Growth Performance and Nutrient Retention of Broiler Chickens Fed *Aspergillus niger* Hydrolysed Cassava Peel Based Diet

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ABSTRACT

The effect of *Aspergillus niger* hydrolysis on cassava peel meal based diet on the growth performance and nutrient retention of broiler chickens was studied. Delignified cassava peel was used as the carbon source in a composed medium under a pH of 5.0, concentration 3% and 35^{o}C to grow *Aspergillus niger* for five days. The culture filtrate obtained was then used to hydrolyze delignified cassava peel used as replacement for maize in broiler chicken feed at 25%, 50%, 75% and 100% respectively to meet the nutrient requirement of broilers. A total of thirty six, two weeks old unsexed broiler chickens with average initial bodyweight of 0.685±0.0027g were divided into six groups A to F (two replicates of three chickens per group) and allocated to six dietary treatments. Growth and cost of production of the chickens decreased significantly as the cassava inclusion increases ($P<0.05$) while nutrient retention also decreased significantly ($P<0.05$) as inclusion level of cassava increases. All chickens fed on hydrolyzed cassava peel (A to E) recorded 0% mortality while those in group F fed on unhydrolyzed cassava peels recorded 100% mortality at the end of the 42 days feeding trials. It was then concluded that maize can be replaced with up to 50% hydrolyzed cassava peels in chicken feed without deleterious effects.

Key words: cellulolytic culture filtrate, cassava peel, broiler, *Aspergillus niger***,** hydrolysis, Growth

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1.0 INTRODUCTION

Basically, feedstuffs consist of protein, starch, fat and fiber. In monogastric animals, the fiber component has been considered to be wasted and in some instances, compounds called Non-starch polysaccharides (NSP) can exert anti-nutritive activity on the animal. Cassava peel is very rich in carbohydrate but has high fibre content that makes it indigestible to monogastrics when included in their feed. Fungi have been shown to have cellulase enzyme which can degrade the fibre in cassava peel thereby making available more energy to monogastrics from hydrolysis of the fibrous materials (Sani *et.al.*,1992; Raji *et.al*.,1998; Belewu and Banjo, 1999).This ultimately promotes weight gained and overall improved performance (Atteh,2000; Abdulrashid *et.al*., 2007). Enzyme addition to monogastric feed reduced viscosity of the digester in the intestine as opposed to a situation of association with digestion of cereal grain and (by –products) and showed a marked improvement on the various morphological effect of feeding fibrous materials to non- ruminant. Dietary supplementation with microbial enzyme preparations are capable of hydrolyzing endosperm cell walls and has increased performance of broiler chickens receiving cereal based diets (Atteh, 2000; Abdulrashid *et al.*,2007; Apata, 2009 and Kayode,2009.). The effect of carbon source replacement of maize in broiler chicken feed is well documented. (Atteh , 2000; Abdulrashid *et al.,* 2007; Kayode , 2009 and Mohammad and Oloyede, 2009).

However, information on the effect of hydrolyzed cassava peel as maize replacement on the growth performance and nutrient retention are very scanty in literatures. The current study therefore investigated the effect of fungal hydrolyzed cassava peel as main energy source in broiler chicken feeds on the growth performance and nutrient retention of the chickens after 42 days of feeding trials.

2.0 MATERIALS AND METHODS

Aspergillus niger was isolated from cassava peel collected from cassava peel dumpsite. A modified method of Ali *et.al.,* (1991) was used to delignify the cassava peel which was autoclaved for one hour at 121 ^{0}C with 5% (w/v) NaOH. The autoclaved materials were filtered through muslin cloth, neutralized with dilute acids (0.1M H_2SO_4), and then washed with water. They were finally washed in distilled water and dried at 70^{0}C in a regulated oven (Gallenkamp). Each was then grinded with domestic blender (Nakai, Japan Mx- 736) for increased surface area. Mineral salts medium (MSM) was prepared for cultivation of fungal isolate using the compositions as shown below {g/l}.

