CARCASS CHARACTERISTICS, LIPID PROFILE AND MEAT QUALITY OF BROILER CHICKEN FED CASSAVA PEEL MEAL BLENDED WITH PALM OIL SLUDGE.

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ABSTRACT

This study was carried out to determine the effect of dietary inclusion of processed cassava peel meal (sundried or fermented and sundried)blended with palm oil sludge oncarcass characteristics, serum lipid profile and meat quality of broiler chicken. A batch of fresh cassava peels were sundried, while another batch was fermented in air-tight polythene bags for 4 days and sundried thereafter. Both batches were subsequently milled, and yielded sundried cassava peel meal (SCPM)and fermented cassava peel meal (FCPM), respectively. Portions of the meals were blended with palm oil sludge (POS) in the ratio of 10 kg of meal to 1 litre of POS. Five diets were formulated with diet 1 as the control, while diets 2 (SCPM), 3 (FCPM), 4 (SCPM+POS) and 5 (FCPM+POS) had 20 kg of the maize in diet 1 replaced by the equivalent weight of SCPM, FCPM, SCPM+POS and FCPM+POS, respectively. A fifty-six-day feeding trial was conducted using 156day-old chicks that were raised on deep liter. 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. At the end of the trial, 2 birds from each replicate of average weight were slaughtered for the determination of carcass characteristics, serum lipid levels and meat quality. Significant differences ($p<0.05$) were observed in abdominal fat, neck, back, wing, head and bile proportions. In meat quality, only drip loss showed significant differences, while other parameters were not significantly different ($p>0.05$). Birds reared on the SCPM+POS diet were significantly higher ($p<0.05$) in percentage bile content and percentage drip losses than bird on the other dietary treatments. The concentrations of total cholesterol, high density lipoprotein, low density lipoprotein and total triglyceride were similar across the five dietary treatments. It was concluded that feeding sundried or fermented and sundried cassava peel meal blended with POS had no deleterious effect on carcass characteristics and meat quality.

Keywords: Broilers, cassava peel meal, palm oil sludge, carcass characteristics, serum lipid profile and meat quality

INTRODUCTION

Investigations on alternative feed sources for feeding monogastric animals have been carried out in recent times as a means of discovering an alternative to maize and minimizing the continued inflationary pressure on this critical conventional feedstuff (Iyayi and Davies, 2005). A promising candidate is cassava peels because of its availability in significant quantity, relatively appreciable nutrient content and cheap methods of processing method into usable forms (Udedibie, 2004). Utilization of cassava peels for good growth and performance of poultry species may be limited due to the presence of anti-nutritional factors such as cyanogenic glucosides, tannins, phytates and saponnins (INRA, 2012b). Hence, the need for processing through various methods such as sun drying and fermentation which exerts beneficial effects by reducing or destroying the inherent anti-nutritional factors (Udedibie, 2004). A major problem associated with inclusion of sundried and milled cassava peels into poutry diets is its dustiness. 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 and / or *okara* (Aladi, 2006). Cassava peel meal may be blended with another agro-industrial waste, palm oil sludge (POS) to control this problem. POS non-toxic and is normally 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; makes it a potentially cheap and convenient material for enhancement of mineral profile of cassava peel meal for poultry feeding. The aim of this study was to investigate the effect of inclusion of sundried or fermented and sundried cassava peal meal blended with palm oil sludge on the carcass characteristics, lipid profile and meat quality of broiler chicken. In a previous paper (in press), the growth, feed intake and blood cell counts were published

MATERIALS AND METHODS

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 area of West Africa. According to Obi *et al.* (2010), Owerri is situated between longitude 7^0 01' 06 " and 7^0 03' 00 " E and latitude 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.

The climatic data as summarized by the Ministry of Lands and Survey Atlas of Imo State (1984) shows that Owerri stands at an altitude of 90m, 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 1450mm. The soil is sandy loam with an average pH of 5.5.

Collection of test material

Cassava peels

Cassava peels were sourced from Garri Processing Units within Owerri West Local Government Area, Imo State, Nigeria. The peels were divided into two batches; one batch was sundried immediately on a clean concrete slab while the second batch was fermented for four days in an airtight high density polyethylene bag. The bags were compressed to exclude as much air as possible and then tied firmly. After the fourth day, the peels were sundried to constant. Both batches were ground in a hammer mill fitted with 0.2mm sieve. The meal from the sundried peels was labelled sundried cassava peel meal (SCPM) while the other meal was labelled fermented cassava peel meal (FCPM).

