

Original Research Article

Comparative evaluation of composite cassava root meal, palm oil and crayfish waste mixture as substitute for maize in broiler chicken diet

ABSTRACT

Aim: To investigate the response of broiler chickens to diets containing levels of composite cassava root meal, palm oil and Cray fish dust (CCPCM) as replacement for maize.

Study Design: The experiment involved three treatments with three replicates per treatment in a Completely Randomized Design.

Place and Duration of Study: The study was carried out in the Teaching and Research Farm of the University of Calabar, Nigeria, between September 2014 and December, 2014.

Methodology: Three hundred (300) one week old unsex broiler chicks were randomly allotted to five dietary treatments consisting of three replicates of 20 birds each. The control diet (T1) contained 56% maize which was replaced with 25%, 50%, 75% and 100% of CCPCM to form T2, T3, T4 and T5 respectively. The mixture was in such that it insinuates the maize in Crude Protein and Metabolisable energy (Iso-nitrogenous and Iso-Calorie). After 21 day of feeding the experimental meal, two hundred and forty of the birds were further re- randomized into 5 dietary treatments of three replicates. The control diet (T1) contained 60% maize and was replaced with 25%, 50%, 75% and 100% of CCPCM. The diets were all made to be iso-nitrogenous and iso-caloric.

Results: The Final Live Weight (FLW), weight gain (WG) and Feed Conversion Ratio (FCR) did not vary significantly with the control up to 50% at Chick phase and up to 75% at Finisher phase but above this levels they showed significant ($P=0.05$) depression. Feed intake at starter phase were significantly ($P=0.05$) affected only at above 50% replacement of maize with CCPCM while At the finisher phase the feed intake were not significantly affected by the levels of CCPCM in the diets. Cost of feed per kg decreased while cost of feed per kg live weight gain increased ($P=0.05$) with increasing level of CCPCM up to 75% inclusion level.

Conclusion: It was concluded that 50% and 75% CCPCM could replace maize in broiler starter and finisher diets respectively.

-keywords: Composite cassava root meal, palm oil, Cray fish dust, broiler chickens

1. INTRODUCTION

The highly growing demand for maize as a result of its use in most livestock feeds, as food to man and as well as raw materials for industries, has in turn raised its market price beyond the reach of an average Nigerian farmer [1,2]. Thus research for cheaper feedstuffs has been the concern of animal nutritionists [3,4,5].

Cassava root meal is a less well known source of energy in livestock feed. This is because of its bulkiness, low level of protein (1.2-2.4%) which is low quality, relatively low level of energy (2360Kca/kg) when compared to maize and its high levels of Linamarin and Lotaustralin, a cyanonogenic glucoside which releases highly toxic hydrogen cyanide(HCN) during hydrolysis at the time of digestion[6,7].

The ease of cultivation, tolerance to draught and poor soil condition, lower cost of production, stable market price, all year availability makes it preferable to maize [8]. Supplementation of cassava meal with good Protein and energy sources like crayfish dust and palm oil respectively coupled with good processing methods such as cooking, sun drying, roasting, ensiling or fermentation to reduce or eliminate the hydrogen content before they are incorporated in diets could make it compete with maize [2].

Most of the fish meal used in poultry diets in Nigeria are not just expensive but are also contaminated and of poor quality, research for cheaper protein source to replace fish meal has been concern of animal nutritionist [3].

The use of Cray fish waste, as feed for various categories of livestock has been a continuous subject of investigation [4]. The use of Cray fish waste was explored in this experiment. Cray fish waste has been reported to constitutes over 70% of sea catch and on processing leaves the head, limbs, tails and so on to be waste that are often discarded. It is rich in protein that varies from 46.00 – 58.00% [9,10,4]. Is an essential protein source in broiler diets [10].

Most of the fish meal used in poultry diets in Nigeria are not just expensive but are also contaminated and of poor value. Palm oil has relatively 2-3 times more energy than maize per unit value [11,12]. It reduces dustiness [13,14]. Is one of the good sources of energy in broiler diets [14].

This study therefore is designed to investigate the effect of replacing maize with composite mixture of cassava root meal with Cray fish waste and palm oil in broiler birds' diets.

2. MATERIALS AND METHODS

2.1 Location of experiment:

The experiment was conducted at the University of Calabar Teaching and Research Farm of the Department of Animal Science, Calabar, Nigeria, between Sept, 2014 and Dec, 2014.

