Growth performance of starter broilers fed processed cocoyam (*Xanthosoma sagittifolium*) as energy source in place of maize

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Abstract

Considering the inherent attributes of cocoyam (*Xanthosoma sagittifolium*), its appropriate utilization for chicken diets may enhance performance of starter broilers. The study was therefore, carried out to determine the growth performance of starter broilers fed processed cocoyam tuber meal as energy source in place of maize. *Xanthosoma* cocoyam corms were harvested, cleaned of soil and chopped into bits of about 0.2 cm. The chopped tannia was soaked in water in a large vat for 24 hours to reduce the ant nutrients and later on separated from the water and dried with microwave oven. The dried cocoyam was milled and then used. The proximate chemical composition showed that soaked cocoyam tuber meal contained 8.05% moisture, 91.95% dry matter, 10.08% ash, 2.01% crude protein, 1.60% ether extract, 3.80% crude fibre, 74.46% NFE and 3158.92Kcal/kg DM metabolizable energy. In the starter broiler experiment, five experimental diets were formulated such that, diet 1 (control) contained yellow maize as the main energy source, while soaked CTM was used to replace maize at levels of 15%, 20%, 25% and 30% respectively in the control diet. Each starter diet was fed to a group of 30 broiler chicks for 4 weeks using completely randomized design. Each treatment was further grouped into 3 replicates of 10 birds each. The broiler chicks were kept in deep litter and given feed and water ad libitum. Parameters measured included initial body weight, final body weight, feed intake, feed conversion ratio and cost of production. In the starter feeding trial, the group on 30% soaked CTM (30% SCYM) compared favorably with the control group ($P < 0.05$) and recorded the highest body weight gain. It appeared that, the starter broilers could tolerate high levels of soaked CTM in their diets. Cost of production (cost of feed x feed conversion ratio) was lowest for diet 5 (30% SCYM) N248.15 as against N281.86 for control diet in the starter feeding trial. CTM meal can be used to replace maize at 30% in the diets of starter broilers without affecting weight gain, feed intake and feed conversion ratio as indicated in the study.

Keywords: Growth, performance, processed, cocoyam, energy source, broiler starter.

Introduction

The need for replacement of the conventional feed ingredients has been paramount in the mind of animal nutrition expert for over a decade (Onyimonyi and Okeke, 2015). Feed cost account for up to 60-80% of the total cost of production in intensive poultry production (Tewe, 1997).

The rising cost of feed resources in livestock production have been established as a serious impediment to meeting the demand for animal protein particularly in developing countries (Adejinmi *et al.*, 2000). Therefore, there is the need to reduce the cost of feed ingredients for poultry if the industry should survive. The reduction in cost should be such

that the performances of the birds are not affected. This approach should involve compounding feed in a way that all the required nutrients come from cheap alternative energy and protein sources in developing countries (Adejinmi, *et al.*, 2005). Maize is the major source of energy in diets for monogastric animals in Nigeria and may constitute up to 60% of a commercial poultry ration (FAO, 2004).

Therefore, there is a need to look for cheap alternative non-conventional feedstuffs as energy source in place of maize for domestic poultry ration in Nigeria. Cocoyam (*Xanthosoma sagittifolium*) is another cheap source of available energy for monogastric animal. Its carbohydrate is easily digestible. Its nutritional qualities can compare favourably with yam, cassava and potato (Bello, 1976). It is high yielding, disease resistant and almost competition free with man in most places as it is eaten only as a last resort when a family can no longer afford, garri or yam. It is therefore more likely to be available for use at lower cost. Its energy content appears moderate when compared with maize. However, like most varieties of cocoyam, the problem with *X. sagittifolium* is its content of some anti-nutritional factors which could be a limitation to its use (Okon *et al.*, 2007). These limiting factors can be removed by boiling or sundrying (Abdulrashid *et al.*, 2006). Ohaemenyi (1993) reported that *Xsagittifolium* corms can be cooked and used to some extent in the diets of growing pigs. Esonu (2000) reported that starter broilers could tolerate up to 20% inclusion levels of wild variegated cocoyam *Canadium hortulanum*. (Anyaegebu *et al.*, 2016) report that sun dried cocoyam (*X. sagittifolium*) could be used up to 15% in the finisher broiler diet without affecting body weight

gain, feed intake and feed conversion ratio. (Onunkwo *et al.*, 2016) reported that the broiler chicks fed 10% sundried cocoyam (*X. sagittifolium*) compared favorably with the control group ($P < 0.05$) in terms of feed intake, weight gain and feed conversion ratio and recorded the highest weight gain.

