PERFORMANCE AND HAEMATOLOGICAL PROFILE OF BROILER CHICKEN FED CASSAVA PEEL MEAL BLENDED WITH PALM OIL SLUDGE.

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ABSTRACT

This study investigated the growth performance and haematological profile of broiler chicken fed sundried and fermented cassava peel meal mixed with palm oil sludge (POS). The sundried cassava peel meal was obtained by sun drying the cassava peels to a constant weight, while the fermented cassava peel meal was obtained by packing the fresh cassava peels in an air tight polyethene bag for 4 days to enhance the fermentation process after which it was sundried. Then both sundried and fermented cassava peels were milled separately to obtain sundried cassava peel meal (SCPM) and fermented cassava peel meal (FCPM). The POS was mixed with the cassava peel meals in the ratio of 1 litre of POS to 10 kg of meal to produce SCPM+POS and FCPM+POS, respectively. A 56-day feeding trial was conducted using one hundred and fifty day-old broiler chicks raised on deep litter. On the first day of the study, the birds were weighed and randomly separated into five groups of 30 birds each. Each group was further subdivided into three replicates of 10 birds each. Five diets were formulated with diet 1 as the control, while 20 % of the maize component in diet 1 was replaced in diets 2, 3, 4, and 5 with SCPM, FCPM,SCPM+POS, and FCPM+POS, respectively. The calculated crude protein contents of the starter diets were 23.00, 22.70, 22.40, 22.10 and 21.80 %, while that of the finisher diets were 21.56, 21.26, 20.96, 20.66 and 20.36 % for diets 1, 2, 3, 4 and 5, respectively. At the end of the trial, the growth performances were estimated. Blood samples were collected from 2 birds of average weight per replicate, giving a total of 30 and were used for the determination hematological counts. There were significant differences in daily weight gain, final body weight and feed conversion ratio (P<0.05), but feed intake showed no significant differences (P>0.05). The cost of feed was reduced by about 36 % in starter and 36.01 % in the finisher diets, by replacing 20 kg of the maize in the control diet with the test materials. There were no significant differences in all the blood parameters measured (P>0.05). It was concluded that 20 % processed cassava peel meal mixed with palm oil sludge could replace maize in broiler diets and still produce acceptable growth performance and healthy blood profile.

Keywords: Broilers, cassava peel meal, palm oil sludge, growth performance and haematological assays

INTRODUCTION

Increasing the level of poultry production is strongly predicated on the availability and affordability of cereals, especially maize. Because of alternative demands for maize in the country, as human food, in brewery and other uses, a stiff competition for this foodstuff is increasing daily. This has pushed the price of maize beyond the reach of the common man, thereby raising ethical questions on the use of maize and other grains for livestock feed production, particularly in Sub Sahara Africa, when human need is far from being satisfied. This situation has compelled researchers and farmers alike to search for alternatives to maize, such as other feed materials commonly referred to as non-conventional feed resources (NCFRs). These NCFRs are largely farm wastes and by-products of agro processing industries, such as cassava peels, maize cob, soy bean hull, rice bran, etc. To be effective as an NCFR, the material must be relatively cheap, have little or no human food value, available in sufficient quantities throughout the year and be easily transportable with minimal costs (Udedibie, 2004). A common agricultural by-product that meets most of these requirements is cassava peel. Cassava peel is the peel removed during the primary processing of cassava tubers. It consists of the outer coverings of the tuber (epicarp plus mesocarp) and a little quantity of flesh (endocarp) inadvertently removed with the outer coverings. Cassava is a staple food for over 40% of the Nigerian population and so is processed daily in most communities, yielding large quantities of cassava peels (INRA, 2012b). Cassava peels are available throughout the year due to the proliferation of cassava processing factories in the country. The peel constitutes about 15 to 23 % of cassava tuber and with increasing demand for cassava products, large quantities accumulate around processing centres thereby causing environmental menace (Amaza, 2021). Cassava peels, however, contain anti nutritional substances such as cyanogenic glycosides, phytates and oxalates (Ayasan, 2010) which limit their use as a livestock feed material. Cassava peels are low in crude protein and energy but high in crude fiber. Dry cassava peel is powdery and dusty when milled (Udedibie, 2007). To reduce the dustiness and increase energy content for poultry feeding, it can be blended with vegetable oil or agro products rich in oil such as palm kernel cake (Aladi, 2006). Oil palm processing yields large quantities of palm oil sludge (POS) a liquid colloidal discharge (residue) left from the clarification of the crude palm oil (CPO). It includes aqueous liquid, dirt, residual oil and suspended solids, mainly cellulosic material from the fruits. Usually, this by-product is discharged into ponds or farmlands leading to environmental pollution. Dry POS is high in ether extract (11.7%), ash (19.5%) and of medium crude protein content (12.5%). Its mineral content (0.8% Ca, 0.3% P, 2.5% K and 0.7% Mg) is good, thus making it a potentially cheap and convenient material for enhancement of physiochemical characteristics of cassava peel meal for poultry feeding. POS is non-toxic as no chemical is usually added during the palm oil extraction process. Therefore, blending cassava peel meal and POS for poultry feeding will reduce the quantity of POS discharged into the environment and limit environmental pollution. The aim of this study was to investigate the effect of the dietary inclusion of sundried and fermented cassava peels mixed with palm oil sludge on growth performance, profitability and carcass characteristics.