2.2 Test ingredients and diets

A local Variety (TMS-30572) of fresh cassava tubers, Cray fish waste, palm oil and maize were bought from Calabar. The cassava tubers were peeled, washed, milled in a hammer mill then squeezed using pressure technique, thereafter sieved through a mesh of 5mm, the crystalline dust were subjected to frying. The representative samples of the test ingredients were subjected to test for proximate analysis [15]. The cassava meal, Cray fish waste and palm oil were mixed in proportions that made the resulting mixture to have the same levels of protein and energy as the experimental maize through calculation and subsequent chemical analysis. The fortified meal was then used to replace maize at 0, 25, 50, 75 and 100% levels. The composition of the diets, are shown in Tables 1 and 2.

Table 1: Gross Composition of experimental Diet of Broiler Starter chicks with composite cassava root meal, palm oil and Cray waste mixture

INGREDIENTS	REPLACEMENT LEVEL OF MAIZE WITH FORTIFIED CASSAVA ROOT MEAL				
	0%	25%	50%	75%	100%
Maize	56.00	42.00	28.00	14.00	0.00
CCPCM	0.00	14.00		42.00	56.00
Soybean meal	34.00	34.00		34.00	34.00
Wheat offal	28.00	3.00	3.00	3.00	3.00
Palm kernel cake	34.00	2.00	2.00	2.00	2.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit/mineral premix*	0.25	0.25	0.25	0.25	0.25
Calculated analysis					
CP%	24.01	24.00	24.00	24.00	24.00
M.E.KCal/Kg	2890.90	2895.10	2897.00	2899.34	2901.28
Determined Analysis					
CP%	23.78	23.81	23.55	23.71	24.02
Crude fiber%	4.21	4.38	4.53	4.60	4.77
Ash%	6.42	6.23	6.12	6.06	6.01
Determined analysis (fortified cassava root meal mixture)					
CP%	9.98				
(M.E.)Kcal/Kg	3434.10				
Crude fiber%	4.56				
Ether extract %	4.97				

Ash% 5.43

*1 kg of premix contained the following: vitamin A(5000,000 I.U), Vitamin D3 (1,000,000 I. U.), Vitamin E (16,000mg), Vitamin K3 (800mg), Vitamin B1 (1,200mg), Vitamin B2 (22,000mg), Niacin (22,000mg), Calcium pantothenate (4,600mg), Vitamin B6 (2,000mg), Vitamin B12(10mg), Folic aci (400mg), Biotin (32mg), Cholin chloride (200,000mg), Manganese (48,000mg), Iron (40,000mg), Zinc (32,000mg), Copper (3,400mg), Iodine (600mg), Cobalt (120mg), Selenium (48mg), Antioxidant (48,00mg)

Table 2: Gross composition (%) of the experimental Diets of Broiler finisher birds with composite cassava root meal, palm oil and Cray fish mixture

INGREDIENTS	REPLACEMENT LEVEL OF MAIZE WITH COMPOSITE CASSAVA ROOT MEAL,PALMOIL AND CRAY FISH WASTE MIXTURE				
	0%	25%	50%	75%	100%
Maize	60.00	45.00	30.00	15.00	0.00
CCPCM	0.00	15.00	30.00	45.00	60.00
Soybean meal	27.00	27.00	27.00	27.00	27.00
Wheat offal	6.50	6.50	6.50	6.50	6.50
Palm kernel cake	3.00	3.00	3.00	3.00	3.00
Fish meal	1.5	1.5	1.5	1.5	1.5
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit/mineral premix*	0.25	0.25	0.25	0.25	0.25
Calculated analysis					
CP%	21.00	21.00	21.00	21.00	21.00
M.E.(KCal/Kg)	3100.03	3100.21	3100.76	3100.90	3102.00
Determined Analysis					
CP%	19.93	19.73	19.59	19.98	21.02
Crude fiber%	6.58	7.01	7.65	7.99	8.33
Ash%	6.77	6.79	6.41	6.63	6.19

*1kg of premix contained: Vitamin A (5,000,000 I.U.), Vitamin D3 (1,000,000 I.U), Vitamin E (16,000mg), Vitamin K3 (800mg), Vitamin B1 (1,200mg), Vitamin B2 (22,000mg), Niacin (22,000mg), Calcium pantothenate (4,600mg), Vitamin B6 (2,00mg), Manganese (48,000mg), Zinc (32,000mg), Copper (3,400mg), Iodine (600mg), cobalt (120mg), Selenium (48mg), Antioxidant (48,00mg).

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108 **2.3 Animals feeding and management**

109 Three hundred (300) unsexed one week old-Elite broiler chicks previously brooded with commercial
110 broiler starter diet were weighed and randomly allotted to the five treatment diets. Each dietary
111 treatment had 60 chicks, of three replicates with 20 birds per replicate.

112 At the end of 21 days of the starter phase experiment, two hundred and forty (240) of the birds were
113 selected and re-randomized into the five experimental finisher diets. Each treatment had 48 birds of 16
114 birds per replicate.