Considering the various attributes of cocoyam (*X. sagittifolium*), it would appear that appropriate utilization of this feedstuff can be used to replace maize to produce low cost diets that can be efficient in promoting performance of starter broilers and reduce demand pressure on maize as well as cost of production.

Materials and methods

Experimental site

The experiment was carried out at the poultry unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State in Nigeria. The area is located on latitude $5^{\circ}27'$ North, longitude $7^{\circ}32'$ East, in the rain forest zone in Umuahia, Abia State of Nigeria. This site has a mean daily temperature of between 27°C - 36°C and a minimum of 20°C - 26°C with relative humidity between 57 and 91% and annual rainfall of 200mm per annum and an altitude of 122m above sea level. It is therefore, a humid tropical environment with temperature and relative humidity that are significant in agriculture production (Eburuja, 2010).

Procurement and processing of feed ingredients

T a n n i a c o c o y a m c o r m (*Xanthosomasagittifolium*) was obtained from Ikot Ekpene L.G.A, in Akwa-Ibom State. The corms were harvested, cleaned of soils and chopped into bits of about 0.2cm. Chopped Tannia cocoyam were soaked in water for about 24 hours to reduce the anti-nutrients and later on separated from the water and dried with Microwave oven. The

dried cocoyam were milled and then stored. Other ingredients like maize, palm kernel cake, fish meal, blood meal, bone meal, vitamins premix, salt, etc. were procured from Jocan Agro Services Umuahia, Abia State.

Chemical analysis of feed ingredients

All the processed feed ingredients; Tannia cocoyam, palm kernel cake, brewers dried grains, blood meal, fish meal, were subjected to proximate analysis according to AOAC (1995) to determine their nutrient composition and gross energy. All analysis was based on 100% dry matter. This was done so as to use the value to determine the nutrient composition of the experimental diets which were formulated from them. The components determined were dry matter (DM), crude protein (CP), ether extract (EE) and nitrogen free extract (NFE).

Experimental Design

The design of the study was completely randomized design (CRD).

The Statistical Model is;

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where;

Y_{ij} = Individual observation

μ = Population mean

T_i = Treatment effect

e_{ij} = Error effect

Anti-nutrients determination

The test materials; fresh and soaked cocoyam (*Xsagittifolium*) were analyzed for the anti-nutrients content such as oxalate, phytic acid, saponins, tannins and cyanide.

Experimental starter broiler diets

Five experimental starter broiler diets were formulated for the starter phase of the feeding trial. The control diet (diet 1) contains 58% maize, as the major source of energy. Diets 2, 3, 4, and 5 contain as major source of energy and fiber, soaked cocoyam at 15%, 20%, 25% and 30% supplemented with palm oil to replace maize respectively. Other ingredients remained the same in the diets (Table 1).

Table 1: Ingredient and nutrient composition of the experimental starter broiler diets

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
	Control	15% SCYM	20% SCYM	25% SCYM	30% SCYM
Maize	58.00	49.30	46.40	43.50	37.70
SCYM*	-	8.70	11.60	14.50	20.30
Soya bean meal	30.85	30.85	30.85	30.85	30.85
PKC	1.55	1.55	1.55	1.55	1.55
BDG	2.00	2.00	2.00	2.00	2.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	2.60	2.60	2.60	2.60
Vit/mineral premix **	0.25	0.25	0.25	0.25	0.25
Palm oil	-	0.40	0.40	0.40	0.40
L-methionine	0.10	0.10	0.10	0.10	0.10
Common salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition of the Experimental Starter Broiler Diets					
Crude Protein (%)	23.00	23.55	23.36	23.19	23.00
Crude Fibre (%)	3.81	3.79	3.78	3.78	3.77
Ether Extract (%)	7.67	7.93	7.83	7.74	7.63
Ash (%)	3.02	3.21	3.27	3.31	3.37
Calcium (%)	1.35	1.28	1.28	1.28	1.27
Phosphorus	1.70	1.00	1.00	1.00	1.00
M.E Kcal/kg	2839.08	2845.50	2835.64	2825.78	2815.92