KH_2PO_4 ,10g;$(NH4)_2SO4$,10.5 g ; $MgSO_4.7H_2O$, 0.3g; $CaCl_2$, 0.5 g; $FeSO_4$, 0.013g ; $MnSO_4.H_2O$ 0.04; $ZnSO_4.7H_2O$ 0.04; Yeast extract 0.5g; Cassava peel (40g). *Aspergillus niger* was grown in this composed medium under a pH of 5.0, concentration 3% and 35^{o}Cfor five days after which the culture filtrate was filtered with whatman under suction. 100ppm of the cellulase enzyme was incorporated into cassava peel so as to hydrolyze it. The cassava peel was then air dried and then used to replace maize in broiler chicken feeds for groups A to E (0% , 25% , 50% , 75% and 100% respectively). Also, unhydrolyzed cassava peel was used to replace maize 100% for group F. Starter and finisher diets at 0%, 25%, 50%, 75% and 100% replacement value for maize were composed to meet the NRC (1984) nutrient requirement of broiler chickens. The chickens were fed starter diet for the first three weeks of the feeding trials and then fed finisher diets from the fourth to the sixth week. Soya bean oil was added to obtain equal metabolizable energy.

2.1 Chickens Grouping and Feeding

The chickens were randomly allocated to six dietary treatments A - F using a completely randomized design. Each treatment group contained two replicates of three broiler chickens each. Group A chickens (A_1 and A_2) were fed with the control diet (0% hydrolyzed cassava peel as main carbon source). Groups B-E (in replicates 1 and 2) were administered with experimental diets containing 25%, 50%, 75%, 100% of hydrolyzed cassava peels respectively replacing maize while group F (F_1 and F_2) were fed with diet containing 100% unhydrolyzed cassava peels replacing maize as the main carbon source. Feed and water were supplied *ad libitum* for the six weeks feeding trial period. Vaccine and drugs were administered as at when due. Records of feed consumption and body weight were taken weekly. Body weight gain, cost of production and feed to weight gained ratio (Feed Conversion Ratio) were estimated from the data collected. Nutrient retention was also evaluated from the data collected.

3.0 RESULTS AND DISCUSSIONS

The results from this study showed that feeding chickens with hydrolyzed cassava peel as maize replacement in diet had beneficial effects on body weight gained, cost of production and nutrient retention. At 42 days, feed intake and body weight were significantly affected by dietary treatments, Chicks fed 0%, 25% and 50% maize replacement by cassava peel recorded better body weights than those fed 75% and 100% maize replacement ($P < 0.05$). The average feed intake of the feed for the six weeks differ significantly ($P < 0.05$) while the weight gained also differ significantly across the six weeks of feeding trials ($P < 0.05$). Clearly, a number of scientific resaerches and commercial field observation regarding the replacement of feed components by cheaper sources with no serious deleterious consequences are available in literatures.(Oruwari *et al.*, 1995; Atteh 2000; Adebiyi,2007; Kayode,2009; and UNEP,2009). In this study, the feed intake and weight gained reduced significantly as the amount of cassava supplement increases in the feed as shown in Tables 1 and Table 2 respectively. The higher values of feed intake and nutrient retention in addition to the subsequent higher values of weight gained of the birds as the age increases indicated that there was a better utilization of the nutrients with increase in the age of the chickens. The weight gain of the chickens in groups A to C was significantly higher (P< 0.05) than that of D and E showing that the birds were able to retain more nutrients from the diets that aided the development of the muscles which is consistent with earlier reports. However, there was no significant difference in the weight gained of chickens that fed on 0%, 25% and 50% hydrolyzed cassava peel as carbon source meaning that their diets were more acceptable to the birds and seem adequate for the growth and development of the chickens during the six weeks feeding trials as compared to the other treatments that fed on 75% and 100% hydrolyzed cassava peel as carbon source in feed(Tables3)

The steady decline in body weight gain of the broilers as the cassava replacement increased in the diets may be attributed to the concomitant reduction in feed intake with increase in the inclusion levels of cassava peels. The reduction in feed intake may be associated with the residual cyanide which is inherent in cassava peels. The progressive decrease in nutrient retention and the observed increase in feed conversion ratio with increase in the inclusion level of the hydrolyzed cassava peels may be attributed to the fact that cyanide has binded and probably complexed with some nutrients thereby obstructing nutrient absorption and complete utilization of the diets (Kayode,2009).There could also be deconjugation of bile salts that resulted in poor feed conversion ratio observed in the diets containing higher inclusion of cassava peels.(Table 4)

