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EVALUATION OF YAM-SWEET POTATO PEELS MIXTURE AS SOURCE OF ENERGY IN BROILER CHICKENS DIETS

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ABSTRACT

In the search for alternative energy sources for poultry feeding, a 9-week experiment was conducted to ascertain the replacement value of yam-sweet potato peels mixture (YSPPM) for maize in broiler chickens diets. One hundred and eighty (180) Anak-2000 broiler chicks aged 6 days were randomly assigned to 12 floor pens containing 15 birds each. Four diets, based on 23 and 20% crude protein in the starter and finisher respectively, were formulated to contain 0, 15, 30, and 45% YSPPM as replacement for maize grain. Each of the diets was fed to 3 pens of 15 birds in a completely randomized design. Data were collected on growth indices, haematological profile, and carcass measurements and organs weights. During the starter period (7-28 days), daily feed intake and feed cost/kg gain were not adversely affected by feeding the test ingredient, but weight gain and feed conversion ratio (FCR) were depressed above 15% replacement of maize with the test material. In the finisher phase (28-63 days), feed intake was significantly increased on the 45% replacement diet compared to the control but did not differ statistically amongst the YSPPM-based diets as well as amongst the control, 15 and 30% replacement diets. The highest daily gain was recorded on the 15% replacement diet, but its values did not differ markedly amongst the control, 30 and 45% diets. Feed conversion ratio was significantly increased above 15% replacement of maize with YSPPM. Feed cost per kg gain was significantly reduced on the 15 and 45% replacement diets. The results of haematology did not show any depressive effect of feeding YSPPM. Similarly, the results of carcass measurements and organs weights did not show any disadvantage of feeding YSPPM, but there were beneficial effects of its feeding over the control maize-based diet with respect to breast meat and abdominal fat deposition. It was concluded that YSPPM can replace maize up to 15 and 45% in broiler starter and finisher diets respectively without adverse effects on the growth, haematological profile and carcass measurements.

Keywords: broiler chickens diet, yam-sweet potato peels mixture, maize, alternative energy sources.

INTRODUCTION

The scarcity and high cost of cereal grains, especially maize, has necessitated research into alternative energy sources for feeding poultry. Sweet potato (*Ipomea batatas*) and yam (*Dioscorea rotundata*) are produced in large quantities in Nigeria and form important energy sources for human and livestock feeding. The peels from the processing of these roots are readily available at cheap costs in many parts of the country because they have limited or no human food value.

Yam peel meal (YPM) is reported to be a good source of protein [1, 2] but poor in energy [1, 3]. On the other hand, sweet potato peel meal (SPPM) is high in energy but low in protein [4]. Mixing SPPM and YPM (50:50) will therefore, give a product with intermediate protein and energy contents. Although YPM and SPPM have been used singly to replace part of dietary maize, replacement levels have not been high in broiler diets. At the moment, there is no literature on the feeding value of the mixture of the two peels to poultry.

This study reports the effect of feeding yam-sweet potato peels mixture (YSPPM) as a source of dietary energy on broiler chickens' performance.

MATERIALS AND METHODS

Study site

The study was conducted at the Poultry Unit of the University of Maiduguri Livestock Research Farm between September and November, 2011. The area falls in the semi-arid zone with an annual rainfall of 500-600mm [5]. Sweet potato and yam are very important energy sources in human diets and their peels are readily available because they have little or no human food or industrial uses in the area.

Source of the test materials

Sun-dried peels (sweet potato and yam) were purchased from restaurateurs in Maiduguri Metropolis, further allowed to dry in the sun for 72 hours and ground separately in a hammer mill to pass through a 40-mesh sieve. The ground peels were then mixed in the ratio of 50:50 weights for weight to produce yam-sweet potato peels mixture (YSPPM) which was analyzed for proximate composition (Table-1) and used in the formulation of the experimental diets.

Experimental birds and diets

Two hundred and forty (180) day-old Anak-2000 broiler chicks purchased from Obasanjo Farms, Otta, Nigeria, were brooded together for the first 6 days during which they were fed a commercial starter diet from ECWA feeds, Nigeria. On the 7th day, the chicks were weighed and randomly allotted to 4 diets/treatments containing 3 replicates of 15 chicks each of similar weight (100 ± 0.2g/bird). Each replicate was housed in a floor pen measuring 1.95m^2 with wood shaving on the floor as litter material. The birds were vaccinated against Gumboro

disease at 2 and 4 weeks and Newcastle disease at 3 weeks of age.

Four diets containing 23% and 20% crude protein in the starter and finisher respectively were formulated (Table-2). The control diet was based on maize as energy source which was replaced with YSPPM at 15, 30 and 45% in diets 2, 3 and 4, respectively. The diets and clean drinking water were supplied *ad-libitum* throughout the period of the experiment (8 weeks). The starter diets were fed for 3 weeks and the finisher for 5 weeks.

