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The Response of Broiler Finisher Birds Fed Graded Levels of Yam Peel Meal in Place of Maize-Based Diets

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Abstract: Performance of broiler finisher birds fed graded levels of yam peel meal in place of maize-based diets was investigated. 120 Anak broilers with likely equal weights were randomly allocated to 4 dietary treatments. Each treatment having 3 replicates with 10 birds per replicate in a completely randomized design (CRD). Diet 1 which was maize-based served as control, while yam peel meal quantitatively replaced 5%, 10% and 15% of maize meal in diets 2, 3 and 4 respectively. Each diet was offered *ad libitum* to the broiler birds for 28 days. Yam peel meal consists of 89.25 dry matter, 12.17 crude protein, 9.3 ash, 6.3 crude fibre, 1.05 crude fat and 2.980kcal/g gross energy. Anti-nutritional factors like tannin (0.57), saponin (0.87), oxalate (1.19), phytate (0.89), trypsin inhibitor (0.0) are in yam peel meal. There were no significant ($P<0.05$) differences for the mean values of growth performance among the diets but all the same, diet 2 is most favoured numerically. There were significant ($P<0.05$) differences for all the parameters considered for cut parts, with the exception of wing, thigh and breast cut. Over all, it favoured diet 2 among others. For serum chemistry (total protein, urea, creatinine, alkaline phosphatase and albumin) values fall within the normal range of biochemical indices for broilers. For gross margin, diet 2 had the highest value (₦151.36) when compared with the control diet (₦138.5), diet 3 (₦126.80) and diet 4 (₦101. 47). Judging from growth performance, carcass characteristics, biochemical values and economics of the diet, diet 2 is recommended.

Key words: Response, broiler finisher bird, graded levels, yam peel meal, maize-based diets

Introduction

Great emphasis continue to be placed on research into the use of alternative feedstuff for energy sources for poultry and livestock production, due to the increasing price of conventional energy sources such as maize, guinea corn e.t.c for livestock and poultry production (Ojewola and Annah, 2006). The resultant effect of this is shortage in animal protein and high cost of poultry production and hence poor animal protein intake among Nigerians (Akinmutimi, 2004).

The average Nigerian consumes only 3.245g of animal protein per person per-day which is far below the FAO (2000) recommended value of 34g. This low level of animal protein intake by Nigerians has generated concern as it affects both physical and mental development of Nigerian youths and labour force in Nigeria (Akinmutimi, 2004). One way of solving this problem is by focusing on production of animals with high rate of production and growth. One of such animals is poultry (Ezieshi *et al*., 2004). It is the quickest source of meat and it matures very quickly as compared to livestock production. Poultry is free from the various social religious taboo and economic constraints which affects the commercial production of livestock. They are also characterized by low capital requirement and quick returns (Obioha, 1992, Onwukwe, 2000).

However, feed accounts for between 70-80% of the total cost of production in Nigeria (Ogunfowora, 1984). This is as a result of the fact that the conventional energy source that has the lion share is being competed for by man, livestock and industries. To solve the above-mentioned problem, is to search for or identify an alternative energy source such that can meet the nutrient requirement of farm animals, less competed for by man and of no industrial usage (Akinmutimi, 2004).

Yam peel (*Dioscorea rotundata*) is one of the various farm wastes that have such potentials (Adeyemo and Borrie, 2002). Yam peel is cheaply available in Nigeria (Akinmutimi *et al*., 2006). White yam peel consists of 11% crude protein with metabolizable energy of 2604kcal/g (Eka, 1985 and Akanno, 1998). *Dioscorea rotundata* peels are rich in amino acid (Eka, 1985).

Materials and Methods

Environment of study: The study was carried out at the livestock unit of the Michael Okpara University of agriculture, Umudike, Abia state, Nigeria.

Umudike bears the co-ordinate of 5^{o} 28^{1} north and 7^{o} 31^{1} east and lies at altitude of 122m above sea level. It is located within the tropical rail forest zone and the environment is characterized by an annual rainfall of about 2177mm. The relative humidity during raining season is well above 72%. Monthly ambient temperature ranges from 17^{o}C – 36^{o}C. March is the warmness month with an average temperature range of 22^{o}C - 30^{o}C.

Processing of the test feed stuff (Yam Peels): The yam peels were collected from the University environs (Umudike). The Yam peels were sun dried, oven dry at 60°C and milled to fine particles of 2mm in diameter and used to formulate the test diets.