115 At the end of the experiment, 4birds per replicate were randomly selected and kept in metabolic cages
116 for faecal collection. The birds were allowed 6 days of adaptation to their different diets followed by 5
117 days of collection of droppings. The droppings were collected every morning and stored at -18°C. The
118 samples were pooled: individual samples were thawed, mixed and dried.

119 Feed and water were given *ad libitum* and the birds were reared on deep litter house with wood
120 shavings as litter material.

121 **2.4 Experimental design and Data collection**

122 The experiment was designed to be a Completely Randomized Design. The first phase (starter phase)
123 lasted for 21 days while the second phase (Finisher phase) lasted for 28 days.

124 Individual birds were weighed at the beginning of the experiment to obtain the initial weight of birds
125 and subsequently weight were taken weekly, feed intake was measured by calculating the difference in
126 the quantity of feed offered daily and the quantity left and at the end of the finisher phase, 5 birds per
127 replicate were sacrificed for abdominal fat measurement. Nutrient retention was calculated based on
128 the data gotten from birds kept in metabolic cages.

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131 2.5 Chemical analysis

132 Feed, test ingredients and droppings samples were dried at 60°C for 24 hours and milled (1mm screen)
133 before analyses and all analyses were performed on dried samples, except for nitrogen (N) of droppings
134 which was determined in fresh samples. Dry Matter (DM), Ash, Crude Protein (NX6.25), Crude Fiber(CF)
135 were determined [15].

136 2.6 statistical analyses

137 All data collected were subjected to analysis of variance (ANOVA) using the Completely Randomized
138 Design [16]. and treatment means were separated using The Multiple Range Test [17] Prevailing prices
139 of feed ingredients at the time of the experiment were used to calculate the economic parameters such
140 as cost of feed per kg (N), cost of feed per weight gain (N).

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143 3. RESULTS AND DISCUSSION

144 The results of the performance of broiler chicken fed the experimental diets are presented in Tables 3
145 and 4

146 3.1 Final body weight and weight gain

147 The final body live weight FBLW and body weight gain (BWG) did not vary ($P>0.05$) significantly up to
148 50% and 75% replacement level of maize with fortified cassava root meal(FCRM) in both starter and
149 finisher birds respectively, but above these levels there were significant ($P<0.05$) depression as the level
150 of fortified FCRM increased in the diets. This observation indicated that young birds could conveniently
151 tolerate up to 50% CCPCM as replacement for maize while mature birds could tolerate a higher level of
152 75%. The poor performance of young chicks when the level of FCRM was above 50% may be due to
153 higher dietary fiber as contributed by CCPCM (Table 1). Mature birds are said to tolerate higher level of
154 fiber than young birds [18, 14]. This observation for chicks is in consonant with these authors [19 ,20, 12,
155 8, 21]. They all confirmed that replacement levels beyond 50% of maize in diet of grower cockerels,
156 weaner rabbit and layers may lead to reduction in weight gain. The step up for matured birds up to 75%
157 may probable due to the cassava meal being fortified with Cray fish and palm oil to have equivalent
158 protein and energy levels with maize.

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163 **Table 3: Effect of replacing maize with composite cassava root meal, palm oil and Cray fish waste**
 164 **mixture in broiler starter diets**

PARAMETERS	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	SEM
Initial body wt(g)	76.75	78.00	80.13	77.45	75.92	1.26NS
Final body wt(g)	760.13 ^a	755.40 ^a	731.00 ^a	632.71 ^b	540.40 ^c	2.47*
Weight gain, g/d	22.40 ^a	22.21 ^a	20.64 ^a	16.17 ^b	14.29 ^b	0.19*
Feed intake g/d	60.61 ^a	60.06 ^a	57.40 ^{ab}	49.17 ^b	45.88 ^b	2.10*
FCR	2.71 ^d	2.70 ^d	2.78 ^c	3.04 ^b	3.21 ^a	0.05*
PER	1.54	1.54	1.50	1.37	1.30	0.03NS
Cost/kg feed(N	101.20 ^a	96.40 ^b	90.20 ^c	80.53 ^d	75.17 ^e	1.45*
Cost/kg WG(N	274.25 ^a	260.28 ^b	250.76 ^c	244.81 ^d	241.30 ^d	3.55*

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169 **Table 4: Effect of replacing maize with composite cassava root meal, palm oil and Cray fish waste**
 170 **mixture in broiler finisher diets**

