CHAPTER 16

THE GROWTH PERFORMANCE, COST AND RETURNS OF FEEDING DIFFERENTLY PROCESSED YELLOW COCOYAM CORM MEAL ON TURKEY BROILER STARTER

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Abstract

The daily rise in market price of maize as the main energy source in poultry production coupled with its scarcity raises an alert for energy ingredient diversification to other sources which however are compounded with anti-nutritional factors. Therefore, to harness the nutitional benefits of the alternative feedstuffs, some processing may be necessary in other to reduce the anti-nutrients to a tolerable limits. Present study was carried out to investigate the growth performance, cost and returns of feeding differently processed yellow cocoyam corm meal on turkey broiler starter. Cocoyam corms were cut into pieces, some were sundried raw, some were cooked and sundried and others were fermented for three days and sundried. The cocoyam corms were ground in a hammer mill to make yellow cocoyam corm meal. The differently processed yellow cocoyam corm meal was used to compound seven experimental diets represented as $T_1 0$, $T_2 R_{15}$, $T_3 F_{15}$, $T_4 C_{15}$, $T_5 R_{25}$, $T_6 F_{25}$, and $T_7 C_{25}$. $T_1 0$ represented the control containing 100% maize. R in T_2 and T_5 represented raw and dried cocoyam at 15% and 25% dietary inclusion level respectively. C in T_4 and T_7 represented cooked and dried cocoyam at 15% and 25% dietary inclusion levels respectively and F in T_3 and T_6 represented fermented and dried cocoyam at 15% and 25% dietary inclusion levels respectively. 7 groups of 15 turkey starter per group were assigned to one of the treatment diets in a completely randomized design (CRD). At the end of the 28 days feeding trial, performance indices result showed that there was no significant differences ($P>0.05$) in average weight changes, and average daily weight gain. Feed conversion ratio showed a significant difference ($P<0.05$) . The best feed conversion ratio was $T_6 F_{25}$. The cost and returns on production showed that $T_6 F_{25}$ had high earnings for revenue and gross margin with reduced cost/kg weight gain. It was concluded that fermented cocoyam corm meal should be included in turkey starter ratio at 25% level due to its heavier weight gain, better feed conversion ratio, cost effectiveness and increased revenue and profit margin.

Key words: turkey, processed, yellow cocoyam, Performance, Cost and returns

INTRODUCTION

Maize is a key energy feed in live stock production and contributes about 45% to 60% (45kg to 60kg per 100kg feed) in the ration of poultry. Maize is widely used in industries for the manufacture of various foods, man also plants and consumes maize in a variety of ways at home level. The multiplicity of importance of maize and its diverse use has led to its scarcity and consequently the price is being skyrocketed compared to other energy feeds. This has led to high cost of production of poultry products and invariably high cost of poultry products making it difficult for the ordinary man to consume enough poultry products or enough proteins of animal origin.

The escalating cost of conventional energy feedstuffs such as maize has immensely contributed to the observed declining animal protein and animal production in Nigeria, (Ogbonna *et al.,* 2000). FAO (2010) reported that out of the 53g of protein per caput per day, Nigeria obtains 10–15g of proteins per caput per day from animal sources as against the recommended 35g per caput per day. It is therefore necessary to investigate into the value of other cheap and neglected energy sources in poultry to substitute for maize either partially or wholy and thus reduce cost of enrgy feedstuff and hence cost of production and consumption.

