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## Growth Indices and Cost Implications of Hybro Broiler Chicks Fed with Graded Levels of Fermented Wild Cocoyam *Colocasia esculenta* (L.) Schott Corm Meal as a Replacement for Maize

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**Abstract:** Corms such as wild cocoyam [*Colocasia esculenta*] have potential to replace maize as a cheaper energy source in poultry rations. A feeding trial was conducted to evaluate the effects of graded levels of fermented wild cocoyam [*Colocasia esculenta* (L.) Schott] corm (FWCC), as substitutes for maize in the diets of broilers at the starter phase. One hundred and twenty unsexed day-old Hybro broiler chicks were randomly distributed to four dietary treatments in a Completely Randomized Design (CRD). There were 3 replicates per dietary treatment with 10 birds per replicate. Diet 1 without FWCC served as the control. Diets 2, 3 and 4 contained 10, 20 and 30% FWCC. Each of the diets represented a treatment. The experimental diets and clean drinking water were supplied *ad libitum* for 4 weeks (28 days) representing the starter phase of the broiler production. Result of the performance revealed significant ( $p < 0.05$ ) differences in feed intake, weight gain and feed conversion ratio. The economic analysis also showed that cost (₦58.52) of a kilogram feed was highest ( $p < 0.05$ ) for the control and least (₦53.10) for 30% FWCC. The least cost (₦101.24) of feed per kilogram weight gain ( $p < 0.05$ ) was obtained for birds fed 30% FWCC compared to (₦105.53) for the control. It was concluded that maize can economically be substituted with 30% FWCC in broiler starter diets.

**Key words:** Cocoyam corms, anti-nutritional factors, performance, broiler chicks, profitability

### INTRODUCTION

High cost of cereals used for livestock feed is a major constraint to meeting the animal protein requirements of Nigerians and other developing countries of the world. Another major challenge is the need for suitable alternatives with minimal contents of anti-nutritional factors (ANFs) especially in the area of unconventional feed resources.

It has consistently been established that the demand for protein of animal origin in Nigeria and indeed Africa is greater than the supply (Oyenuga, 1973; Onwueme and Charles, 1994; Lamorde, 1998; Akinmutimi and Onwukwe, 2002). Poultry production has short generation intervals (Longe, 2006; Havenstein *et al.*, 2003a, b) fewer religious or social taboos associated with it than other livestock species like pigs. It also has high standard protein and all essential amino acids (Smith, 2001). It therefore, represents one of the fastest means of correcting the shortage and insufficiency of animal protein in the developing countries. However, high cost of poultry feeds has marred these superior benefits of poultry over other livestock species. Feed represents the major cost of poultry production and 80% of the total cost of

production of the finished feed is the cost of raw materials (Longe, 2006). The energy component of a feed is usually high and a reduction in the cost of energy would translate to reduced cost of feeding livestock (Ayuk *et al.*, 2009). The energy content of a diet determines the extent of feed intake since birds are known to eat in order to satisfy their energy requirement (Ranjhan, 1980; Ewing, 1995; Oluyemi and Roberts, 2002). The competition among various alternative users of cereals (man, livestock and industry) coupled with the high cost of these energy ingredients call for alternatives in poultry diets. Root and tuber crops have been described as potential energy feed resource for monogastric animals (Dominguez, 1992). Previous studies have also indicated that maize could be substituted by processed cassava as cheaper alternative source of energy in pigs (Aro *et al.*, 2009), poultry (Reddy and Qudratullah, 2006) and rabbits (Shaahu *et al.*, 2009). It has also been recorded that cocoyam corms and cormels have been used as animal feed to some extent (Lee, 1977; Ravindran and Rajaguru, 1985; Anigbogu, 1997; Reddy and Qudratullah, 2006). However, the presence of anti-nutritional factors (ANFs) could limit their use (Isikwenu and Bratte, 1999; Panigrahi, 1996). Fermentation has been recommended to solve this

problem and thus improve the nutritional value of the products (Ikediobi and Onyike, 1982; Marfo and Oke, 1988; Nnanyelugo *et al.*, 2003). This study was therefore designed and carried out to investigate the replacement value of fermented wild cocoyam [*Colocasia esculenta* (L.) Schott] corm for maize in broiler starter diets.