PKC: PALM KERNEL CAKE, BDG: BREWERS DRIED GRAIN, *Soaked cocoyam meal, **To provide per kg diet: Vit. A 2000000 iu, D3 4000 iu, Vit. E 80g; Vit. K 0.4g; Vit. B 0.3g; Vit. B2 1.0g; Folic acid 0.2g; Biotin 8.00mg; Choline 48.00g; BHT 32.00g; Manganese 16.00g; Iron 8.00, Zinc 7.2g; Copper 0.32g; Iodine 0.25g; Cobalt 36.00mg; Selenium 16.00g

Management of the experimental starter broilers

One hundred and fifty day old Anak broiler chicks (Fidan broilers) were brought from C&G Agric. Enterprise Umuahia, Abia State. They were brooded together for one week with commercial starter broiler diet (Top broiler starter feed) to stabilize them before distributing them into five experimental treatment groups. Each treatment group contained 30 broiler chicks. Then each treatment group was subdivided into three replicates of 10 birds per replicate. Each replicate was kept in a pen and covered with polythene sheets to conserve heat. Heat was supplied with electricity and kerosene lantern during the brooding period. The floor of the pen was covered with wood shavings. Each group was randomly assigned to an experimental starter diet in a completely randomized design (CRD) and was fed for four weeks. Feed was supplied in feeding troughs built in such a way as to minimize wasting of feed. Water was supplied ad libitum. Feeding was done once daily around 8am. The birds were weighed at the beginning of feeding trial and weekly thereafter. Feed intake was recorded daily by weighing the quantity of feed given and the left over the following morning. The starter phase of the trial lasted for 4 weeks.

Health management practices were carried out on the broiler chicks. The chicks were given anti-stress on arrival to boost their energy level. They were given Newcastle

disease vaccine strain (NDV) by intraocular (I/O). the first Gumboro vaccine was administered at the end of the second week through drinking water and Lasota vaccine against Newcastle disease (Lasota strain) was administered at the end of the third week and the final Gumboro vaccine was administered at the end of the forth week against infectious bursa disease (Gumboro). Coccidiostat and other antibiotics were also administered by drinking water when there were signs of infection.

Data collection

Parameters determined were; daily feed intake, body weight gain, final live weight, weekly body weight gain, feed conversion ratio, mortality, cost of production.

Data analysis

The data collected were subjected to one way Analysis of Variance (ANOVA) according to Snedecor and Cochran (1989), where significant treatment effects was detected from the ANOVA, means were separated using Duncan's New Multiple Range Test (Steel and Torrie, 1980).

Results

Data on the anti-nutrients and proximate composition of fresh and soaked cocoyam tuber meal are shown in Table 2. The hydrogen cyanide content of fresh cocoyam (*Xanthosoma sagittifolium*) was high but soaking in water for 24 hours and oven drying reduced the hydrogen cyanide in the cocoyam from 7.55g/100 to 6.25g/100 DM. There were no significant ($P < 0.05$)

Table 2: Anti -nutrient and Proximate Composition of Fresh and Soaked Cocoyam Tuber Meal (*Xanthosoma sagittifolium*)

Parameters	Fresh Cocoyam Tuber	Soaked Cocoyam Tuber	SEM
Tannins (g/100 DM)	0.20 ^a	0.03 ^a	0.06
Phytate (g/100 DM)	0.28 ^a	0.19 ^a	0.032
Oxalate (g/100 DM)	0.41 ^a	0.38 ^a	0.011
Saponin (g/100 DM)	0.21 ^a	0.20 ^a	0.005
Hydrocyanide (g/100 DM)	7.55 ^a	6.25 ^b	0.29

^{ab} means within the same row with different superscript are significantly different ($P < 0.05$)

differences in tannins, phytate, oxalate and saponin contents of the fresh and soaked cocoyam tuber meal. This means that soaking was not effective for removing these anti-nutrients. There were no

significant ($P < 0.05$) differences in crude protein, nitrogen free extracts, dry matter, but their ash, moisture and ether extract differed significantly ($P < 0.05$) with the fresh tuber containing less.