Yellow Cocoyam (*Xanthosoma sagittifolum*) has a great potential as enrgy source. It is a corm that is third in importance after cassava and yam among the root and tuber crops (Ekwe *et al.,* 2012). Lewu and Adebola (2010) reported that yellow cocoyam corm contains digestible starch, good quality protein, vitamin C, thiamine, riboflavin, niacin, and high scores of essential amino acids Utilisation of the corms as energy source for poultry have been reported (Onu *et al*., 2001), It has been reported that cocoyam meal contained 7.87% crude protein, 31% dry matter, 4.75% crude fiber, and 3214.91 Kcal/kg metabolisable energy on dry matter basis (Abdulrashid and Agwunobi, 2009). This root crop has been undermined and under-utilized due to the presence of anti-nutritional factors such as oxalate, phytates, saponin, tannin and flavonoids (Alcantara *et al*. 2013). It therefore becomes necessary to pass the cocoyam corm through processing in other to harvest the rich nutrients contained in it and make it available for tissue growth and development of the animals after consumption.. Fermentation, cooking and sundrying are some of the the traditional and most effective old known ways of detoxifying feed items before use. Igbabul *et al*., (2012) reported that fermentation increased the protein content, moisture and crude fibre content of the *Mucuna sloanei* flour. Ukachukwu and Obioha (1997) recommended detoxification by cooking for 90 minutes or toasting for 60 minutes.

This study therefore, was aimed at evaluating the growth performance, cost and returns on turkey broiler starter offered differently processed yellow cocoyam corm meal.

MATERIALS AND METHODS

The study was carried out at the Imo State University, Faculty of Agriculture Teaching and Reaearch farm, Owerri. Owerri is located within the South−Eastern agro‒ecological zone of Nigeria. Owerri lies between latitude 5°29″ North and longitude 7°20″ East. It is almost 73m above sea level with annual rainfall, temperature, and humidity ranging from 1,500mm to 2,200mm, 28°C and 75 – 90% respectively (Meteoblue, 2021).

The yellow cocoyam corms used for this experiment were bought from rural areas and markets from Atta in Njaba L.G.A. and Egbu in Owerri North L.G.A. of Imo State Nigeria. These areas do not use yellow cocoyam corms as food and this has resulted to its trying to go into extinction. The cocoyam corms were cut into pieces and peeled. Some were sundried at its raw state, some were cooked and sundried while some were fermented for three days and sundried. Thereafter the cocoyam corms were ground in a hammer mill to make yellow cocoyam corm meal. The samples of the raw, cooked and fermented cocoyam corm meal were analyzed to determine the proximate and phytochemical composition according to AOAC (2010).

Seven experimental diets were formulated to contain the differently processed yellow cocoyam corm meal. The experimental diets were represented as $T_1$0, T_2R_{15}, T_3F_{15}, T_4C_{15}, T_5R_{25}, T_6F_{25}, and T_7C_{25}. $T_1$0 represented the control containing 100% maize. R in T_2 and T_5 represented raw and dried cocoyam at 15% and 25% dietary inclusion level respectively. C in T_4 and T_7 represented cooked and dried cocoyam at 15% and 25% dietary inclusion levels respectively and F in T_3 and T_6 represented fermented and dried cocoyam at 15% and 25% dietary inclusion levels respectively. The experimental diet and calculated nutrient composition for the turkey broiler starter is presented in Tables 1.

A total of 105 day old turkey broiler starter were used for the experiment. The turkey day old chicks were purchased from a reputable hatchery in Owerri. The day old turkey broiler were brood for four weeks in the brooder house. Thereafter brooding was discontinued and the birds were reared for another four weeks during which they were given turkey starter ration. The turkey broiler starter were divided into 7 groups of 15 birds per group and each group assigned to one of the treatment diets in a completely randomized design (CRD). Each of the groups were further divided into three replicates of 5 turkey starter per replicate. The initial weights of the turkey starter were weighed and recorded and weekly thereafter for another four weeks. Feed intake was recorded daily and the birds weighed weekly after taking the initial body weight. Feed intake was determined by weighing the feed offered and the left-over the following day. The difference between the two values was taken as the feed consumed. Feed conversion ratio was determined by dividing the average daily feed intake by average daily body weight gain. Economic indices determined were average weight changes, average daily weight gain and average daily feed intake. Other indices were calculated as followed (i) cost/kg weight gain was calculated as feed conversion ratio multiplied by cost/kg of feed; (ii) cost of feed consumed was taken as cost of production; (iii) cost of production was calculated as cost/kg weight gain multiplied by average weight changes; (iv) price/kg meat = price of selling one kg of meat; (v) revenue = price /kg meat multiplied by average weight changes and (vi) gross margin (profit) was calculated as revenue minus cost of production.