Palm oil sludge

Palm oil sludge (POS) was collected from an Oil Processing Plant at Owerri, Imo State, Nigeria. The POS was mixed with some of the SCPM and FCPM in the ratio of 1 litre to 10 kg to produce SCPM + POS and FCPM + POS, respectively.

Experimental diets

Five experimental diets were formulated following standard nutrient requirements for poultry (NRC, 1994). Diet 1 (control) contained maize, but none of the test ingredients, whereas 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 the same in all the diets.

Management of experimental birds and experimental design

One hundred and fifty day-old broiler chicks were procured from a vendor in Owerri. Chicks were randomly divided into five treatment groups and further subdivided into three replicates of 10 birds each. Each dietary group was assigned to one of the five diets in a Completely Randomized Design (CRD). Starter diets were offered from the first day of arrival of the day old chicks and ended on the 28th day of the trial period. Then, the finisher diets were given from the 29th day and stopped on the 56th day which is 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 Teaching & Research Farm, Federal University of Technology, Owerri.

Slaughter of birds and determination of carcass and internal organ weights

At the end of the feeding trial, the chickens were starved of feed for 12 hours, two broilers whose live weights are closest to the mean of each replicate was selected, tagged and slaughtered. The dead bird was scalded at 55ºC for one minute and dressed. The carcass weights were taken and each carcass was cut into primal parts following the guidelines of USDA (2000). The cut-out parts (head, neck, shank, wings, thigh, drumsticks, breast, back, liver, heart, gizzard, intestine, abdominal fat) were weighed using an electronic scale, model: EK5055. Carcass and internal organs weights were expressed individually as percentages of the liveweight of each carcass.

Determination of serum lipid profile

Prior to the slaughter of the birds, blood samples were collected from the wing vein of each bird, and transferred into labelled sterile universal bottles as outlined by Uko *et al.* (2000). The serum lipids were determined by the ferric chloride – sulphuric acid reaction method according to Colville (2002). Into each of the 0.2 ml of serum in a tube was added 5.0 ml of isopropyl alcohol and spun vigorously. The standard was prepared by transferring 0.2 ml of cholesterol and 0.2 ml of triglycerides into appropriate tubes. Three ml of glacial acetic acid was pipetted into all the tubes and mixed properly and thereafter 0.3 ml of iron was added and mixed. Next, 0.5 ml of H_2SO_4 was added to one tube at a time and allowed to cool. Cholesterol and triglyceride absorbances were read at 450 mm and 570 nm, respectively, after zeroing the spectrophotometer with reagent blank. The cholesterol value of the treatment sample was calculated using the following general formula:

Cholesterol in sample (mg/dl) = [Absorbance of serum samples/Absorbance of standard] x Cholesterol standard x 200.

Triglycerides (TG) sample (mg/dl) = [Absorbance of serum samples/ Absorbance of standard] x TG standard x 200.

Low Density Lipoprotein: This was calculated from the values obtained from the total cholesterol, triglycerides and high density lipoprotein concentrations of the blood sample.

Calculation: $\text{LDL-C} = \text{TC} - \frac{TG_S}{5} - \text{HDL-C}$

Where:

LDL-C = Low density lipoprotein cholesterol

HDL-C = High density lipoprotein cholesterol

TC = Total cholesterol

TGs = Triglycerides

Meat quality

Meat quality attributes

Drip loss

The right quadriceps muscles of the thighs of birds from each treatment were individually weighed (W_0), and kept in air tight polythene bags (Ziploc®), properly labelled and stored in a refrigerator at 7 ^{0}C. After 24 hours, the samples were carefully removed from the polythene bags, wiped with filter paper and reweighed (W_1). The drip loss was calculated as the difference between the initial and final weight (W_0 - W_1), and expressed as percentage of initial weight for each sample

Drip loss (%) = ((W_0-W_1)/W_O) x 100

Cooking loss

After the determination of drip loss, the quadriceps muscles were weighed. The samples were transferred into air tight polythene bags and cooked under steam for 20 minutes. The samples were then allowed to cool to room temperature. After this, the exuded liquid was mopped off using paper towels and the weight of each sample was taken again. The cooking loss was calculated using the formulae below.

