daily

Table 1. **Analysis (percent DM) of breadfruit meal**

	URBF[1]	UCBF
Dry matter	89.87	89.57
Crude protein	18.26	17.73
Crude fibre	1.34	2.97
Ether extract	2.87	6.97
Ash	2.07	3.97
Nitrogen free extract	65.33	57.93
Gross energy (MJ/kg)	16.54	16.88
Oxalate ($\times10^{-6}$)	4.00	2.10
Phytic acid	1.09	0.69
Tannin ($\times10^{5}$)	6.90	6.00

[1] URBF=Unpeeled raw breadfruit meal ; UCBF=Unpeeled cooked breadfruit meal.

Table 2. **Composition of the experimental diets (percent)**

Ingredient and analysis	Unpeeled raw breadfruit meal				Unpeeled cooked breadfruit meal			
	0%	10%	20%	30%	0%	10%	20%	30%
Maize	47.5	37.50	27.50	17.50	47.5	37.50	27.50	17.50
Breadfruit meal	—	10.00	20.00	30.00	—	10.00	20.00	30.00
Full-fat soybean	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Wheat offal	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Blood meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Bone meal	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Determined analysis (DM basis)								
Crude protein	22.04	21.70	21.88	21.93	22.04	21.23	21.19	21.34
Crude Fibre	4.08	5.18	5.22	5.34	4.08	5.06	4.93	4.88
Ether Extract	3.69	3.72	3.81	3.79	3.69	3.75	3.82	3.77
Ash	11.56	12.16	12.20	11.35	11.54	11.76	11.84	11.73
Phytate	0.79	1.04	1.09	1.08	0.79	0.69	0.66	0.62
Oxalate	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.01
Dry Matter	90.62	89.76	90.06	89.83	90.61	89.43	89.39	89.41
Digestible energy (MJ/kg)	12.62	12.65	12.61	12.63	12.62	12.59	12.56	12.52

[1] Provided per kg diet : 1500 I.U, Vit A ; 1500 I.U, Vit D ; 3000 I.U, VitE ; 3.0 g, VitK ; 2.5 g, Vit B_2 ; 0.3 g, Vit B_6 ; 8.0 mg, Vit B_{12} ; 8.0 g, Nicotinic acid ; 3.0 g Ca-Pantothenate ; 5.0 mg, Fe ; 10.0 g, Al, 0.2 g, Cu ; 3.5 mg, Zn ; 0.15 mg, I ; 0.02 g, Co ; 0.01 g, Se.

Table 3. **Growth performance and apparent nutrient utilization of broilers fed experimental diets**

Parameters	Raw breadfruit				Cooked breadfruit				
	0%	10%	20%	30%	0%	10%	20%	30%	±SEM
Initial live-weight (g/bird)	162.50	160.00	160.00	160.00	162.50	161.00	161.00	162.00	0.39
Final live-weight (g/bird)	2009.20^{b}	1990.00^{bc}	1766.70^{c}	1640.00^{d}	2009.20^{b}	2057.70^{ab}	1867.70^{bc}	2102.00^{a}	56.14
Weight gain (g/bird/day)	37.33^{a}	37.33^{a}	33.00^{bc}	30.00^{c}	37.33^{a}	38.33^{a}	34.33^{b}	39.33^{a}	1.11
Feed intake (g/bird/day)	120.00	111.33	105.33	100.67	120.00	107.00	114.00	119.33	1.94
Feed/gain	3.22^{b}	2.97^{bc}	3.21^{b}	3.71^{a}	3.22^{b}	2.80^{bc}	3.33^{b}	2.72^{c}	0.15
Protein intake (g/bird/day)	27.52	25.53	24.15	25.38	27.52	24.54	26.12	25.07	0.44
Protein efficiency ratio	1.38^{c}	1.19^{d}	1.36^{c}	1.48^{b}	1.48^{c}	1.58^{ab}	1.38^{c}	1.61^{a}	0.05
Mortality (%)	0.00^{b}	4.77^{b}	0.00^{b}	4.77^{b}	0.00^{a}	0.00^{b}	4.77^{b}	0.00^{b}	2.12
Crude protein retention (%)	84.68	87.25	88.42	65.79	84.68	85.63	80.32	82.20	2.54
Ether extract (%)	79.90	85.22	93.73	66.24	79.90	92.98	88.17	86.22	3.13
Crude fibre (%)	62.04^{bc}	78.21^{ab}	81.17^{a}	69.36^{b}	62.04^{bc}	76.67^{ab}	51.82^{d}	63.11^{bc}	3.56
Nitrogen free extract (%)	83.97^{c}	89.38^{a}	57.13^{ab}	84.25^{b}	83.97^{c}	87.25^{a}	82.12^{d}	84.34^{b}	0.84
Ash (%)	73.86^{b}	79.41^{ab}	81.18^{a}	70.87^{c}	73.86^{b}	75.56^{ab}	64.39^{d}	71.90^{b}	1.84