Materials and methods

Experimental site

The research was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology (SAAT), Federal University of Technology, Owerri (FUTO), Imo State, Nigeria. Owerri is in the South-eastern part of Nigeria, and lies in the humid tropical zone of West Africa. Owerri is situated between Longitudes 7^0 01' 06 " and 7^0 03' 00 " E and Latitudes 5^0 28 ' 24 " and 5^0 30 ' 00 " N, while FUTO is on Latitude $05^0$29'06 " N and Longitude $07^0$02 ' 06" E (Obi *et al.,* 2010). Owerri stands at an altitude of 90 m, with mean annual rainfall, temperature and relative humidity of 2500 mm, 26.5-27.5 ^{0}C and 70 – 80 %, respectively. The dry season lasts for three months and mean annual evaporation is 1450 mm. The soil is sandy loam with an average pH of 5.5 (Ministry of Lands and Survey Atlas of Imo State, 1984).

Collection of test material

Cassava peels

Cassava peels were collected from garri processing units within Owerri West Local Government Area. The cassava peels were divided into two batches. One batch was sundried immediately after collection on a clean concrete slab and thereafter milled in a hammer mill fitted with 0.2 mm sieve; while the second batch was chopped into smaller pieces and fed into high density polyethene bags. The bags were compressed to exclude as much air as possible and then tied firmly. The pack was allowed to ferment for four days under ambient conditions before sun drying to constant weight. The dry mass was also milled in the same hammer mill. The meal from the first batch was labelled sundried cassava peel meal (SCPM) while the meal from the second batch was labelled fermented cassava peel meal (FCPM).

Palm oil sludge

Palm oil sludge (POS) was collected from an oil processing plant at Owerri West Local Government Area, Imo State. The sludge was mixed with cassava peel meals in the ratio of one litre of sludge to ten kg of cassava meal to produce sundried cassava peel meal plus oil palm sludge (SCPM + POS) from SCPM, and fermented cassava peel meal plus oil palm sludge (FCPM + POS) from FCPM.

Experimental diets

Five experimental broiler starter and finisher diets were formulated according to NRC (1994) standard. Diet 1 (control) contained maize as the major source of dietary energy. In diets 2, 3, 4 and 5, 20kg of maize was replaced by SCPM, FCPM, SCPM + POS, and FCPM + POS, respectively. The inclusion levels of other ingredients were similar in all the diets.