Experimental birds and management: One hundred and twenty, four week old Anak broiler birds were used for this experiment. They were randomly assigned to four experimental treatments; each treatment was replicated thrice in a completely randomized design. They were assigned to four diets designated as, T_1, T_2 T_3 and T_4. Feed and water were given *ad libitum* and its remnant were measured and used to calculate parameters like final body weight gain, and feed conversional ratio.
The birds were given routine vaccination such as intra-ocular in the first day of life, Gumboro and lasota vaccine were given in the 2nd and 3rd week of life respectively and other medication followed for good health.

Experimental diet: Treatment I is maize base diet (control diet) while the test ingredient replaced maize at 9.09% (5%), 18.08% (10%) and 27.27% (15%) in diets 2, 3 and 4 respectively (Table 1).

Chemical and statistical analysis: Proximate composition of the diets and Test feed stuff were analyzed by the method of A.O.A.C (1990). Anti-nutritional factors such as tannin, saponin, oxalate, phytate and trypsin inhibitors were determined using the methods below. Data collected were subjected to analysis of variance according to Steel and Torrie (1980) and significant means were separated using Duncan's multiple range test (Duncan, 1955).

Parameters evaluated

Growth performance: Record of data were collected on initial weight of birds, final weights of the birds, feed intake, weight gain and the number of birds that died during the experiment in each replicate. The values obtained wee used to obtain the following parameters:

$$\text{Feed intake/bird/day (g)} = \frac{\text{Quantity of feed given (g)} - \text{refusal (g)}}{\text{No. of birds} \times 28 \text{ days.}}$$

$$\text{Daily weight gain/bird (g)} = \frac{\text{Final live weight} - \text{Initial weight}}{\text{No. of birds} \times 28 \text{ days.}}$$

$$\text{Feed conversion ratio} = \frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

$$\% \text{ Mortality} = \frac{\text{Number died}}{\text{Number housed}} \times \frac{100}{1}$$

Gross margin: This reveals the profitability of the test diets. It was calculated using the method of Sonaiya *et al*. (1986).

Evaluation of carcass quality: Evaluation of carcass quality was carried out as described by Ojewola and Longe (1999). This involves the selection of 2 birds from each treatment (birds closest in mean weight per replicate). The selected birds wee fasted overnight and thereafter bled by severing the jugular vein. They were then scalded in hot water and subsequently de-feathered. The head, neck, shank and viscera were removed to have the dressed weight and percentage dressed weight calculated. The wings were removed by cutting anteriorly, severing at the humero scapular joint. The cut was made close to the body line. Lateral cuts were made through the rib heads to the shoulder girdle and the breast was removed intact by pulling anteriorly. The thigh, drumstick and back cuts were also dissected from each carcass. All parts were weighed and expressed as percentage dressed weight. Also, organs like heart, kidney, spleen and gizzard were weighed and expressed as percentage of dressed weight.

Determination of blood constituents: Blood samples were collected in labeled sterile bottles, without anti coagulants. These samples were used to determine the biochemical indices such as total protein, albumin, serum alkaline phosphatase, serum creatinine and urea. The blood chemistry was determined as described by Morbert (1979).

Determination of anti nutritional factors

Phytic acid: The determination of the phytic acid was done by the procedure described by Lucas and Makakas (1975). This entails the weighing of 2g of each sample into 250mls conical flask. 100mls of 2% concentrated hydrochloric acid was used to soak each sample in the conical flask for 3 hours. This was subsequently filtered through a double layer of hardened filter paper. 50mls of each filtrate was placed in 250mls beaker and 107mls of distilled water was added in each case to give proper acidity. 10mls of 0.3% ammonium thiocyanate solution was added into each solution as indicator. This was titrated with standard iron (III) chloride solution, which contained 0.00195g iron per ml. The end point was slightly brownish yellow, which persisted for 5 minutes. The percentage phytic acid was calculated using the formula:
% Phytic acid = X x 1.19 x 100 / 2
where X = Titre value x 0.00195

Tannic acid (Tannin): The tannin in the test feedstuff were determined according to the method of Mega (1982). Thus 2g of each sample was weighed into a beaker. Each was soaked with solvent mixture (80mls of

acetone and 20mls of glacial acetic acid) for 5 hours to extract tannin. Each filtrate was in the water bath for 4 hours, after which the filtrate was removed. The sample was filtered through double layer filter paper to obtain the filtrate. A set of standard solution of tannin acid was prepared ranging from 10ppm to 50ppm. The absorbance of the standard solution as well as that of the filtrate was read at 500nm on a spectronic 20. The percentage tannin was calculated using the formula:
% Tannin = absorbance x Average gradient x Dilution factor / 10,000