$^{a, b, c, d}$ Means in the same row with different superscripts differ significantly ($P < 0.05$).

Table 3. (Continuation) **Growth performance and apparent nutrient utilization of broilers fed experimental diets**

Parameters	Processing method			Inclusion level (%)				
	Raw	Cooked	±SEM	0%	10%	20%	30%	±SEM
Initial live-weight (g/bird)	160.62	161.63	0.63	162.50	162.50	160.50	161.00	0.47
Final live-weight (g/bird)	1851.48	2005.15	97.79	2009.20^{b}	2023.50^{a}	1817.20^{d}	1871.00^{c}	57.37
Weight gain (g/bird/day)	34.42^{b}	37.33^{a}	1.80	37.33^{a}	37.83^{a}	33.67^{c}	34.66^{b}	1.15
Feed intake (g/bird/day)	111.83	112.58	0.47	120.00	109.17	109.67	110.00	2.60
Feed/gain	3.28	3.02	0.16	3.22	3.26	3.27	2.85	0.10
Protein intake (g/bird/day)	25.65	25.81	0.09	27.52	25.04	25.14	25.23	0.59
Protein efficiency ratio	1.35	1.49	0.09	1.38	1.39	1.37	1.54	0.04
Mortality (%)	3.18	1.59	0.74	0.00	2.39	2.39	2.39	1.61
Crude protein retention (%)	81.54	83.21	0.84	84.68	86.44	84.37	73.99	2.83
Ether extract (%)	81.27	86.82	3.44	79.90	89.10	90.95	76.23	2.83
Crude fibre (%)	72.69^{a}	63.41^{b}	5.76	62.04	77.44	66.50	66.24	3.29
Nitrogen free extract (%)	86.18^{a}	84.42^{b}	1.09	83.97^{c}	88.32^{a}	84.63^{ab}	84.30^{b}	1.01
Ash (%)	76.33	71.43	2.63	77.49^{a}	73.86^{b}	72.79^{b}	71.39^{c}	1.30

$^{a, b, c, d}$ Means in the same row with different superscripts differ significantly ($P < 0.05$).

weight gain of birds with cooking of the BFM while it decreased ($P < 0.05$) with increase in inclusion level of BFM. The interaction between processing and inclusion levels of BFM was significant ($P < 0.05$) for daily weight gain, feed/gain and protein efficiency ratio. The growth of poultry has frequently been shown to be reduced by presence of anti-nutritional inhibitors in the diet may be because some of them if not all reduce utilization of energy, protein and specific amino acids (Trevino *et al.,* 1992 ; Elkin *et al.,* 1995). With these negative factors, the birds are able to meet their maintenance requirements but not their needs for tissue accretion. This eventually results in poor growth rates. The better weight gain of birds fed diets containing cooked BFM might be due to the effectiveness of the processing method in reducing the anti-nutritional factors contained in the BFM. The decrease weight gain of broilers with increased inclusion level of BFM indicates the nutritional inferiority of BFM compare to maize. There was no significant difference in feed intake across the treatments.