## MATERIALS AND METHODS

**Preparation of the test ingredients:** The preparation, nutrient and anti-nutritional factors (ANFs) of fermented wild cocoyam [*Colocasia esculenta* (L.) Schott] corms were as reported by Olajide *et al.* (2011).

**Chemical analysis:** Determination of the proximate chemical composition of the experimental broiler starter diets was according to the method of AOAC (1995). Nitrogen Free Extract (NFE) was determined by difference while the metabolisable energy was calculated according to the procedure of Ponzenga (1985) as:

$$\text{ME (kcal/kg DM)} = 37\% \text{ Protein} + 81.8\% \text{ Fat} + 35.5\% \text{NFE}$$

**Experimental diets:** The four broiler starter diets were compounded based on partial substitution of maize with FWCC. The substitution of maize with FWCC was on weight for weight (w/w) basis. Diet 1 was the control and contained no FWCC. Diets 2, 3 and 4 were formulated with 10, 20 and 30% FWCC, respectively replacing maize in the diets. Each of the diets represented a treatment.

**Site of the experiment:** The study was carried out at the rearing section of the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria (7°27'N) and 3°45' E at altitude 200-300 m above sea level; mean temperature of 25-30°C and the average annual rainfall of about 1255 mm.

**Management of the experimental birds:** The brooder house was thoroughly cleaned, washed, disinfected, allowed to rest for a week before the arrival of chicks and artificial light provided to encourage the birds to eat in the night.

One hundred and twenty Hybro broiler chicks were purchased from a reputable Hatchery in Ibadan Oyo State for this study. The birds were randomly distributed to four treatments of three replicates per treatment. Each treatment represented a diet and there were 30 birds of similar average weight per diet (treatment) and 10 birds per replicate. Feed and water were provided *ad libitum*. The

birds were weighed and feed intake recorded weekly from which average daily weight gain and feed intake were computed.

**Data collection:** The parameters monitored on which data were collected include the proximate composition of the broiler starter diets, feed intake, body weight gain, feed conversion ratio and economy of production.

**Cost estimation:** The prevailing cost (₦) of all the ingredients at the time of purchase was used in calculating the total cost (₦) of 100 kg feed. Subsequently, cost (₦)/kg feed and cost (₦) of feed/kg live weight gain was calculated.

**Statistical analysis:** Data collected for all the parameters were subjected to analysis of variance (ANOVA) using SAS statistical package, SAS (1999). The means were separated using Duncan multiple range test.

## RESULTS AND DISCUSSION

The proximate composition and contents of anti-nutritional factors (ANFs) in FWCC are shown in Table 1, as reported by Olajide *et al.* (2011). Cooking reduced the crude protein, crude fibre, ash, ether extract; and increased the NFE, gross and metabolisable energy contents compared with the raw values showed by this authors. The trend reported was attributed to effect of heat and loss of nutrients already degraded by destruction or chemical changes like oxidation.

**Gross determined nutrient composition of the experimental diets:** Table 2 shows the gross and the determined nutrient compositions of the diets. The diets were formulated to meet the nutrients and ME requirements of broiler chicken under the tropical climatic conditions under which the study was carried out as recommended (Olomu, 1995). Diets containing CP

Table 1: Proximate composition, metabolisable energy and anti-nutritional factors' contents of FWCC

Parameters	Fermented wild cocoyam corms
Dry matter (%)	87.90
Crude protein (%)	7.44
Crude fibre (%)	3.45
Ether extract (%)	0.88
Ash (%)	2.63
Nitrogen free extract (%)	73.50
ME (kcal kg <sup>-1</sup> DM)	2956.52
<b>Anti-nutrients</b>	
Tannins (g/100 DM)	0.04
Phytate (g/100 DM)	0.05
Oxalate (g/100 DM)	0.14
Hydro cyanide, HCN (mg kg <sup>-1</sup> )	7.20

Source: Olajide *et al.* (2011)