Oxalate estimation / determination: Oxalate determination was carried out as described by Fasset (1966). 2g of sample was boiled in 40ml of water for 30 minutes in reflux condenser. 10 ml of 20% Na_2CO_3 was added and boiled for another 30 minutes. The liquid was extracted and the residue was washed with hot water until the wash water stopped showing any alkaline reaction. The combination of wash water and filtrate were concentrated to a small volume and cooled. With constant stirring, HC was added (1:1) drop wise until the final acid concentration after neutralization was about 1% at which stage, a heavy precipitate appeared (which was allowed to flocculate). The extract was carefully filtered into a 250ml flask and made-up to mark. It was kept over-night, then the supernatant liquid was filtered through a dry filter paper in a dry beaker. An aliquot of this filtrate was taken into a 400ml beaker, diluted with water to 200ml and made just ammonia cal and rectified with acetic acid. In the cold medium, 10ml of a 10% calcium chloride solution was added and stirred well to induce calcium oxalate precipitate to appear and it was allowed to settle overnight. The clear supernatant liquid was carefully decanted off through Whatman No 42 filter paper, without disturbing the precipitate. The precipitate was dissolved in HCl (1:1). Oxalic acid was re-precipitated bv adjusting the pH with ammonium hydroxide solution. Contents were boiled and allowed to settle overnight. Oxalic acid as determined by titrating against 0.05N $KMnO_4$ solution.

Calculation:
1ml of 0.05N $KMnO_4$ = 0.0225 anhydrous oxalic acid.

% Oxalic acid = Titre value x 0.00225 / 2
= T.U x 0.1125.

Saponnin: The spectrophotometric method of Brunner (1984) was used for Saponnin analysis. 1g finely ground sample was weighed into a 250ml beaker and 100ml of 150tyl alcohol was added. The mixture was shaken on a UDY shaker for 5 h to ensure uniform mixing.
Thereafter, the mixture was filtered through Whatman No. 1 filter paper into a 100ml beaker and 20ml of 40% saturated solution of magnesium carbonate was added.

Table 1: Experimental diets

	T_1	T_2	T_3	T_4
Maize	55.00	50.00	45.00	40.0
Yam Peel	-	5.00	10.00	15.0
Soya-Bean Meal	25.00	25.00	25.00	25.0
Wheat Offal	13.30	13.30	13.30	13.3
Fish Meal	3.00	3.00	3.00	3.0
Bone Meal	3.00	3.00	3.00	3.0
Salt	0.25	0.25	0.25	0.25
Vit.Premix	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Crude Protein (%)	19.72	19.72	19.84	19.90
Metabolizable Energy (Kcal/g)	2939.21	2897.71	2856.21	2814.71

Table 2: Proximate composition of yam-peel meal

Constituent	Percentage
Crude Protein	12.17
Crude Fat	1.05
Crude Fibre	6.30
Ash	9.30
Dry matter	89.25
Gross Energy Kcal\g	2.98

Table 3: Proximate composition of experimental diets

Constituent	T_1	T_2	T_3	T_4
Crude protein (%)	19.67	19.990	20.14	20.360
Crude fat (%)	3.55	3.610	3.66	3.660
Crude fibre (%)	3.81	3.950	4.10	4.160
Ash (%)	6.99	7.230	7.45	7.550
Dry matter (%)	89.70	89.610	89.69	89.830
Gross energy (kcal\g)	3.081	3.099	3.09	3.090

Table 4: Anti-nutritional factors in yam peels

Anti-Nutritional Factors	% in Yam Peels
Tannin	0.57
Saponin	0.87
Oxalate	1.19
Phytate	0.89
Trypsin inhibitor	0.0

The mixture obtained with saturated $MgCo_3$ was again filtered through a Whatman No. 1 filter paper to obtain a clear colourless solution. 1ml of the colourless solution was pipetted into 50ml volumetric flask and 2ml of 5% $FeCl_3$ solution was added and made up to mark with distilled water. The reaction was stopped 30 min for blood red colour to develop. 0-10ppm standard saponnin were prepared from saponnin stock solution. The standard solutions were treated similarly with 2ml of 5% $FeCl_3$ solution as done for 1ml sample above.
The absorbances of the sample as well as standard saponnin solutions were read after colour development on a spectronic 2ID spectrophotometer at a wavelength of 380nm.
% saponnin = Absorbance of sample x Gradient factor x Dilution factor / wt sample x 10,000.