The feed/gain values tend ($P > 0.05$) to increase in the raw BFM and with increase in inclusion level of BFM. This indicates a reduced utilization of feed as the BFM inclusion level increased. This result is in support of Ortiz *et al.* (1994) who reported adverse effect of depressing factor on feed conversion ratio. There were no significant ($P > 0.05$) effect of processing and inclusion level of BFM on bird mortality. Nyachoti *et al.* (1997) reported that anti-nutritional factors do not usually result in mor-

Table 4. **Serum metabolites of broilers fed experimental diets**

Parameter	Raw breadfruit				Cooked breadfruit				
	0%	10%	20%	30%	0%	10%	20%	30%	±SEM
Total proteins (g/l)	33.00[d]	41.67[ab]	42.90[a]	42.00[ab]	33.00[d]	39.00[c]	40.67[b]	42.07[ab]	1.54
Uric acid (mg/dl)	8.03[a]	6.00[b]	7.00[ab]	4.00[c]	8.03[a]	6.00[b]	5.00[c]	5.00[c]	0.52
Albumin (g/l)	23.33[bc]	28.20[a]	26.97[ab]	24.00[b]	23.33[bc]	23.77[b]	23.50[b]	23.50[b]	0.67
Globulin (g/l)	9.67[d]	13.47[c]	15.93[bc]	18.00[b]	9.67[d]	15.23[bc]	17.17[b]	18.57[a]	7.24
Creatinine (mg/dl)	1.50	1.70	1.87	1.70	1.50	1.60	1.70	1.67	0.04
Cholesterol (mg/dl)	118.60[c]	123.53[bc]	140.57[a]	129.00[b]	118.60[c]	117.60[c]	120.43[bc]	105.83[d]	1.54
SGOT (iu/l)	19.67[ab]	21.67[a]	20.00[ab]	16.00[b]	19.67[ab]	14.00[c]	14.00[c]	10.00[d]	1.93
SGPT (iu/l)	11.67[bc]	18.00[a]	15.00[b]	11.00[c]	11.67[bc]	7.67[d]	10.00[c]	6.00[d]	1.35

[a, b, c] : Means in the same row with different superscripts differ significantly ($P<0.05$).

Table 4. (Continuation) **Serum metabolites of broilers fed experimental diets**

Parameter	Processing method			Inclusion level (%)				
	Raw	Cooked	±SEM	0%	10%	20%	30%	±SEM
Total proteins (g/l)	40.42	38.67	1.09	33.00	40.37	41.48	42.03	2.26
Uric acid (mg/dl)	6.26	6.01	0.16	8.03[a]	6.00[b]	6.00[b]	4.50[c]	0.72
Albumin (g/l)	25.63	23.53	1.30	23.33	25.98	25.24	23.75	0.62
Globulin (g/l)	14.27	15.16	0.55	9.67[d]	14.35[c]	16.55[b]	18.28[a]	1.86
Creatinine (mg/dl)	1.69	1.61	0.05	1.50	1.65	1.77	1.68	0.06
Cholesterol (mg/dl)	127.93	115.63	2.64	118.60	120.57	130.05	117.47	2.98
SGOT (iu/l)	19.34	14.42	3.05	19.67	17.84	17.00	13.00	1.41
SGPT (iu/l)	13.92[a]	8.84[b]	3.15	11.67[b]	12.84[a]	12.50[a]	8.50[c]	0.99

[a, b, c] : Means in the same row with different superscripts differ significantly ($P<0.05$).

tality.