Table 2: Gross composition of FWCC-based diets

Item	Diets for different maize replacement level			
	1	2	3	4
	0% FWCC	10% FWCC	20% FWCC	30% FWCC
<b>Ingredients</b>				
Maize	56.00	50.40	44.80	39.20
FWCC	0.00	5.60	11.20	16.80
PKC	3.00	3.00	3.00	3.00
Wheat offal	2.50	2.50	2.50	2.50
GNC	16.10	16.10	16.10	16.10
Soybean meal	14.00	14.00	14.00	14.00
Palm oil	0.50	0.50	0.50	0.50
Fish meal (72% CP)	5.00	5.00	5.00	5.00
Bone meal	1.10	1.10	1.10	1.10
Oyster shell	1.15	1.15	1.15	1.15
Salt	0.20	0.20	0.20	0.20
*Premix	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
<b>Determined nutrients composition (%)</b>				
Dry matter	89.78	89.63	89.90	89.72
Crude protein	23.98	23.83	22.91	22.66
Crude fibre	3.66	3.67	3.70	3.72
Ash	4.84	4.96	5.46	5.66
Ether extract	3.73	3.56	3.48	3.36
Nitrogen free extract	53.62	53.61	54.35	54.32
**ME (kcal kg <sup>-1</sup> DM)	3095.88	3076.07	3061.76	3041.63

\*\*Calculated analysis. PKC: Palm kernel cake, FWCC: Fermented wild cocoyam corn, GNC: Groundnut cake. \*Composition of premix: 2.5 kg of premix contains: Retinol acetate (10000000 iu), Vit. D3 (2000000 iu), Vit. E (15000 iu), Vit. B (3000 mg), Niacin (15000 mg), Vit. B6 (3000 mg), Vit. B12 (10 mg), Vit. K3 (2000 mg), Biotin (20 mg), Folic acid (500 mg), Calcium pantothenate (800 mg), Chlorine chloride (250000 mg), Manganese (75000 mg), Iron (25000 mg), Copper (5000 mg), Zinc (70000 mg), Selenium (150 mg), Iodine (1300 mg), Magnesium (100 mg), Ethoxyquine (500 g), BHT (700 g)

Table 3: Performance of broiler chicks fed graded levels of FWCC-based diets

Item	Diets for different maize replacement level				SEM
	1	2	3	4	
	0% FWCC	10% FWCC	20% FWCC	30% FWCC	
<b>Performance parameters</b>					
Average daily feed intake (g/bird/day)	49.86 <sup>a</sup>	44.64 <sup>b</sup>	43.37 <sup>b</sup>	42.73 <sup>b</sup>	0.54
Average daily weight gain (g/bird/day)	27.64 <sup>a</sup>	24.35 <sup>b</sup>	23.54 <sup>b</sup>	22.41 <sup>b</sup>	1.14
Feed conversion ratio	1.80	1.83	1.85	1.91	0.11
<b>Economic analysis</b>					
Total feed intake (g/bird/4weeks)	1395.95 <sup>a</sup>	1249.88 <sup>b</sup>	1214.47 <sup>b</sup>	1196.25 <sup>b</sup>	7.51
Total weight gain (g/bird/4weeks)	773.93 <sup>a</sup>	681.79 <sup>b</sup>	659.17 <sup>b</sup>	627.50 <sup>b</sup>	25.55
Cost per kg feed (₹)	58.52 <sup>a</sup>	56.72 <sup>b</sup>	54.91 <sup>c</sup>	53.10 <sup>d</sup>	3.67
Cost of feed per kg weight gain (₹)	105.53	103.99	101.59	101.24	2.24
Mortality (%)	3.33	0.00	0.00	0.00	NSA

FWCC: Fermented wild cocoyam corn, NSA: Not statistically analysed, Means in the same row with different superscripts differ significantly (p<0.05). SEM is standard error of the means

(22.66-23.98%), CF (3.66-3.72%), EE (3.36-3.73%) and ME (3040.18-3095.88 kcal/kg DM) were fed during the starter phase (0-28d). The control diet had the highest CP (23.98%), ME (3095.88 kcal/kg) while 30% FWCC had the least CP (22.66%) and ME (3041.63 kcal/kg). The EE (3.73%) of the control diet was the highest and EE (3.36%) of the 30% FWCC was the least. The CF (3.66%) and Ash (4.84%) of the control diet were the least compared to highest values of CF (3.72%) and Ash (5.66%) in 30% FWCC-based diet. The CP, EE and ME decreased while

the CF and Ash increased with increasing contents of FWCC in the diets. This reflected the nutrients and caloric or energy profiles of maize and FWCC.