Table 3: Proximate Composition of Fresh and Soaked Cocoyam Tuber Meal

PARAMETERS	Fresh Cocoyam Tuber	Soaked Cocoyam Tuber	SEM
Moisture (%)	48.63 ^a	8.05 ^b	1.32
Dry matter (%)	86.05 ^a	91.95 ^a	2.95
Ash (%)	5.24 ^b	10.08 ^a	1.72
Crude protein (%)	3.94 ^a	2.01 ^a	0.68
Ether extract (%)	2.26 ^a	1.60 ^b	0.24
Crude fibre (%)	10.70 ^a	3.80 ^b	2.45
Nitrogen free extract (%)	63.91 ^a	74.46 ^a	3.74
Metabolizable energy kcal/kg DM	3179	3158.92	

^{abc}means within the same row with different superscript are significantly different ($p < 0.05$)

Table 4: Proximate composition of experimental starter broiler diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6
Dry matter (%)	90.47	90.51	90.55	90.17	90.06	0.09
Moisture (%)	9.53	9.49	9.45	9.83	9.94	0.09
Ash (%)	7.20	9.40	10.57	8.29	7.98	0.53
CP (%)	22.20	24.20	24.35	24.00	23.12	0.45
EE (%)	2.50	3.60	3.60	4.05	4.40	0.29
CF (%)	5.50	5.75	5.75	5.20	5.35	0.08
NFE (%)	53.07	47.56	47.56	47.59	49.21	1.03

CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract

Performance of the experimental starter broilers

In the starter trial, the average daily feed

intake of the experimental groups were 76.50g, 67.25g, 74.00g, 69.00g for the control (diet 10), diet 2, diet 3, diet 4 and diet 5 respectively.

Table 5: Effect of experimental diets on the performance of starter broilers

Parameters	Diet 1 Control	Diet 2 15% SCYM	Diet 3 20% SCYM	Diet 4 42.5% SCYM	Diet 5 30% SCYM	SEM
Initial body wt (g)	166.67 ^a	166.67 ^a	170.00 ^a	166.67 ^a	180.08 ^a	2.31
Final body wt (kg)	1.19 ^{ab}	1.03 ^b	1.09 ^b	1.0 ^b	1.22 ^a	0.04
Daily body wt gain (g)	36.42 ^{ab}	30.71 ^c	32.85 ^b	31.07 ^b	37.14 ^a	1.18
Body wt. gain (kg)	1.02 ^{ab}	0.86 ^c	0.92 ^b	0.87 ^c	1.04 ^a	0.04
Daily feed intake (g)	76.50 ^a	67.25 ^b	74.00 ^a	69.00 ^b	75.50 ^a	1.63
Feed conversion ration	2.10 ^{ab}	2.18 ^{ab}	2.25 ^b	2.22 ^b	2.03 ^a	0.04
Mortality	-	-	-	-	-	-

^{abc}means within the same row with different superscripts are significantly different ($P < 0.05$)

Growth performance of starter broilers fed processed cocoyam (Xanthosoma sagittifolium)

Significant ($P<0.05$) differences existed among the groups in their feed intake. Generally, the high feed intake of the starter broilers on soaked cocoyam based diets could be due to the low energy and high fibre dietary content of cocoyam based diets as well as the reduced cyanide due to the soaking method. According to Oluyemi and Roberts (2000), birds tends to eat lower energy and higher dietary fibre based diets to satisfy their energy needs.

Body weight gain

In the starter feeding trial, the group fed 30% soaked cocoyam tuber meal recorded the highest weight gain and was significantly ($P<0.05$) different from other groups. This was followed by those on the control diet, maize based diet.