Cooking of BFM reduced ($P<0.05$) the crude fibre (CF), ash and nitrogen free extract (NFE) digestibility while NFE digestibility was increased. The digestibility of CF, NFE and ash were significantly ($P<0.05$) affected by the interaction between processing and inclusion level of BFM. The presence of oxalate in the diets has been reported to have the ability to form complexes with cations resulting in a reduced availability of calcium, magnesium, potassium, iron and copper and these reduced the absorption of these elements and render them biologically unavailable (Birk and Peri, 1980). But this study revealed that, ash digestibility reduced with cooking of the breadfruits, probably due to loss of minerals in water during cooking.

Serum Metabolites

Table 4 shows the serum metabolites of the birds. The values were within normal ranges (Sturkie, 1986). Processing of BFM had no effect ($P>0.05$) on the measured parameters except serum glutamate pyruvate transaminase (SGPT) which was reduced ($P<0.05$) with processing of BFM. Serum albumin concentration is not a very sensitive index of protein adequacy. A drop in serum albumin of blood was observed only after prolonged periods of protein inadequacy (Eggum, 1989). Ekpenyong and Biobaku (1986) reported that the values of serum glutamate oxalo-acetate transaminase (SGOT) and SGPT were normally low in blood. Eggum (1976) reported that activities of several enzymes decrease in animal suffering from protein inadequacy. The effect of inclusion level was significant ($P<0.05$) on the uric acid, globulin and SGPT. Uric acid decreased ($P<0.05$) while globulin increased ($P<0.05$) with increased inclusion level of BFM. No consistent trend was observed for the SGPT. The highest value was at 10 and 20% BFM while the least value was at 30% BFM. Three factors influence blood urea concentration : the quality of protein in the diet, the quantity of protein in the diet, and the time of sampling after feeding (Eggum, 1976). The three factors were similar in the dietary treatments except the quality of the protein mixture. The low blood uric acid levels of birds with increasing level of BFM indicated a higher utilization of the protein. Oduguwa *et al.* (2000) found a high negative correlation between biological value of dietary

Table 5. **Carcass traits of broilers fed experimental diets**

Parameters	Raw breadfruit				Cooked breadfruit				
	0%	10%	20%	30%	0%	10%	20%	30%	±SEM
Dressing percentage (%)	76.30	92.92	87.73	82.61	76.30	86.30	92.41	88.48	2.29
Live weight (g/bird)	2009.2[b]	1990.00[bc]	1766.70[c]	1640.00[d]	2009.20[b]	2057.70[ab]	1867.70[bc]	2102.00[a]	56.14
Cut parts and organs (as percent liveweight)									
Head	3.41	3.48	3.47	3.37	3.41	3.26	3.47	3.28	0.033
Neck	4.90[b]	5.55[a]	5.57[a]	5.15[ab]	4.90[b]	4.98[ab]	5.46[a]	4.90[b]	0.11
Breast	19.07[c]	18.50[c]	16.20[d]	24.62[b]	19.07[c]	24.63[b]	21.11[c]	29.33[a]	1.53
Back	18.24	22.87	15.85	16.11	18.24	21.54	20.63	27.59	1.32
Drums tick	8.60[d]	11.13[a]	10.37[b]	9.31[c]	8.60[d]	8.97[cd]	9.86[bc]	8.87[cd]	0.32
Thighs	9.60[c]	10.67[d]	10.30[b]	9.67[c]	9.60[c]	9.19[d]	9.96[bc]	9.96[bc]	0.16
Shanks	2.58[d]	3.26[a]	2.99[b]	2.93[b]	2.58[d]	2.66[c]	2.89[b]	2.80[bc]	0.08
Wings	7.97	8.54	8.07	8.19	7.97	7.91	8.62	7.82	0.10
Heart	0.39	0.44	0.41	0.40	0.39	0.40	0.41	0.42	0.01
Kidney	0.55	0.67	0.60	0.51	0.55	0.51	0.55	0.49	0.02
Lungs	0.40	0.49	0.45	0.44	0.40	0.41	0.44	0.41	0.01
Liver	1.87	2.23	2.08	1.99	1.87	1.97	2.02	1.94	0.04
Gizzard	2.00	2.40	2.22	2.10	2.00	2.02	2.21	2.00	0.05
Abdominal fat	2.42[a]	0.82[cd]	0.12[d]	0.06[d]	2.42[a]	2.06[c]	2.90[b]	2.31[c]	0.39
Small intestine	3.57[c]	4.54[a]	4.60[a]	4.68[a]	3.57[c]	3.88[b]	3.95[b]	3.90[b]	0.14
Large intestine	0.15	0.20	0.23	0.20	0.15	0.20	0.20	0.20	0.01