Amuchie (2001) also reported that anti- nutritional factors in the diet of any livestock specie may negative effects such as reduction in palatability, digestibility and utilization of ration, intoxication of different classes of livestock, resulting in mortality or decreased production of animal and reduction in quality of meat, eggs and milk products due to the presence of hazardous residues. There were no physical deformities on the birds fed with all classes of feeds in groups A to E for the six weeks trial period. All the birds were active and the group fed 100% hydrolyzed cassava peels was more aggressive than the others probably due to insufficient energy available to them in their feed.

The feed to weight gain ratio of the experimental chickens is shown in Table 5. There was no significant difference in the feed to weight gained ratio of chickens in groups A (0%) to C (50% maize replacement) but there are significant differences in the feed to gain ratio of the chickens in groups D (75% maize replacement) and E (100 % maize replacement). The highest feed to weight gain ratio was in A (1.45) while the lowest feed to weight gain ratio was in E (2.37).

The economy of production of broiler chickens fed on hydrolyzed cassava peels as main carbon source in feeds is as shown in Table 4, Cost of feed, total feed intake, total weight gained, cost per weight gained, marginal cost/kilogram flesh and marginal revenue per kilogram flesh were considered. There was progressive decrease in cost per weight gained from chickens in group A to E with increase in inclusion level of cassava peel (₦ 72 in A to ₦26 in E). Relative cost benefit increased progressively as inclusion level of hydrolyzed cassava peels increases being ₦41.15 in E and # 10.15 in B. cost differential of E was also highest and least in A. There are significant differences ($P<0.05$) in the total weight gained per bird as well as the total feed intake from Groups A to E(Table 6).

The nutrient retention in broiler chickens fed hydrolzed cassava peel substitute at 0%, 25%, 50%, 75% and 100% respectively are as shown in Table 7. The dry matter as well as the crude protein reduced as the cassava inclusion increases in the feed although not uniformly. Also, crude fibre and crude fat reduces as the cassava inclusion level increases in the feed. However, the total ash increases in the feed as the cassava inclusion level increases in the feed.

Table1: Composition of the experimental broiler starter diet (%)

Ingredients	A (0%) Control	B (25%) Cpm	C (50%) Cpm	D (75%) Cpm	E (100%) Cpm	F (100%) Cpm
Maize	45.00	33.75	22.50	11.25	-	-
Hydrolyzed Cassava peels	-	11.25	22.50	33.75	45	-
Unhydrolyzed Cassava peel	-	-	-	-	-	45
Soya bean meal	15.00	15.00	15.00	15.00	15.00	15.00
Groundnut cake	20.00	20.00	20.00	20.00	20.00	20.00
Brewers dried grain	10.00	10.00	10.00	10.00	10.00	10.00
Wheat offal	4.45	3.95	3.45	2.95	2.45	1.95
Fish meal (72%)	1.50	1.50	1.50	1.50	1.50	1.50
Soya Bean oil	0.50	1.0	1.50	2.00	2.50	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Oyster shell	0.30	0.30	0.30	0.30	0.30	0.30
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30	0.30
*Vit/min premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100
Proximate Composition						
Crude Protein(%)	24.42	23.86	23.30	22.74	22.17	22.17
Crude Fibre (%)	4.25	4.41	4.55	4.71	4.86	7.63
Metabolizable Energy (Kcal/kg)	2811.86	2649.72	2480.60	2332.13	2183.66	2183.66

* Vit. A,, 4,000,000 IU; Vit. D3, 800,000 IU; Tocopherols, 4,000 IU; Vit. K3, 800mg; Folacin, 200 mg; Thiamine, 600 mg; Riboflavin, 1,800 mg; Niacin,6,000 mg; Calcium Panthothenate, 2,000 mg; Pyridoxine, 600 mg; Cyanocobalamin,4 mg; Biotin, 8 mg; Manganese, 30,000 mg; Zinc, 20,000 mg; Iron,8,000 mg; Choline chloride, 80,000 mg; Copper, 2,000mg; Iodine, 480 mg; Cobalt, 80 mg; Selenium, 40 mg; BHT, 25,000; Anticaking agent, 6,000 mg. Cpm is cassava peel meal. Values were calculated from published composition of the ingredients (NRC,1984) while Metabolizable energy was calculated from its predicted data(Pauzenga,1985).