#### Performance of broiler chicks fed the experimental diets:

The summary of the performance characteristics of Hybro broiler chicks as affected by the levels of substitution of FWCC for maize in the diets are shown in Table 3. The birds on control diet had the highest (p<0.05) average daily feed intake (ADFI) of 49.86 g/bird/day while those

on 30% FWCC consumed the least ( $p < 0.05$ ) ADFI of 42.73 g/bird/day. Although the variations obtained in the ADFI of chicks fed 10-30% FWCC were lower than that of the control, this was however similar ( $p > 0.05$ ) for the chicks fed with 10-30% FWCC. The slight numerical but non-significant decrease in the ADFI with increasing levels of substitution of FWCC for maize could be explained by residual anti-nutritional factors in FWCC. Olajide (2012) however reported that the feed intake of the broiler finishers fed processed wild cocoyam-based diets were similar to that of control. This was attributed to ability of older birds (finishers) to better handle or tolerate ANFs in the ingredient. Similar results indicating better ability of older birds to tolerate ANFs than younger ones were reported (Bedford, 2006; Egena, 2006). The average daily weight gain (ADWG) followed the same trend with the ADFI. The highest ( $p < 0.05$ ) ADWG of 27.64 g/bird/day was obtained in the birds fed the control diet. This was followed by those on 10, 20 and 30% FWCC with respective values of 24.35, 23.54 and 22.41 g/bird/day. The feed: gain ratio expressed as feed conversion ratio (FCR) of the birds fed the control diet and 10-30% FWCC-based diets were similar ( $p > 0.05$ ). The highest ADFI and ADWG recorded in birds fed purely maize-based diet (control) was as a result of absence of ANFs in FWCC. Similar records of depressed feed intake and growth have been reported with tannins (Marguardt *et al.*, 1978; Kumar, 2003), cyanide (Panigrahi, 1996), oxalates (Clerke and Clerke, 1975), phytate (Ahmad *et al.*, 2000). Esonu *et al.* (2000) recorded similar decrease in body weight gain with increased replacement level of maize with wild variegated cocoyam (*Caladium hortulanum*). The non-significant ( $p > 0.05$ ) ADFI and ADWG of birds on 10-30% FWCC-based diets could be as a result of improved acceptability and utilization of nutrients due to minimal ANFs in it. The relatively better performance of birds on control diet could also probably be attributed to higher CP, EE, ME and lower CF in this diet compared to those formulated on graded levels of FWCC. This improvement in utilization of nutrients in maize could be explained by complete absence of ANFs in it. Non significant ( $p > 0.05$ ) FCR of chicks on all dietary treatments could also be linked to minimal ANFs in FWCC brought about by improved processing technique (fermentation of grated corms) of FWCC. This is in line with the submission of Emiola *et al.* (2003). The FCR obtained in the present study were lower than the values obtained from other studies under the tropical environmental conditions (Akpodiete *et al.*, 1997; Adetunji and Ologhobo, 1999; Olaka and Steamer, 2000; Esonu *et al.*, 2000).

**Economy of production of broiler starters:** The cost of a kg feed (CPKF) of control diet (Diet 1) was the highest ( $p < 0.05$ ) and the cost of the diets decreased with

increasing levels of FWCC in the diets. This was as a result of lower cost per kg of FWCC than maize. The economic analysis of the substitution of maize with FWCC in broiler starter diets showed that birds fed the control diet consumed 1395.95 g/bird and gained 773.93 g/bird in the first 28 days. Despite the lower feed need per kg gain of birds fed the control than 10-30% FWCC, the lower cost per kg feed (CPKF) of FWCC resulted in birds fed 10-30% FWCC-based diets having the lower cost per kg weight gain (CPKWG) than the control, the lowest being 30% FWCC.

## CONCLUSION

These results showed that maize could economically be substituted with 30% FWCC in the diets of broiler chicks.

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