Data collected were subjected to analysis of variance using the SPSS software (2012). Where analysis of variance indicated significant treatment effects, means were compared using Duncan′s New Multiple Range Test (DNMRT) (SPSS, 2012)

Table 1: Ingredients and calculated nutrient composition of the experimental turkey broiler starter diet

Ingredients	$T_1 0\%$	$T_2R_{15\%}$	$T_3F_{15\%}$	$T_4C_{15\%}$	$T_5R_{25\%}$	$T_6F_{25\%}$	$T_7C_{25\%}$
Maize	43.56	28.56	28.56	28.56	18.56	18.56	18.56
YCCM	0.00	15.00	15.00	15.00	25.00	25.00	25.00
SBM	38.59	38.59	38.59	38.59	38.59	38.59	38.59
Fishmeal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bloodmeal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
PKC	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Wheat offal	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0..25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
*Vit. Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100
Calculated Nutrient Composition							
CP (% DM)	26.00	26.42	26.34	26.26	26.70	26.57	26.44
ME(Kcal/kg)	2757.09	2694.09	2707.40	2715.29	2652.31	2674.28	2687.42
EE (%DM)	6.74	6.77	7.13	7.13	6.79	7.39	7.39
CF (%DM)	3.98	4.95	4.39	4.97	5.60	4.67	5.63
Ash (%DM)	3.16	4.06	4.96	3.88	4.66	6.15	4.35
Ca (%DM)	0.27	5.67	5.67	5.67	9.27	9.27	9.27
P (%DM)	0.46	2.94	2.94	2.94	4.59	4.59	4.59
Lysine (%DM)	0.89	0.90	0.90	0.90	0.90	0.90	0.90
Methionine	0.34	0.32	0.32	0.32	0.31	0.31	0.31

*Provided the following per kg of feed; vitamin A, 1000iu; vitamin D3, 1500iu; vitamin E 51mg; vitamin K, 2mg; Riboflavin, 3mg; Pantothenic acid, 10mg; Nicotinic acid, 25mg; Choline, 350mg; Folic acid, 1mg; Mg, 56mg; Iodine, 1mg; Fe, 20mg; Zn, 50mg; Co, 1.25mg.

Note: YCCM (Yellow cocoyam corm meal); SBM (Soya bean meal); GNC (Groundnut cake); PKC (Palm kernel cake); CP (Crude protein); ME (Metabolizable energy); EE (Ether extract) and CF (Crude fibre)

RESULTS

Proximate and phytochemical composition of yellow cocoyam corm meal ((*Xanthosoma sagittifolum*)

The proximate composition of the raw cocoyam corm meal was 24.08% carbohydrate, 8.26% crude protein, 3.21% crude fibre, 1.06% crude fat and 3.43% ash. Cooked dried cocoyam had 62.52% carbohydrate, 10.67% crude protein, 9.31% crude fibre, 6.59% crude fat and 6.05% ash, Fermented and dried cocoyam corm meal was 63.00% carbohydrate, 11.72% crude protein, 9.19% crude fibre, 4.19% crude fat and 7.26% ash. The raw dried cocoyam corm meal was 60.51% carbohydrate, 11.20% crude protein, 35.47% crude fibre, 6.58% crude fat and 13.24% ash. All the nutrients were increased after processing most importantly were the total carbohydrate and crude protein. Fermented and dried, cooked and dried and raw and dried cocoyam corm meal gave a higher value for crude protein compared to the raw cocoyam. It was a pointer to the fact that fermention, cooking and drying as a processing method improved the nutritive value of the cocoyam. The processing methods may have influenced the release of bound crude proteins. The values of crude protein reported by Olajide *et al*. (2011), and Ndabikunze *et al*. (2011) for fermented cocoyam (7.44%), cooked cocoyam (6.11%), soaked cocoyam (6.56%), raw sundried (4.93–7.07%) were lower than the values obtained in this study. The processing method and the duration of drying, may be respomsible for the variation in crude protein content.