Table 2: Composition of the Experimental Broiler Finisher Diet (%)

Ingredients	A (0%) Control	B (25%) Cpm	C (50%) Cpm	D (75%) Cpm	E (100%) Cpm	F (100%) Cpm
Maize	45.00	33.75	22.50	11.25	-	-
Hydrolysed Cassava Peels	-	11.25	22.50	33.75	45	-
Unhydrolyzed cassava peel	-	-	-	-	-	45
Soya bean meal	8.00	8.00	8.00	8.00	8.00	8.00
Groundnut cake	15.00	15.00	15.00	15.00	15.00	15.00
Brewers dried grain	10.00	10.00	10.00	10.00	10.00	10.00
Wheat offal	15.50	15.00	14.50	14.00	13.50	13.00
Fish meal (72%)	1.50	1.50	1.50	1.50	1.50	1.50
Soya bean oil	0.50	1.0	1.50	2.0	2.50	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Oyster shell	0.30	0.30	0.30	0.30	0.30	0.30
Salt (Nacl)	0.50	0.50	0.50	0.50	0.50	0.50
*Vit/min premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Proximate Composition						
Crude Protein(%)	24.42	23.86	23.30	22.74	22.17	22.17
Crude Fibre (%)	4.25	4.41	4.55	4.71	4.86	7.63
Metabolizable Energy (Kcal/kg)	2811.86	2649.72	2480.60	2332.13	2183.66	2183.66

* Vit. A,, 4,000,000 *Vit. D3, 800,000 IU; Tocopherols, 4,000 IU; Vit. K3, 800mg; Folacin, 200 mg; Thiamine, 600 mg; Riboflavin, 1,800 mg; Niacin,6,000 mg; Calcium Panthothenate, 2,000 mg; Pyridoxine, 600 mg; Cyanocobalamin,4 mg; Biotin, 8 mg; Manganese, 30,000 mg; Zinc, 20,000 mg; Iron,8,000 mg; Choline chloride, 80,000 mg; Copper, 2,000mg; Iodine, 480 mg; Cobalt, 80 mg; Selenium, 40 mg; BHT, 25,000; Anticaking agent, 6,000 mg. Cpm is cassava peel meal.Values were calculated from published composition of the ingredients(NRC, 1984) while Metabolizable energy was calculated from its predicted data(Pauzenga,1985)

Table 3 : Daily feed intake of experimental chickens

Treatment	Week 1 (g/bird/day)	Week 2 (g/bird/day)	Week3 (g/bird/day)	Week 4 (g/bird/day)	Week 5 (g/bird/day)	Week 6 (g/bird/day)
A	38.57^{a}	61.43^{b}	71.43^{c}	100.00^{d}	134.29^{fe}	194.29^{f}
B	34.29^{a}	50.00^{b}	60.00^{ab}	74.29^{ac}	111.43^{d}	142.89^{e}
C	37.14^{a}	52.86^{ac}	57.14^{ac}	67.14^{b}	100.00^{d}	137.14^{e}
D	34.29^{a}	37.14^{a}	47.14^{b}	62.86^{c}	91.43^{d}	104.29^{de}
E	34.29^{a}	38.57^{a}	38.57^{b}	51.43^{c}	68.57^{bc}	100.00^{d}

[abc]..Means on the same row with the same superscript are significantly different ($P < 0.05$) Values are means of three replicate determinations.

Table 4: Changes in weights of chickens over the six weeks feeding trial Period.