Data collection

Data were collected on growth parameters (feed intake, weight gain, and feed conversion), haematological indices, and carcass measurements. Feed intake was monitored by feeding weighed quantities of feed daily and subtracting the left over from the quantity fed the previous day. The birds were weighed weekly and daily weight gain calculated as the difference between two (2) consecutive weighing divided by 7 (number of days in the week). Feed conversion ratio (FCR) was then deduced as the ratio of feed consumed to weight gained.

At the end of the experiment (9^{th} week), 3 birds were randomly selected from each treatment for collection of blood samples for haematological analysis and carcass measurements. The birds were fasted overnight and blood samples collected early in the morning through the wing veins into sample tubes containing ethylene diethyl tetra-acetic acid (EDTA) as anticoagulant. The haematological analyses were carried using the methods described by [6]. The birds were then weighed, slaughtered, plucked and eviscerated. The eviscerated weights (carcasses), the weights of carcass cut-up parts and organs (gizzard, liver, heart, and pancreas) and abdominal fat were expressed as percentages of the slaughter weights.

Data analysis

Proximate composition of the test material was carried out according to the procedure of [7]. Data on the growth, haematology and carcass measurements were subjected to analysis of variance [8] of a completely randomized design using Statistix [9].

Table-1. Proximate composition of YSPPM.

Principles	**Crude protein** (CP)	**Ether extract** (EE)	**Crude fibre** (CF)	**Total ash**	**Nitrogen free-extract** (NFE)	***ME** (Kcal/Kg)
Concentration (%)	3.66	4.00	14.00	8.00	70.34	2956.49

*Metabolizable energy calculated according to [10] as:
ME (Kcal/Kg) = 37× %CP + 81× %EE + 35.50 × %NFE.

Table-2. Ingredient and calculated composition of the experimental diets.

Ingredients	**Replacement levels of YSPPM for maize** (%)							
	Starter diets				**Finisher diets**			
	0	15	30	45	0	15	30	45
Maize (white)	45.11	38.34	30.57	23.80	49.88	42.40	34.92	27.44
YSPPM	0.00	6.77	13.54	20.31	0.00	7.48	14.96	22.44
Wheat bran	10.82	10.82	10.82	10.82	20.45	20.45	20.45	20.45
Soybean meal	31.28	31.28	31.28	31.28	18.95	18.95	18.95	18.95
Fish meal	10.64	10.64	10.64	10.64	6.48	6.48	6.48	6.48
Bone meal	2.50	2.50	2.50	2.50	3.50	3.50	3.50	3.50
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis (%)								
Crude protein	23.79	23.40	22.97	22.61	18.34	17.95	17.56	17.18
Crude fibre	2.88	2.69	3.47	4.27	3.30	4.19	5.07	5.97
ME (Kcal/Kg)	2870.53	2829.13	2787.72	2746.32	3167.53	3130.05	2947.18	3020.01

YSPPM: yam-sweet potato peels mixture, ME: Metabolizable energy
*Vit-Mineral Premix from Bio-mix supplied/kg: Vit A 4,000,000.00 IU; Vit D_3 800,000.00 IU; Vit E 9, 200.00mg; Niacin 11, 000.00mg; Vit B_1 720.00mg; B_2 2000.00mg; B_6 1, 200.00mg; B_{12} 6.00mg; Pantothenic acid 3, 000.00mg; Biotin 24.00mg; Folic acid 300.00mg; Choline Chloride 120, 000.00mg; Cobalt 80.00mg; Copper 1, 200.00mg; Iodine 400.00mg; Iron 8, 000.00mg; Manganese 16, 000.00mg; Selenium 80.00mg; Zinc 12,000.00mg; Anti oxidant 500.00mg

RESULTS

The results of growth of the broiler chickens are presented in Table-3. Daily feed intake and feed cost of broiler meat production (₦/kg gain) were not markedly (P>0.05) affected by dietary inclusion level of YSPPM during the starter phase (7- 28 days), but daily gain and body weight at 28 days were significantly (P<0.05) depressed above 15% replacement of the test ingredient for maize. Birds fed the 45% replacement diet converted their feed poorly (P<0.05) compared to those fed the control and the 15% replacement diets, but feed conversion ratio (FCR) did not differ (P>0.05) between the 45 and 30%, the 30 and 15%, and the 15% and the control fed groups.