Table 1: Ingredient composition of broiler starter experimental diets

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	55.00	35.00	35.00	35.00	35.00
SCPM	00.00	20.00	00.00	00.00	00.00
FCPM	00.00	00.00	20.00	00.00	00.00
SCPM + POS	00.00	00.00	00.00	20.00	00.00
FCPM + POS	00.00	00.00	00.00	00.00	20.00
Palm kernel	3.00	3.00	3.00	3.00	3.00
Soybean meal	29.00	29.00	29.00	29.00	29.00
Wheat offal	2.00	2.00	2.00	2.00	2.00
Brewers dry grains	2.00	2.00	2.00	2.00	2.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
***Vit/Min. Premix**	0.25	0.25	0.25	0.25	0.25
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated chemical composition (%)					
ME (Kcal/Kg)	2977.00	2696.00	2696.00	2696.00	2696.00
Crude protein	23.00	22.70	22.40	22.10	21.80
Crude fibre	3.77	5.27	5.27	5.27	5.27
Crude fat	3.84	4.20	4.20	4.20	4.20
Ash	3.67	4.85	4.85	4.85	4.85
Calcium	1.49	1.49	1.49	1.49	1.49

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**Provides the following per kg of feed: Vitamin. A, 10,000 iu; Vitamin. D_3, 1,500 iu; Vitamin. K, 2 mg; riboflavin, 3 mg; Pantothenic acid, 6 mg; Niacin, 15 mg; Choline chloride, 3 mg; Vitamin. B_{12}, 0.08 mg; Folic acid, 4 mg; Mn, 8 mg; Zn, 0.5 mg; Iodine, 1.0 mg; Co 1.2 mg; Cu, 10 mg; Fe, 20 mg.*

Note: SCPM = Sundried cassava peal meal; FCPM = Fermented cassava peel meal; SCPM + POS = Sundried cassava peal meal plus palm oil sludge; FCPM + POS = Fermented cassava peal meal plus palm oil sludge

Table 2: Ingredient composition of broiler finisher experimental diet

Ingredients	Diet 1	**Diet 2**	**Diet 3**	**Diet 4**	Diet 5
Maize	60.00	40.00	40.00	40.00	40.00
SCPM	00.00	20.00	00.00	00.00	00.00
FCPM	00.00	00.00	20.00	00.00	00.00
SCPM + POS	00.00	00.00	00.00	20.00	00.00
FCPM + POS	00.00	00.00	00.00	00.00	20.00
Palm Kernel	3.00	3.00	3.00	3.00	3.00
Soybean meal	22.00	22.00	22.00	22.00	22.00
Wheat offal	2.00	2.00	2.00	2.00	2.00
Brewers grains	4.00	4.00	4.00	4.00	4.00
Fish meal	4.5	4.5	4.5	4.5	4.5
Bone meal	3.50	3.50	3.50	3.50	3.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
***Vit/min. Premix**	0.25	0.25	0.25	0.25	0.25
TOTAL	100.00	100.00	100.00	100.00	100.00

Calculated chemical composition (%)					
ME (Kcal/Kg)	2985.00	2705.00	2705.00	2705.00	2705.00
Crude protein	21.56	21.26	20.96	20.66	20.36
Crude fibre	3.64	5.15	5.15	5.15	5.15
Crude fat	3.89	4.25	4.25	4.25	4.25
Ash	3.33	4.51	4.51	4.51	4.15
Calcium	1.64	1.64	1.64	1.64	1.64

**Provides the following per kg of feed: Vitamin. A, 10,000 iu; Vitamin. D_3, 1,500 iu; Vitamin. K, 2 mg; riboflavin, 3 mg; Pantothenic acid, 6 mg; Niacin, 15 mg; Choline chloride, 3 mg; Vitamin. B_{12}, 0.08 mg; Folic acid, 4 mg; Mn, 8 mg; Zn, 0.5 mg; Iodine, 1.0 mg; Co 1.2 mg; Cu, 10 mg; Fe, 20 mg.*