Phytochemically, the raw cocoyam corm contained 14.22% phytate and 7.041 oxalate mg/g. Cooking reduced the phytate and oxalate to 4.43% phytate and 0.26mg/g oxalate ; fermentation reduced the anti-nutrients, phytate and oxalate to 4.59% phytate and 0.29mg oxalate respectively and raw sun-dried cocoyam corm reduced phytate and oxalate to 3.79% and 0.23mg/g oxalate respectively. Olajide *et al*. (2011) reported a similar reduction in antinutrients when subjected to processing methods such as fermentation, cooking and sundrying.

Data on the performance of the experimental turkey starter broilers are presented in Table 2. There was no significant difference (P>0.05) in the mean inital weight, mean final weight, mean weight changes, mean daily weight gain and mean daily feed intake. There was a significant treatment effect (P<0.05) on the feed conversion ratio. The value of the feed conversion ratio of the turkey starter birds was significantly decreased at 15% and 25% inclusion level of the fermented cocoyam corm meal compared to cooking and raw dried at 25% inclusion levels. It all means that fermentation gave a superior feed conversion ratio that means, birds that consumed the fermented cocoyam corm meal diet yielded more body weight with less feed. This implies that the die tat 15% and 25% inclusion level of fermented cocoyam corm meal was efficiently utilized. Anti¬nutrient had no adverse effect on their performance characteristics. The feed conversion ratio of 2.77 to 2.80 agrees with the standard reference range reported (2.7 to 2.8) reported by Ghosh (2015).Data on the cost and returns of feeding differently processed yellow cocoyam corm meal on turkey grower poult are shown in Tables 3. The feed cost, cost per kg weight gain and cost of production were highest in T_1O. This implies that it costs more to produce one kg of meat compared to others. This is attributed to the high cost of maize which is 100% in the ration of T_10 compared to other treatments that are partly maize and partly cocoyam corm meal.

Table 2: The result of the performance of turkey starter broiler offered differently processed yellow cocoyam corm meal

Indices	T_1O	T_2R_{15}	T_3F_{15}	T_4C_{15}	T_5R_{25}	T_6F_{25}	T_7C_{25}	SEM
Av. Initial weight (g)	594.45	605.55	605.55	583.33	577.78	583.33	605.55	297.07
Av. Final weight (g)	2219.44	2150.00	2188.89	1927.78	1916.67	2127.78	1961.11	324.22
Av. Weight change (g)	1624.99	1544.45	1583.34	1344.44	1338.89	1544.45	1355.56	307.40
Av. Daily weight change (g)	58.04	55.16	56.55	48.02	47.82	55.16	48.41	4.01
Av. Daily feed intake (g)	162.40	158.17	156.94	148.82	155.54	154.47	145.75	27.42
Feed conversion ratio	2.80^c	2.86^c	2.77^c	3.10^b	3.25^a	2.80^c	3.01^b	0.04

Abcd means within the same row with different superscripts are significantly different (P<0.05)

Table 3: Cost and returns of turkey broiler starter offered differently processed cocoyam corm meal

Parameters	T_1O	T_2R_{15}	T_3F_{15}	T_4C_{15}	T_5R_{25}	T_6F_{25}	T_7C_{25}
Feed cost/kg	300	270	273	270	250	255	250
Cost/kg weight gain	840.00	772.2	756.21	837.00	812.50	714.00	752.50
Cost of production	1364.99	1192.62	1197.34	1125.30	1088.81	1102.74	1020.06
Cost of feed consumed	1364.99	1192.62	1197.34	1125.30	1088.81	1102.74	1020.06
Price/kg meat	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Revenue	2437.49	2316.68	2375.01	2016.66	2008.34	2316.68	2033.34
Gross margin (profit)	1072.5	1182.39	1177.67	891.36	920.53	1213.94	1013.28