Determination of trypsin inhibitors: The determination of trypsin inhibitors was carried out according to the

Table 5: Growth performance of broiler birds fed graded level of yam peel

	Levels of yam peel inclusion				
	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	SEM
Initial weight/bird (g)	446.60	450.00	446.60	450.00	21.73
Mean final weight/bird (g)	1261.70	1280.00	1228.00	1230.00	20.74
Feed intake/bird/day(g)	119.30	118.10	120.40	120.10	1.09
Weight gain/bird/day (g)	29.10	29.64	27.20	27.86	1.10
Feed conversion ratio	4.12	3.99	4.44	4.35	0.17
Gross margins (N)	138.50	151.36	126.80	101.45	23.38

Table 6: Cut-parts (weight) of broiler finisher birds fed graded level of yam peels expressed as percentage dressed weight

	Levels of yam peel inclusion				
	T_1	T_2	T_3	T_4	SEM
Live weight (g)	1.80^{c}	1.82^{ab}	2.02^{a}	1..89^{ab}	0.06
Dressing percentage(g)	69.50^{a}	70.58^{a}	64.28^{ab}	55.6^{b}	2.79
Thigh (g)	212.50	225.00	200.00	212.33	8.83
Drum stick (g)	165.83^{b}	180.00^{b}	180.00^{b}	237.50^{a}	11.83
Breast cut (g)	240.00	250.00	179.16	179.16	27.69
Back cut (g)	436.83^{a}	300.00^{b}	425.00^{a}	415.00^{a}	22.69
Wing (g)	162.50	175.00	145.83	142.50	18.14

a-e treatment means in the same row not followed by the same letter are significantly different from one another (P<0.05).

Table 7: Mean Biochemical Values of Broiler Finishers Fed Experimental Diets

Parameters	T_1	T_2	T_3	T_4	SEM
Total protein (g/dl)	3. 40	2.80	2.85	3.10	0.22
Urea (mg/dl)	8.00^{b}	9.16^{a}	8.50^{ab}	8.00^{ab}	0.33
Creatinine (mg/dl)	4500.00	4500.00	5000.00	4000.00	0.04
Alkaline phosphatase (µ/l)	123.50^{b}	122.50^{b}	121.00^{b}	155.00^{a}	9.55
Albumin (g/dl)	2.15^{a}	2.00^{a}	2.20^{a}	1.25^{b}	0.11

*a-e treatment means in the same row not followed by the same letter are significantly different from one another (P<0.05).

Table 8: Economics of Replacing Maize With Yam Peel meal in Broiler Finisher Diet

Parameters	T_1	T_2	T_3	T_4	SEM
Cost/kg feed (N)	56.65	54.65	52.65	50.65	1.04
Cost/kg feed consumes/ bird	188.00^{a}	180.40^{b}	177.20^{bc}	171.40^{c}	2.02
Cost/kg weight gain	230.90	218.16	234.15	220.20	9.65
Cost of production	188.14^{a}	180.40^{b}	177.20^{bc}	171.40^{c}	2.08
Revenue	326.60	332.00	304.00	278.66	23.23
Gross margin	138.50	151.36	126.80	101.47	23.38

*a-e treatment means in the same row not followed by the same letter are significantly different from one another (P<0.05).

procedure outlined by Kakade *et al.* (1969). This involves weighing of 0.2g of the samples into a screw cap centrifuge tube. 1ml of 0.1M phosphate buffer was added and the contents shaken at room temperature for one hour on a UDY shaker. The suspension obtained was centrifuged at 5000rpm for 5 minutes and filtered through whatman No 42 filter paper. The volume of ach as adjusted to 2ml with phosphate buffer. The test tubes were placed in a water bath, maintained at 37^{o}C. Six milliliters of 5% TCA solution was added at one of the tubes to serve as a blank. 2ml of casein solution was added to all the tubes, which were previously kept at 37^{o}C. These were incubated for 20min. The reaction was stopped after 20 min by adding 6ml of TCA solution to the experimental tubes and the tubes were shaken. The reaction was allowed to proceed for 1 hour at room temperature. The mixture was filtered though whatman No 42 filter paper. Absorbance of filtrate from sample and trypsin standard solutions were read at 280nm. The trypsin inhibitors in mg g^{-1} was calculated using the formula:

$$\text{T.I. mg g}^{-1} = \frac{\text{A standard} - \text{A sample x Dilution factor}}{\text{0.1g x sample wt in g 1000 x sample size}}$$

Economics of the diets-as described by Sonaiye *et al.* (1986).