Note: SCPM = Sundried cassava peal meal; FCPM = Fermented cassava peel meal; SCPM + POS = Sundried cassava peal meal plus palm oil sludge; FCPM + POS = Fermented cassava peal meal plus palm oil sludge

Management of experimental birds and experimental design

One hundred and fifty (150) day old broiler chicks were procured from a reputable vendor in Owerri town and was randomly divided into five treatment groups of thirty (30) birds each. The thirty (30) birds were further sub-divided into three replicates of ten (10) birds each. The groups were randomly assigned to the five dietary treatment in a completely randomized design (CRD). Starter feed was offered from the day of arrival of the day old chicks and ended on the 28th day of the trial period. Then the finisher feed was given from the 29th day and ended on the 56th day which was the last day of the study. Each replicate was housed in a deep litter poultry pen. Routine medications, vaccinations and other management practices were applied following the guidelines of the FUTO Teaching & Research Farm.

Determination of feed intake, weight gain and feed conversion ratio

The birds were weighed on replicate basis at the beginning of the experiment and at the end of every week. The mean weight gain was determined by the difference between the initial weight and final weight divided by the number of chicken per replicate. Average daily weight gain (ADWG) was calculated by dividing the weight gain by the number of days the trial lasted. Feed intake was determined daily on replicate basis as the difference between the quantity of feed offered and quantity leftover the next morning. This was divided by the number of birds per replicate to determine the feed intake per bird, and from this the average daily feed intake was calculated. Feed conversion ratio (FCR) was computed by dividing the average daily feed intake (ADFI) by the average daily body weight gain (ADWG). Feed cost/kg was calculated by summing the cost of feed ingredients per 100 kg feed and then dividing it by 100. Feed cost per kg meat produced was calculated by multiplying the feed cost per kg by the feed conversion ratio.

Blood collection and analyses

At the end of the finisher feeding trial (56th day), two birds per replicate were randomly selected and weighed. Blood samples were collected from the wing vein of each bird, and transferred into labelled sterile universal bottle containing 1.0 mg / ml ethylene-diamine tetra-acetic acid (EDTA) and 0.1 mg / ml heparin as outlined by Uko *et al.* (2000). This was used to determine the haematological parameters according to the methods described by Ajagbonna *et al.* (1999) and Uko *et al.* (2000). Haematological parameters determined included red blood cell (RBC) count, white blood cell (WBC) counts and haemoglobin concentration (Hb). This was done not later than three hours after blood collection. Other haematological indices such as mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and mean cell volume (MCV) were calculated.

Statistical analysis

Data collected was subjected to analysis of variance (ANOVA) as outlined by Snedecor and Cochran (1980). Where significant differences were observed between treatments, means were compared using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (1990). The SPSS Statistics 23 package was used in statistical analysis.

Results and discussion

Initial liveweight

Table 3 shows that the average initial liveweight of chicks allotted to the different treatment groups in the starter phase were similar (P>0.05). The initial liveweights varied from 34.00 g to 35.40 g.

Feed intake

There was no significant difference (P>0.05) in feed intake among the treatment groups. The average daily feed intake values during the starter phase were 67.42 g, 61.84 g, 72.26 g, 75.85 g and 72.61 g for the control, SCPM, FCPM, SCPM+POS and FCPM +POS dietary groups, respectively. The SCPM+POS dietary group recorded the highest feed intake while the SCPM group recorded the least. Stevenson & Jackson (1983) reported that dried cassava peel meal did not significantly reduce feed intake, which is in line with the result from this study. Egbunike *et al.* (2009) noted that feed intake was generally not highly affected when cassava peel meal was included in chicken diets provided the diets were properly formulated and presented. However, Osei (1992) observed that feed intake tended to increase with increasing levels of cassava peels.