During the finishing period (28-63 days) birds on the 15% replacement diet recorded the highest (P<0.05) daily gain and final body weight. Daily gain was similar (P>0.05) between the control and the 45% as well as between the control and the 30% replacement groups. However, despite this compensatory trend in daily weight gain birds on the 30 and 45% replacement diets recorded lower (P<0.05) final body weights compared to the control. The best (P<0.05) FCR values were recorded on the control and 15% replacement diets compared to the 30 and 45% which did not differ (P>0.05) from one another. Feed cost of meat production was reduced (P<0.05) on the 15 and 45% compared to the control and the 30% replacement diets.

The results of haematological analysis (Table-4) showed higher (P<0.05) packed cell volume (PCV) and red blood cell (RBC) count on the 15% replacement diet but their values were not significantly (P>0.05) different between the control and the 45% replacement diets. Haemoglobin (Hb) concentration was reduced (P<0.05) above 30% replacement. The values for monocytes and eosinophils were not significantly affected by the diets. White blood cell (WBC) count, lymphocytes count and heterophils: lymphocytes ratio were increased on the 45% replacement diet compared to the control, but their values did not differ (P>0.05) between the control and the 30% and between the 15 and 45% replacement diets.

The results of carcass measurements (Table-5) showed no marked (P>0.05) differences in dressing percentage and the percent drumsticks amongst treatments. The percent breast and wings were depressed (P<0.05) in birds fed the maize-based control diet compared to those fed the 45% replacement of maize with YSPPM. There were no significant (P>0.05) differences in the yield of the thighs between the control and the YSPPM-based diets fed birds.

The yields of vital organs (heart, liver and pancreas) were not adversely (P>0.05) affected by dietary inclusion of YSPPM. Gizzard weight was significantly (P<0.05) increased and abdominal fat decreased on the 45% replacement diet compared to the control.

Table-3. Growth performance of broiler chickens fed YSPPM as replacement for maize.

Parameters	Replacement level of YSPPM for maize (%)				
	0	15	30	45	SEM
7- 28 days (starter)					
Initial weight (g/bird)	100.00	99.98	100.01	100.00	0.01^{NS}
Final weight (g/bird)	803.47^{a}	793.61^{a}	668.32^{b}	677.78^{b}	13.58*
Daily feed intake (g/bird)	67.71	67.40	64.71	67.65	1.21^{NS}
Daily weight gain (g/bird)	32.31^{a}	31.13^{a}	27.77^{b}	27.51^{b}	0.70*
FCR (feed: gain)	2.10^{c}	2.17^{bc}	2.35^{ab}	2.48^{a}	0.07*
Cost of feed (₦/kg)	77.08	73.55	69.80	66.15	NA
Feed cost of production (₦/kg gain)	161.86	159.60	164.04	164.06	5.29^{NS}
28- 63 days (finisher)					
Initial weight (g/bird)	803.47^{a}	793.61^{a}	668.32^{b}	677.78^{b}	13.58*
Final weight (g/bird)	2618.80^{b}	2776.90^{a}	2438.90^{c}	2500.40^{c}	23.48*
Daily feed intake (g/bird)	154.94^{b}	163.29^{ab}	164.53^{ab}	167.19^{a}	3.27*
Daily weight gain (g/bird)	48.43^{bc}	53.24^{a}	46.89^{c}	49.00^{b}	0.59*
FCR (feed: gain)	3.20^{b}	3.07^{b}	3.51^{a}	3.41^{a}	0.06*
Cost of feed (₦/kg)	71.14	67.81	64.60	61.26	NA
Feed cost of production (₦/kg gain)	227.66^{a}	208.17^{b}	226.75^{a}	208.90^{b}	4.35*

^{abc}= Means within the same row bearing different superscripts differ significantly (P<0.05)
*= Significant (P<0.05)
NA = Not analyzed
NS = Not significant (P>0.05)
SEM = Standard error of the mean
YSPPM = Yam-sweet potato peels mixture

Table-4. Haematological profile of broiler chickens fed YSPPM as replacement for maize.

Parameters	Replacement level of YSPPM for maize (%)				
	0	15	30	45	SEM
PCV (%)	30.50^{b}	32.50^{a}	29.50^{b}	31.00^{ab}	0.56*
RBC (10^6/mm^3)	3.02^{b}	3.47^{a}	2.77^{c}	3.20^{ab}	0.08*
Hb (g/dl)	9.50^{a}	9.50^{a}	9.20^{a}	7.60^{b}	0.25*
WBC (10^3/mm^3)	15.25^{b}	16.77^{a}	15.27^{b}	16.77^{a}	0.25*
Heterophils (%)	34.00^{a}	23.00^{b}	32.50^{a}	26.50^{b}	1.60*
Monocytes (%)	6.00	6.50	6.50	5.50	0.56^{NS}
Eosinophils (%)	4.00	6.00	4.67	5.00	0.79^{NS}
Lymphocytes (%)	56.00^{b}	64.00^{a}	56.00^{b}	63.00^{a}	1.53*
Heterophils: Lymphocytes	1.65^{b}	2.78^{a}	1.72^{b}	2.38^{a}	0.24*

^{abc}= Means within the same row bearing different superscripts differ significantly (P<0.05)
*= Significant (P<0.05)
NS = Not significant (P>0.05)
SEM = Standard error of the mean
YSPPM = Yam-sweet potato peels mixture

Table-5. Carcass measurements and organs weights of broiler chickens fed YSPPM as replacement for maize.