Feed Conversion Ratio/Feed gain ratio

The feed conversion ratio of the starter broilers, were 2.10, 2.18, 2.22 and 2.03 for diets 1, control diets 2, 3, 4 and 5 respectively.

Significant ($P<0.05$) difference existed among the groups in fed conversion ratio. The starter broilers on diet 5 (30% SCYM) recorded significantly ($P<0.05$) superior feed conversion ratio more than other groups. This feed conversion ratio of the starter groups on control diet and diet 2 (15% SCYM) were similar and significantly ($P<0.05$) better than the groups on 20% and 25% SCYM based diets. Generally the feed conversion ratio of the starter broilers on the cocoyam based diets was good.

Economics of production of experimental starter broilers

In the starter trial, the cost of production of 1kg of cocoyam based starter broiler diet was cheapest for diet 5 (₦122.24) and the costliest was the control diet (₦134.22). Consequently, the cost of production of 1kg of starter broiler was cheapest with diet 5 (₦248.15) versus ₦281.80 for the control diet.

Table 7: Economics of starter broilers fed experimental diets

Parameters	Diet 1 Control	Diet 2 15% SCYM	Diet 3 20% SCYM	Diet 25% SCYM	Diet5 30% SCYM	SEM
Cost/kg feed (₦)	134.22 ^c	128.33 ^b	126.40 ^{ab}	124.27 ^{ab}	122.24 ^a	1.33
Cost of prod./bird (₦)	281.86 ^c	279.76 ^b	284.63 ^{ab}	275.88 ^{ab}	248.15 ^a	5.92

^{abc} means within the same row with different superscripts are significantly different ($p<0.05$)

Discussion

Anti-nutrient content and proximate composition of cocoyam (Xanthosoma sagittifolium)

The result of the trials in respect to the anti-nutrients content of both fresh and soaked cocoyam tuber reaffirmed the earlier work of Ahamefule and Odemelan (2008) that 24 hours soaking duration produced better results and would be preferred for reducing tannin and cyanide in feed ingredients. The acidity factors due to the presence of oxalate are reduced by peeling, grading, soaking and fermentation operation during processing (FAO, 1990). It therefore

follows that diets based on soaked cocoyamtubers as source of energy could contain very little trace of Cyanide, tannins, oxalate, saponnins and phytic acid.

Performance of starter broilers

Generally the feed intake of starter broilers on soaked cocoyam diets compared favourably with those on the control diet (maize based diet). This could be due to the lower energy and high dietary fibre content of soaked cocoyam based diets as well as the reduced cyanide content of soaked cocoyam tuber meal. According to Oluyemi and Robert (2000), broilers tend to eat lower energy and high dietary fibre based diets

than high energy feeds to satisfy their energy needs. However, in terms of body weight gain, the starter broilers on 30% soaked cocoyam tuber meal (diet 5) recorded the highest weight gain. This was followed by those on the control diet, diet 5 has the highest level of soaked cocoyam tuber meal.

It appeared that the starter broilers could tolerate higher levels of soaked cocoyam tuber meal in their diets. This result agreed with the findings of Ahamefule and Odemelan (2008) who confirmed that 24 hours soaking duration produced better results and would be preferred for reducing tannin and cyanide in feed ingredients.

In terms of cost of production, diet 5 (30% SCYM) was the most efficient, giving a cost of N248.15 to produce 1kg of broiler versus N281.86 for the control diet.

Conclusion

It is concluded that 24 hour soaking duration of cocoyam tuber (*Xanthosoma sagittifolium*) for processing broilers diets was not an effective method of processing cocoyam tuber meal for use in starter broilers as there were still traces of cyanide, phytic acid, saponins and oxalates in soaked cocoyam tuber meal as illustrated in this experiment but at a tolerable levels. Soaked cocoyam tuber meal (*Xanthosoma sagittifolium*) could be used in the diets of starter broilers up to 30% without affecting weight gain, feed intake and feed conversion ratio. This was shown by superior performance of the starter broiler on diet 5 (30% SCYM).

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