The feed cost per kg weight gain was best or lowest at 15% and 25% inclusion level of fermented cocoyam corm meal indicating that it costs less to produce 1kg of meat at these levels. The revenue and gross margin (profit) was also highest for turkeys at 25% dietary inclusion level of fermented cocoyam corm meal. This research revealed that 25% inclusion level of FCCM was better than the rest treatments, that is to cooking or raw dried because of heavier body weight changes and heavier mean daily weight gain which resulted in better feed conversion efficiency, reduced cost per kg weight gain, reduced cost of production and higher revenue and profit margin.

DISCUSSION

The turkey starter improved performance positively at 25% dietary level of the fermented cocoyam corm meal. The high level of performance of the turkey starter in mean weight gain, mean daily weight gain and feed conversion ratio was a reflection of the effect of fermentation on the test diet. Fermentation released bound nutrients in the cocoyam that were unavailable to be available for tissue growth and production. The solubility of proteins and the

availability of some micronutrients and limiting amino acids are enhanced by the process of lactic acid fermentation (Rollan *et al*.,2019). Fermentation reduced to a tolerable level the anti-nutritional factors in the cocoyam thus eliminating any barrier on nutrient digestion or any deleterious effect on the turkey growth and development. This was also demonstrated in the reduction in the level of pytochemicals in the cocoyam after fermentation. It was reported that fermentation reduced tannins by 50%, phytates and oligosaccharides by 90% (Samtiya *et al*. (2020)) . . The feed conversion ration was better than the control and the raw dried at 15% and 25% dietary inclusion levels. The feed conversion ratio was within the reference range (2.7 to 2.8) recommended by Ghosh (2015) for turkey.

Cost per kg weight gain decreased at 25% inclusion level for all treatments because of the reduced quantity of maize in the meal compared to 15% inclusion levels which had a higher quantity of maize in the ration. The cost per kg weight gain and cost of production were highest in T_1O due to high cost of maize and poor feed conversion ratio. When the feed conversion ratio is poor, it will cost more to produce one kg of meat. Similarly, when the cost of feed ingredient is high, the final cost of production will increase. The feed cost per kg weight gain was at optimum at T_6F_{25} due to reduced cost of test feed ingredient and better feed conversion ratio. Low value for feed conversion ratio or optimum feed conversion ratio leads to low cost of production since it costs less to produce one kg of meat. T_6F_{25} gave higher revenue and gross margin (profit). due to heavier body weight gain and better feed conversion ratio than the rest (that is, more kilos of meat than the rest treatments) which was sold to generate more money. Fermented yellow cocoyam corm meal generally speaking performed best, was cost effective and yielded more revenue and profit margin at 25% inclusion level due to reduced cost of test feed item, heavier body weight gain, and better feed conversion ratio.

CONCLUSION

The result of the trial showed that the different processing methods reduced the antinutrients to a tolerable level.

The study also showed that the turkey starter performed best at 25% inclusion level of the fermented cocoyam corm meal.

The study showed that fermentation was the most effective processing method being able to release cocoyam bound-nutrients for tissue growth. The trial also revealed that Fermented yellow cocoyam corm meal was cost effective, yielded more revenue and profit margin, heavier body weight gain, and better feed conversion ratio at 25% inclusion level.

Recommendation

It was therefore, recommended that fermented yellow cocoyam corm meal should be used as energy source in the ration of turkeys by farmers at 25% inclusion levels.

In the future, it may be necessary to try this fermented yellow cocoyam corm meal on other poultry and livestocks.

Conflict of interest

We declare that there is no conflict of interest in this paper. The work is original document of the authors.

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