[a,b,c], Means in the same row with different superscripts differ significantly ($P<0.05$).

Table 5. (Continuation) **Carcass traits of broilers fed experimental diets**

Parameters	Processing methods			Inclusion level (%)				
	Raw	Cooked	±SEM	0%	10%	20%	30%	±SEM
Dressing percentage (%)	84.89	86.26	0.85	76.30	85.44	90.07	90.54	3.30
Live weight (g/bird)	1851.48[b]	2005.15[a]	97.79	2009.20[b]	2023.83[a]	1812.28[d]	1821[c]	57.37
Cut parts and organs (as percent liveweight)								
Head	3.43	3.35	0.05	3.41	3.37	3.47	3.30	0.53
Neck	5.38	5.06	0.20	4.90	5.24	5.57	5.03	0.13
Breast	19.59[b]	23.54[a]	2.45	19.07	18.78	18.65	26.99	2.04
Back	18.26	22.00	2.32	18.24	19.27	18.24	24.85	1.59
Drums tick	9.07	9.85	0.48	8.60	10.05	10.11	9.09	0.37
Thighs	9.86[b]	10.06[a]	0.12	9.60	10.79	9.74	9.82	0.15
Shanks	2.94	2.73	0.13	2.58	2.96	2.94	2.86	0.09
Wings	8.19	8.08	0.07	7.97	8.22	8.34	8.01	0.09
Heart	0.41	0.40	0.01	0.39	0.42	0.41	0.41	0.01
Kidney	0.58	0.53	0.03	0.55	0.57	0.53	0.53	0.01
Lungs	0.45	0.42	0.02	0.40	0.59	0.45	0.43	0.04
Liver	2.04	1.95	0.06	1.87	2.10	2.05	1.96	0.05
Gizzard	2.18	2.06	0.07	2.00	2.21	2.20	2.05	0.05
Abdominal fat	0.6	2.42	0.96	2.42	1.44	1.51	1.19	0.27
Small intestine	4.39[a]	3.83[b]	0.22	3.57[c]	4.21[ab]	4.27[a]	3.99[c]	0.16
Large intestine	0.19	0.18	0.01	0.15	0.20	0.21	0.20	0.01

[a,b,c], Means in the same row with different superscripts differ significantly ($P<0.05$).

protein and blood urea concentration.

Carcass Evaluation

The carcass evaluation data are presented in Table 5 and 6. The breast muscles, drumstick and thigh are the most economically important portion of the carcass composition and also provide the greatest portions of edible meat in broilers (Smith and Teeter, 1987 ; Fanimo *et al.,* 1996). The relative muscle weights of these three cuts were significantly ($P<0.05$) higher while there was a significant decrease in small intestine weight in cooked BFM. There was also a marginal decrease ($P>0.05$) in liver and gizzard weights in the cooked BFM. Inclusion level of BFM had no significant (P

Table 6. **Sensory evaluation and meat compositional profile of broilers fed experimental diets**