Results and Discussion

Proximate composition of test feedstuff (yam peels) and experimental diets: The proximate composition of the test feedstuff (yam peels) and the experimental diets are presented in Tables 2 and 3 respectively. Yam peel has a crude protein content of 12.7%. This value is

slightly higher than the value obtained by earlier reporter (Eka 1985) who reported 11.21%. The slight differences may be due to the different sources of the yam peel (Akinmutimi, 2004); In comparison with maize with 11.21% (PNMP, 1995).

The above value is slightly higher (12.7% cp), which is an added advantage when used. The gross energy content obtain (2.980kcal/g) is slightly higher than the one obtained by Eka (1985). Who reported 2.604 kcal\g; this could also be due to different sources of yam peel. The crude protein content of 12.7%and gross energy value of 2.980 kcal\g makes it a potential feedstuff.

The proximate composition of the diets values were similar to the calculated ones, this implies good mixing of diets. It also fall within the nutrient requirement for broiler finisher birds particularly the crude protein content which ranges between 19.67-20.36 (Akinmutimi, 2004).

Table 4 shows Anti-nutritional factors present in yam peels. They are as follows: tannin 0.57%, Saponnin 0.87%, Oxalate 1.19%, Phytate 0.89%, Trypsin inhibitor 0.0%. This confirms the report of earlier worker (Anakebe, 2006) who reported similar values in yam peels.

The growth performance of the broiler finishers bird fed graded level yam peel: The growth performance of the broiler finishers bird fed graded level yam peel is as shown in Table 5. There was no significant ($P>0.05$) difference for all the parameters considered. This implies that all the diets were statistically similar and any of them could be recommended. This probably implies that at higher level of inclusion, they may be a significant difference. The final weight, feed intake, body weight gain, feed conversion ratio and gross margin favoured diet 2 numerically.

Cut-Parts of Broiler Finisher Birds Fed Graded Levels of Yam Peel in broiler finisher diets: The values of cut-parts of broiler finisher birds fed graded levels of yam peels are as shown in Table 6. There were significant differences ($p<0.05$) for all the parameters considered with exception of wing, thigh and breast-cut. The back-cut do not follow any specific pattern, that could be attributed to the effect of the test ingredient. The drum stick favoured diet 4 while the dressing percentage favoured diet 2. Despite the non-significant value for thigh, wings and breast cut, for all these values diet 2 is favoured numerically. This shows superiority of diet 2 among others based on the fact that these parts are prime parts.

Blood chemistry of broiler finisher birds fed experimental diet: Table 7 shows the blood chemistry value of broiler finisher birds fed yam peels in place of maize based diets. There were significant differences for albumin, alkaline phosphatase and urea. The albumin value for diets 1, 2 and 3 were statistically ($p<0.05$) similar but differ from that of diet 4. The lower value for diet 4 may be probably due to inherent anti nutritional factors in yam peels. This implies that animals or birds placed on diet 4 may be prone to hemorrhages than others (Roberts *et al.*, 2003; Akinmutimi, 2004) since albumin helps in blood coagulation. The value for alkaline phosphatase followed similar pattern in diets 1, 2 and 3 which values are statistically similar but differ from that of diet 4. The significantly higher ($p<0.05$) value for alkaline phosphatase for diet 4 could also be attributed to the effect of anti nutritional factors and hence more production of these enzymes by the liver in a bit to detoxify them. The urea values do not follow any specific pattern that could be attributed to the effect of the test feed stuff. Despite this, the test diets had values that are numerically higher than the control diet. This could be traced to the effects of anti nutritional factors.

Economic Effect of Replacing Maize With Yam Peel meal in broiler finisher diets: Table 8 shows the economic effect of replacing maize with yam peels in broiler finisher diets. There were significant differences ($p<0.05$) for the values of cost/Kg of feed consumed. Cost of feed consumed/bird ranges from N188.0 to N171.4 with birds fed diet 1 (Control)

having the highest cost and birds fed diet 4 having the least cost. Also significant difference ($p<0.05$) exist between treatment on feed cost per kilogram of feed. This is due to less cost per-unit of yam peel meal compared to that of maize meal.

The revenue generated ranges from N278.66 to 326.6 with birds fed diet 2 giving the highest revenue. Diet 2 also gives the highest gross margin. This could be due to higher body weight gain observed in diet 2.

Since, farmers would not embark on production without giving thought to the likely sales and\or revenue from the ventures product; therefore, his/her primary objectives would be efficient productivity at the least possible cost. From the trial, diet 2 which is 5% level of yam peel meal inclusion in broiler finisher diet prove to be better than diet 1, 3 and 4.

The result of this trial therefore lends support to the need for replacing costly and scarce maize meal with cheap and readily available yam peel meal. This will in no doubt cut down cost and also improve the performance of the birds.

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