Table 3: Effect of processed cassava peel meal on the performance of broiler starter chicks

Parameter	Control	SCPM	FCPM	SCPM+POS	FCPM+POS	SEM
Initial liveweight (g)	35.40	34.36	34.03	34.60	34.00	0.30
Final liveweight (g)	1065.00	1112.67	1140.33	1092.00	1196.00	19.69
Liveweight gain (g)	1029.60	1078.30	1106.30	1057.40	1162.00	19.84
Daily liveweight gain (g)	36.77	38.51	39.51	37.76	41.50	0.70
Daily feed intake (g)	67.42	61.84	72.26	75.85	72.61	2.20
Feed conversion ratio	1.86	1.60	1.85	2.00	1.75	0.76
Feed cost (₦/kg)	175.30	139.30	139.30	139.30	139.30	
Feed cost saving	-	36.00	36.00	36.00	36.00	
Feed cost / kg liveweight (₦/kg)	326.06^{a}	222.88^{b}	257.71^{ab}	278.60^{ab}	243.77^{ab}	13.46

^{a,b}Means within each row with different superscripts are significantly different (P<0.05). SEM: Standard error of the mean

Table 4: Performance of broiler chicks fed finisher diet containing sundried and fermented cassava peel meal

Parameter	Control	SCPM	FCPM	SCPM+POS	FCPM+POS	SEM
Initial liveweight (g)	1065.00	1112.67	1140.33	102.00	1196.00	19.69
Final liveweight (g)	2380.33	2229.00	2563.33	2510.67	2100.33	70.24
Total liveweight gain (g)	1315.33^{b}	1116.33^{b}	1423.00^{a}	1418.67^{a}	904.33^{b}	76.64
Daily liveweight gain (g)	45.97^{ab}	39.86^{ab}	50.82^{a}	50.66^{a}	32.29^{b}	2.73
Daily feed intake (g)	114.90	117.66	109.17	119.53	121.68	2.66
Feed conversion ratio	2.44^{b}	2.94^{b}	2.29^{b}	2.43^{b}	3.78^{a}	0.17
Feed cost (N/kg)	185.37	149.36	149.36	149.36	149.36	
Feed cost saving (N/kg)	36.01	36.01	36.01	36.01	36.01	
Feed cost/liveweight (N/kg)	452.30^{ab}	439.11^{ab}	342.03^{b}	362.94^{b}	564.58^{a}	25.88

^{a,b}Means within each row with different superscripts are significantly different (P<0.05); SEM: Standard error of the mean

Daily body weight gain

There were no significant differences (P > 0.05) in daily body weight gain during the starter phase among the treatment groups (Table 3). The values were 36.77 g, 38.51 g, 39.51 g, 37.76 g and 41.50 g for control, SCPM, FCPM, SCPM+ POS and FCPM +POS dietary groups, respectively. During the finisher phase, the FCPM+POS dietary group was significantly lower in daily weight gain (P<0.05) than the other dietary groups which were similar in weight gain. Atuahene *et al*. (2000) reported no significant effect on weight gain of broilers fed sun-dried POS (11 % moisture) mixed with rice bran which was introduced at 10 % level in broiler diet. However, Chukwukaelo *et al.* (2016) reported significant differences in liveweight gain during the starter and finisher phases when graded levels of fermented cassava root pulp and palm kernel cake mixtures were fed to broilers.

Feed conversion ratio (FCR)

Diet had no effect (P>0.05) on feed conversion ratio during the starter phase (Table 3), whereas during the finisher phase (Table 4) the FCPM+POS recorded significantly higher FCR (P<0.05) than the other groups. This corresponded to the findings of Elanchezhian *et al.* (1999) who reported that diets containing > 5 % cassava peel meal increased the feed conversion efficiency of broilers.

Cost of production

During the starter phase, although the SCPM dietary group was the lowest in feed cost per kilogram liveweight gain, it differed significantly only from the control group (P<0.05). However, during the finisher phase, the FCPM+POS group was highest in feed cost per kilogram liveweight gain (P<0.05). Table 4 shows that this group was also the lowest in daily weight gain. This finding is at variance with the results from Obikaonu *et al*. (2010) on nutritional evaluation of ensiled and sundried cassava peel meal which indicated that inclusion of ensiled cassava peel meal in broiler feed resulted in lowering cost of production.