Parameters	Raw breadfruit				Cooked breadfruit				
	0%	10%	20%	30%	0%	10%	20%	30%	±SEM
Juiciness	5.40	5.23	5.13	4.93	5.40	5.00	5.20	5.50	0.07
Tenderness	6.03	6.33	6.43	6.20	6.03	6.07	6.13	6.07	0.05
Flavour intensity	6.37	6.20	6.50	6.17	6.37	6.00	6.10	5.80	0.07
Off flavour	5.57	5.43	5.50	5.87	5.47	5.43	5.57	5.59	0.05
Crude protein (%)	29.44[b]	30.69[ab]	25.51[d]	31.32[d]	29.44[b]	30.89[a]	30.99[a]	30.87[a]	0.63
Fat (%)	8.06	7.84	8.05	8.18	8.06	8.04	8.09	8.84	0.10
Nitrogen free extract (%)	53.99	53.63	52.93	51.42	53.99	52.41	55.25	50.81	0.48
Ash	8.51[c]	7.88[d]	9.51[a]	9.07[ab]	8.51[c]	8.67[b]	8.37[d]	9.47[a]	0.18
Dry matter (%)	94.24	96.74	97.04	95.64	94.24	95.92	93.92	94.75	0.39

[a,b,c], Means in the same row with different superscripts differ significantly ($P<0.05$).

Table 6. (Continuation) **Sensory evaluation and meat compositional profile of broilers fed experimental diets**

Parameters	Processig types			Inclusion level (%)				
	Raw	Cooked	±SEM	0%	10%	20%	30%	±SEM
Juiciness	5.17	5.28	0.05	5.40	5.12	5.16	5.22	0.05
Tenderness	6.25	6.08	0.07	6.03	6.2	6.28	6.14	0.05
Flavour intensity	6.31	6.07	0.15	6.37	6.10	6.30	5.99	0.08
Off flavour	5.59	5.52	0.03	5.57	5.43	5.33	5.70	0.05
Crude protein (%)	29.24	30.55	0.57	29.44	30.75	28.25	31.09	0.56
Fat (%)	8.03	8.26	0.10	8.06	7.94	8.05	8.50	0.11
Nitrogen free extract (%)	52.99	53.12	0.06	53.99	53.02	54.05	51.11	0.59
Ash	8.74	8.76	0.01	8.51	8.28	8.94	9.27	0.19
Dry matter (%)	95.92	94.54	0.61	94.24	96.00	95.48	95.20	0.32

[a,b,c], Means in the same row with different superscripts differ significantly ($P<0.05$).

>0.05) effect on the cut parts and organ weights. The dressing percentage values were within the range of 69.8% to 93.9% reported for broilers by Longe (1986) and Bolu and Balogun (2003). The interaction between processing and level of inclusion of BFM was significant ($P<0.05$) for relative weights of neck, breast, drumstick, thighs, shanks, abdominal fat and small intestine. The result of the abdominal fat indicated that the control diet (0% BFM) had the highest (2.42%) while the lowest (0.12%) was recorded in diet containing 20% raw BFM. Birds fed diet containing raw BFM had the highest intestinal weight, while inclusion of breadfruit increased its weights. This could be due to the increase in size, length and thickness of the intestine in response to tannin and oxalate. Vohra *et al.* (1966) reported sloughed oesophageal epithelium, thickening of the crop wall in bird fed tannin containing diet. Mitjuvila *et al.* (1977) also reported necrosis of the gastric duodenal mucosal and erosion of the superficial mucosa, such effect could reduce the absorptive capacity of the gastro-intestinal tract, thus contributing to the poor animal performance observed when tannin / oxalate containing diets are fed.

The processing methods, inclusion level and the interaction between the processing and inclusion levels had no significant influence on sensory quality of the meat sample from broilers fed the diets. The off-flavour scores were above the threshold of five (5) indicating that no off-flavour was detected. Meat composition indicated no significant effect of processing and inclusion level on meat crude protein, fat, NFE, ash and dry matter indicating that the BFM had no adverse effect on the composition of the meat. Meat crude protein and ash were affected ($P<0.05$) by interaction between processing and inclusion level.