Sample Diets	Week 1 (g/Bird/Day)	Week 2 (g/Bird/Day)	Week 3 (g/Bird/Day)	Week 4 (g/Bird/Day)	Week 5 (g/Bird/Day)	Week 6 (g/Bird/Day)	SEM
A	22.86^{a}	25.71^{a}	62.86^{b}	78.86^{ab}	108.57^{c}	114.29^{d}	3.20
B	25.71^{a}	27.14^{a}	42.86^{b}	52.86^{c}	67.14^{d}	88.57^{de}	1.96
C	27.14^{a}	25.71^{a}	28.57^{a}	41.43^{b}	70.00^{c}	88.57^{d}	1.67
D	25.71^{a}	30.00^{a}	28.57^{a}	35.71^{b}	64.29^{c}	91.43^{d}	0.70
E	20.00^{a}	21.20^{a}	22.25^{a}	24.36^{a}	25.40^{a}	26.46^{a}	0.05

[abcd] Values are means of three replicates determinations; SEM = Standard error of mean. Means with different superscripts in a row are significantly different ($P < 0.05$).

Table 5: Feed to weight gain ratio of the experimental chickens

Parameters	A (0%) Cpm	B (25%) Cpm	C (50%) Cpm	D(75%) Cpm	E (100%)Cpm
Feed Intake (g/Bird)	600.62^{e}	472.90^{d}	451.52^{c}	377.18^{b}	331.43^{a}
Weight Gained (g/Bird)	413.15^{a}	304.28^{b}	281.42^{c}	184.28^{d}	139.67^{e}
FCR (Feed to gain Ratio)	1.45^{a}	1.55^{b}	1.60^{b}	2.05^{c}	2.37^{d}

[abcde]Means with different superscripts in a row are significantly different (p<0.05).
Cpm = Cassava peel meal. FCR = Feed Conversion Ratio

Table 6: Economy of production of broiler chickens fed on hydrolyzed cassava peels as main carbon source in feeds

Parameters	A (0 %) Cpm	B (25%) Cpm	C(50%)Cpm	D (75%) Cpm	E (100%)Cpm
Cost of Feed(₦/kg)	72.00^{e}	60.50^{d}	49.00^{c}	37.50^{b}	26.00^{a}
Total feed intake /Bird/kg	4.20^{c}	3.31^{cd}	3.16^{b}	2.64^{b}	2.320^{a}
Cost of feeding a Bird (#)	302.40^{a}	200.26^{b}	154.84^{c}	99.00^{d}	60.32^{e}
Total weight gained /Bird/kg	2.89^{a}	2.13^{b}	1.97^{ab}	1.29^{c}	0.98^{d}
Cost/weight gained (#/kg)	104.64^{a}	94.02^{b}	78.60^{c}	76.74^{d}	61.55^{e}
Cost differential (#/Kg)	0.00	10.62^{a}	26.04^{b}	27.90^{b}	43.09^{c}
Relative Cost Benefit (%)	0.00	10.15^{a}	24.89^{b}	26.66^{b}	41.15^{c}

[abcdef] Means with different superscripts in a row are significantly different (P<0.05).

Table 7: Nutrient retention of broiler chicken fed with maize replacement by cassava peels

Dietary Treatment	Dry Matter (%)	Crude Protein (%)	Crude Fat (%)	Crude Fibre (%)	Total Ash (%)
A	78.00^{a}	90.10^{a}	90.00^{a}	63.02^{a}	75.91^{d}
B	73.34^{b}	85.45^{b}	88.36^{a}	54.70^{b}	78.42^{c}
C	69.40^{c}	86.70^{ab}	87.00^{a}	50.75^{c}	80.91^{b}
D	72.50^{b}	84.06^{b}	83.95^{b}	57.62^{b}	83.92^{ab}
E	78.00^{a}	81.89^{c}	81.96^{c}	60.70^{a}	85.09^{a}

^{abcd}Means on the same row with different superscript are significantly different ($P < 0.05$).
Values are mean of three replicates

CONCLUSIONS

It is well recognised that cassava peel has high cyanide and fibre contents making it unacceptable to monogastrics as it affects their digestibility and performance. The use of microbial enzymes has reduced the fibre and cyanide content in chicken feeds such that they lower net feed costs and cost of production

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