Parameters	Replacement level of YSPPM for maize (%)				
	0	15	30	45	SEM
Live weight (g/bird)	2325.00	2250.00	1925.00	2100.00	209.41^{NS}
Dressing (%)	64.57	63.91	61.11	62.86	2.13^{NS}
Carcass cut-up parts (% live weight)					
Breast	17.33^{c}	18.81^{a}	17.87^{bc}	18.59^{ab}	0.29*
Thighs	10.66^{ab}	11.31^{a}	10.18^{b}	10.46^{ab}	0.33*
Drumsticks	9.90	7.90	9.91	9.55	0.63^{NS}
Wings	8.16^{b}	8.32^{ab}	8.48^{ab}	8.49^{a}	0.10*
Organs (% live weight)					
Liver	1.94	2.11	2.28	2.26	0.11^{NS*}
Pancreas	0.27	0.27	0.29	0.35	0.02^{NS}
Gizzard	2.53^{bc}	2.21^{c}	2.79^{ab}	3.00^{a}	0.14*
Heart	0.47	0.50	0.62	0.52	0.05^{NS}
Abdominal fat	1.79^{ab}	2.02^{a}	1.28^{bc}	1.11^{c}	0.16*

^{abc}= Means within the same row bearing different superscripts differ significantly (P<0.05)
*= Significant (P<0.05)
NS = Not significant (P>0.05)
SEM = Standard error of the mean
YSPPM = Yam-sweet potato peels mixture

DISCUSSIONS

The reduced body weight and daily weight gain and the increased FCR above 15% replacement during the starter phase may suggest that young chicks cannot efficiently utilize the test ingredient above this level of inclusion. The similarity in the feed cost of production amongst treatments despite the depressed growth above 15% replacement was the result of the reduced cost of the feed with the inclusion of YSPPM. Yam and potato peels sold for ₦22.00 and ₦18.00, respectively against ₦70.00 for maize. This was the reason for the reduction of the cost of the Kg of both feeds (starter and finisher) as the

replacement level increased. The improved daily weight gain on the 30 and 45% diets during the finisher phase is an indication of the ability of older birds to utilize the test material. Despite the improvement in daily gain on the 30 and 45% diets however, birds on these diets recorded lower final body weights as a result of the carry-over effects from the 28-day weights. The increased daily feed intake on the 45% diet which was probably a way for these birds to meet their energy need, resulted in the higher FCR observed in birds fed this diet compared to the control. The reduction in the feed cost of production on 15 and 45% diets was as a result of the higher gain on the 15% and lower feed cost on the 45% diets compared to the control. Final body weights observed on all the diets were within the range (2, 350- 2, 925g) reported for 9 week-old broiler chickens in the tropics [11] but higher than the 1, 725- 2, 375g recorded recently by [12] in the same strain of broilers at the same age (63 days).

All the haematological values observed were within ranges reported in literature as normal [13, 14]. The pattern of the haematological values was not traceable to the diet. An important factor of variation in the haematological values is the sex, with males generally having higher values than females [15]. In the present study the treatments were not equalized for sex and this may be a reason for some of the variations observed in the haematological parameters.

Carcass yield as well as the yields of carcass cut-up parts observed in the present study was all comparable to yields reported in literature for broiler chickens [11, 16 and 17]. Dietary fibre inclusion has been reported to increase lean meat yield in poultry [18]. This may be the reason for the higher breast yield on the YSPPM based-diets compared to the control. The similarities in the weight of the heart, liver and pancreas amongst treatments are indications that feeding YSPPM did not cause nutritional stress. The increase gizzard weight on the 45% replacement diet was attributed to the significant increased in feed intake on this diet compared to the control during the finisher phase. The lower fat on the 45% YSPPM fed group was attributed to the fibre level of this diet compared to the control. Because fibre and metabolizable energy (ME) in the diet are inversely proportional birds on this diet might have fed strictly to meet their energy requirement for maintenance sparing no extra energy for fat deposition.

It was concluded that YSPPM can replace maize up to 15 and 45% in broiler starter and finisher diets respectively without adverse effects on the growth, haematological profile and carcass measurements. Investigations into higher levels in the finisher diet were recommended.

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