Economy of Feed Conversion

The inclusion of BFM led to a reduction in the cost of feed (Table 7). Also, the total cost of feed consumed per bird and cost of feed per kg weight gain decreased ($P<0.05$) as expected in the BFM diets, since the relatively cheaper BFM replaced the

Table 7. **Economic benefit of feed conversion of broilers fed the experimental diets**

Parameters	Raw BFM 0%	10%	20%	30%	Cooked BFM 0%	10%	20%	30%	±SEM
Initial body weight(g/bird)	162.50	160.00	160.00	160.00	162.50	161.00	161.00	162.00	1.08
Final body weight gain (g/bird)	2009.20	1990.00	1766.70	1640	2009.20	2057.70	1867.70	2102.00	0.05
Total weight gain (g/bird)	1846.70	1830.00	1606.70	1480.00	1846.70	1896.70	1706.70	1940.00	0.05
Total feed consumed (kg/bird)	5.19	5.18	5.16	5.14	5.19	5.20	5.20	5.19	0.01
Cost of feed/ kg diet (N)	45.60	42.91	40.22	37.49	45.60	42.91	40.22	37.49	1.07
Cost of feed consumed/bird (N)	236.66[a]	222.27[a]	207.54[b]	192.70[c]	236.66[a]	233.13[a]	209.14[b]	194.57[c]	0.60
Cost of feed / kg weight gain(N)	128.20[a]	121.46[b]	129.23[a]	130.20[a]	128.20[a]	117.98[c]	122.94[b]	100.26[d]	0.33

Replacement level of breadfruit.

a,b,c, Means in the same row with different superscripts differ significantly ($P<0.05$).

Table 7. (Continuation) **Economic benefit of feed conversion of broilers fed the experimental diets**

Parameters	Processing type: Raw	Cooked	±Sem	Inclusion level (%): 0%	10%	20%	30%	±SEM
Initial body weight(g/bird)	160.63	161.38	0.26	162.50	160.50	160.50	160.50	0.43
Final body weight gain (g/bird)	1851.48	2009.15	0.05	2009.20	2023.05	1817.20	1871.00	0.04
Total weight gain (g/bird)	1690.85	1847.53	0.05	1846.70	1863.35	1656.70	1710.00	0.04
Total feed consumed (kg/bird)	5.16	5.20	0.01	5.19	5.19	5.18	5.18	0.00
Cost of feed/ kg diet (N)	41.56	41.56	0.00	45.60	42.91	40.22	37.49	1.51
Cost of feed consumed/bird (N)	164.80[b]	218.38[a]	0.20	236.66[a]	227.70[a]	208.34[b]	193.64[c]	0.84
Cost of feed / kg weight gain(N)	127.27[a]	117.35[b]	0.35	128.20[a]	119.72[b]	126.09[a]	115.23[b]	0.02

Replacement level of breadfruit.

a,b,c, Means in the same row with different superscripts differ significantly ($P<0.05$).

more expensive maize. Total cost of feed consumed per bird was higher ($P<0.05$) in cooked BFM but the cost of feed per kg weight gain decreased ($P<0.05$) in the cooked BFM. This shows that birds on the cooked BFM with relatively higher cost of feed consumed per bird brought about the most efficient economy of feed conversion, with the least cost of producing one kilogramme liveweight gain. Phillip (1984) reported that reducing feed cost was not only to obtain cheaper feed but that it was also dependent on the production result obtained with this cheaper feed. The result of this study therefore agreed with his conclusion that the efficiency with which the feed was utilized was that which was of major importance as observed with the cheapest cost of feed conversion obtained with cooked BFM. It can therefore be inferred from the results that cooked BFM diets were the most efficient in terms of the economy of feed conversion while BFM-based diets were most efficient in terms of the economy of feed conversion bringing about gains comparable to those of the maize-based control at the cheapest cost.

In conclusion, cooked BFM can adequately replace dietary maize, support attainment of mature body weight, good carcass yield and sustain normal serum biochemistry in broiler chickens.

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