PARAMETERS	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	SEM
Initial body wt(g)	751.50	753.16	759.20	755.59	760.06	1.12
Final body wt(g)	2260.18 ^a	2257.55 ^a	2248.00 ^a	2227.45 ^a	2006.20 ^b	3.89*
Weight gain, g/d	50.52 ^a	49.60 ^a	48.90 ^a	48.56 ^a	40.40 ^b	1.38*
Feed intake g/d	121.06	120.12	118.72	116.00	112.45	6.73 ^{NS}
FCR	2.40 ^b	2.42 ^b	2.43 ^b	2.39 ^b	2.79 ^a	0.01*
PER	1.99	1.97	1.96	1.99	1.31	0.04NS
Cost/kg feed(N	98.65 ^a	93.81 ^b	88.11 ^c	80.10 ^d	73.40 ^e	1.67*
Cost/kg WG(N	236.76 ^a	227.02 ^b	214.11 ^c	191.44 ^d	204.79 ^c	6.77*
Abdominal fat(g)	3.13 ^d	4.66 ^d	7.01 ^c	9.66 ^b	13.15 ^a	1.88*
Nutrient utilization (%)						
Dry matter	70.36	72.11	72.23	72.25	71.55	3.43

Crude Protein	61.44	60.66	60.62	60.31	60.06	5.00
Crude Fiber	30.11	30.16	30.22	28.98	27.69	1.65
Ether extract	69.41	70.14	72.06	72.92	72.90	6.90
N-free extract	75.12	75.06	74.79	74.32	74.01	4.44

Mean on the same row not followed by the same superscript are significantly different from each other.

3.2 Feed intake

The feed intake was not significantly ($P>0.05$) influenced up to 50% CCPCM replacement level in the young chicks but with significant decrease as level of CCPCM was above 50%. This lower feed intake at a high level of replacement of maize could be due to high fiber level in the diet as contributed by high level of CCPCM. Young birds are noted to consume less feed with relative high level of fiber [14, 22]. Finisher birds however, showed no significant differences ($P>0.05$) in feed intake among all the treatment means. This means that there was no inhibition in the consumption of any of the diets. Any differences observed in other performance parameters could therefore only arise from the utilization of the diets. Each ingredients apart from maize and the test ingredients (CCPCM) was included at the same level, therefore, any differences in the utilization of the diets could be attributed to the replacement levels of test ingredients with maize. This observed similarity in feed consumption across the treatment diets could be due to all the experimental diets having the same energy level since birds will eat to satisfy their energy requirement [23]. The improved feed intake as compared to the chick phase shows that matured birds can consume more fibrous feed [24].

3.3 Feed conversion ratio

The Feed Conversion Ratio showed similar trend with live weight as birds above 50% and 75% replacement levels of maize with CCPCM in starter and finisher phases respectively had significantly ($P<0.05$) poor FCR, an indication that high level of CCPCM in diets of broiler chicks discourages effective utilization of feed by the birds.

3.4 Nutrient retention

Results of proximate components and energy retention at finisher phase are shown in Table 4. There were no significant ($P<0.05$) differences at finisher phase across the treatments diets. This means that there were no differences in the utilization of the nutrients. This, at first look, is at variance with observations on the production performance of the birds. It could be that at the time of the metabolism trial (which is at the end of experimental feeding trial) the birds had adjusted and adapted to whatever adverse effects that were occasioned by the dietary levels of CCPCM. Other workers have reported adaptation of broiler chicks to diets containing cassava meal in poultry and rabbit diets [2].

3.5 Abdominal fat deposit

The abdominal fat significantly ($P=0.05$) increased as the composite cassava root meal, palm oil and Cray fish waste mixture increased in the diets with the birds in diet 5 having the highest abdominal fat

deposit. This was expected as diet with excess oil and fat content promote fat storage around belly, abdominal region and some major organs in the body [13].

3.6 Cost gain ratio

The cost per kilogram of feed decreased ($P=0.05$) significantly with increasing level of CCPCM in the diets with the lowest cost of feed obtained in birds fed diet containing 100% CCPCM. This observed trend could be attributed to the lower prices of cassava root meal, Cray fish waste and palm oil that constituted the mixture when compared to the price of maize. [25,26,27]. Highlighted the need for dietary formulation which can be used as an alternative non-competitive, readily available and cheap ingredients which can partly replace the conventional energy and protein feedstuffs in poultry diets.

On the basis of production cost, 75% CCPCM replacement of maize gave the lowest ($P=0.05$) cost (N) per kilogram weight gain than all the other levels of replacement. This means that it is cheaper to raise broilers at finisher phase at 75% replacement level of maize with fortified cassava root meal.

4.0 CONCLUSION

It can therefore be inferred that 50% and 75% of maize replacement with fortified cassava root meal in broiler starter and finisher diets respectively were the most efficient in terms of the economy of feed conversion without any adverse effect on weight gains. Cassava root meal is relatively cheaper than maize and should be encouraged when fortified with good protein and energy sources to contribute to poultry production in the country.

COMPETING INTERESTS

Authors have declared that no competing interest exists.

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