Blood parameters

Results from the haematological analysis (Table 5) showed no significant differences for all parameters across all treatment groups (P>0.05). However, the packed cells volume (PCV) of broilers on diet with 20 % FCPM (30.40 %) was numerically the highest among the treatment groups followed by broilers fed the 20 % SCPM diet (27.57 %). while broilers fed the control diet were the least. Values for white blood cells (WBC) were 108.97, 98.60, 98.47, 96.47 and 66.93 $x10^6/mm^2$ for broilers fed the FCPM, FCPM+POS, SCPM+POS, SCPM and control diets, respectively. All heamatological values were within the normal range provided by Mitruka & Rawnsley (1977). Adejumo (2004) reported that haematological traits especially PCV and Hb were correlated with the quality of the diets and the nutritional status of the animals. Haematorit, erythrocytes and haemoglobin values are known to be positively correlated with protein quality and protein level. Haemoglobin level is associated the ability of an animal to withstand of respiratory stress. Since all values for all parameters did not differ significantly and all were within the normal range, this suggests that none of the dietary treatments posed any health challenge to the birds. Results presented in this study agreed with Elanchezhian *et al. (*1999) and Adedokun *et al* (2017) who found that inclusion of cassava peel meal did not affect blood composition. Similarly, Ngiki *et al*. (2014) observed no significant difference in the red blood cells of broiler chicken fed varying levels of cassava root leaf meal mixture.

Table 5: Effect of processed cassava peels on the blood parameters of broiler chicks

Parameters	CONTOL	SCPM	FCPM	SCPM+POS	FCPM+POS	SEM
PVC (%)	25.97	27.57	30.40	26.33	26.30	0.883
RBC ($x10^6$ /mm^2)	2.27	2.29	2.63	2.33	2.26	0.076
Haemogobin (g/dl)	8.37	9.10	10.00	8.16	8.63	0.304
MCV (%)	114.00	115.46	115.43	113.53	116.27	0.578
MCH (%)	76.40	73.03	71.47	75.17	72.27	1.106
MCHC (%)	67.00	63.23	61.87	66.23	62.23	1.032
WBC ($x10^6$ /mm^2)	66.93	96.47	108.97	98.47	98.60	7.101
Lymphocytes	89.33	88.33	85.33	89.00	86.33	0.984
Neutrophils	9.67	10.67	12.67	10.00	12.67	0.984
Eosinophils	1.50	1.50	2.00	1.00	1.50	0.151
Platelets	76.00	92.33	121.00	81.67	101.67	7.134

^{a,b} Means with different superscripts within a row are significantly different (p<0.05).

PCV = Packed Cell Volume; RBC = Red Blood Cell; MCV= Mean Corpuscular Volume; MCH = Mean Corpuscular Haemoglobin; MCHC = Mean Corpuscular Haemoglobin Concentration; WBC = White Blood Cell.

CONCLUSION

It was observed from this study that the cost of broiler finisher diets decreased with the incorporation of cassava peel and palm oil sludge. The cost of feed was reduced by about 36 % in starter and finisher diets by replacing 20 % of the maize in the control diet with FCPM. Findings from the study showed that broilers that were placed on 20 kg level of inclusion of FCPM diet had good growth performance and carcass characteristics without detrimental health challenges. Utilization of cassava peels and palm oil sludge in poultry feeding will prevent the littering and pollution of farm land with these materials and also increase famer income. Clean farms will give clean environments for healthy living. The non-significant variations observed in the RBC, PCV and hemoglobin values also indicate that the level of anti-nutritional factors in FCPM and SCPM did not cause inadequacy of nutrients which could create an anemic condition. The treatments have equal effects, which indicate that any of the treatments is suitable for raising broilers.

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