% Cooking loss

$$= \frac{\text{Initial meat weight} - \text{cooked meat weight}}{\text{Initial meat weight}} \times \frac{100}{1}$$

Water holding capacity

The water holding capacity of the meat samples were evaluated following the procedure described by Kauffman *et al.* (1992). Subsamples weighing 3 - 5 g (W_0) of quadriceps muscles were taken and wrapped in a filter paper. Each of the samples was subjected to mechanical pressure for 5 minutes using a screw jack to expel the free water / fluid. The meat residues were then removed from the filter paper and reweighed (W_1). The difference between the initial and final weights was recorded as the weight of the expelled fluid. This was expressed as a percentage of the initial weight of the sample and recorded as the water holding capacity of the meat.

Water holding capacity (%) = (W_0-W_1)/(W_0) x 100

Organoleptic properties

Meat preparation was done by the moist cooking method. The meat samples weighting 30 – 35 g were cooked under steam for 30 minutes. The meat was served to a 30 member trained sensory panel drawn from the 500 level students of the Department of Animal Science and Technology, Federal University of Technology, Owerri. The panellists evaluated the samples for colour, flavour, juiciness, tenderness and general acceptability using a 9-point rating scale as described by Sanwo *et al*. (2011). The scores were arranged in a descending order, the maximum score 9 was given extremely (flavoured / juicy / tender / liked) while 1 was for the lowest score, extremely (unflavoured / dry / tough / disliked), respectively.

Statistical analysis

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

RESULTS

Carcass and internal organ weights

The proportions of carcass cut-up parts are shown in Table 1. The liveweight, and percentages of head, wing, back, neck and abdominal fat showed significant differences (P<0.05). Broiler chicken fed the 20 % SCPM diet had lower abdominal fat (0.67%) compared to the control, that is the 0 % dietary group (0.90%). Diet 5 broilers (FCPM+POS) had the highest percentage fat content (1.63%), followed by diet 3 (FCPM) broilers (1.04%). This might be due to the processing method (fermentation) and presence of oil from oil palm sludge used in the formulation of diet 5. Breast muscle was not significantly different (P>0.05) among the treatment groups. The finisher broilers on diet 4 (SCPM+POS) recorded the highest wing muscle which was significantly different (P<0.05) from other groups. The back and neck cuts also followed the same pattern. No significant (P>0.05) differences were observed in percentages of gizzard, intestine, heart and liver. The diet 4 group (SCPM+POS) recorded the highest percentage gall bladder content of 2.62% (P<0.05), whereas differences between the values recorded by diets 2, 3, 1 and 5 groups were not significantly different (p>0.05).

Blood lipid profile

Cholestrol

There were no significant differences (p > 0.05) among the treatment group in total cholesterol level (Table 2). The values were 120.33, 132.67, 118.33, 135.33 and 118.33 mg/dl for 0kg, 20kg SCPM, 20kg FCPM, 20kg SCPM+POS 20kg FCPM+POS dietary levels, respectively. Birds on 20 kg SCPM+POS had the highest (p < 0.05) value of 135.33 mg/dl while those on 20% FCPM and 20kg FCPM+POS recorded the lowest value (118.33 mg/dl). Comparatively, cholesterol level was slightly higher in the groups fed SCPM or SCPM+POS than in the other groups. This may be the effect of the processing method. Notwithstanding, all values were within the normal range of 95.50- 170.00 mg/dl (Nwogu, 2012).

Triglyceride

There were no significant differences (p>0.05) among the groups in serum triglyceride level. The values were 50.67, 54.33, 51.33, 34.33 and 57.00 mg/dl for 0kg, 20kg SCPM, 20kg FCPM, 20kg SCPM+POS and 20 kg FCPM+POS dietary groups, respectively. The highest value (57.00 mg/dl) was recorded by the birds on 20% FCPM+POS diet while the group on the 20 kg SCPM+POS diet recorded the least value (34.33 mg/dl).

Table 1: Effect of processed cassava peel meal blended with palm oil sludge on carcass and internal organ characteristics of broiler chicks

Parameters (%)	Control	SCPM	FCPM	SCPM+POS	FCPM+POS	SEM
Live weight(kg)	2.28[ab]	2.13[ab]	2.50[a]	2.00[b]	2.23[ab]	0.064
Dressed weight	85.71	84.48	83.84	86.16	83.08	1.064
Head	2.38[ab]	2.29[ab]	2.05[b]	2.78[a]	2.21[ab]	0.101
Shank	3.36	3.85	3.52	3.57	3.56	0.186
Wings	3.81[ab]	3.92[ab]	3.93[ab]	4.68[a]	2.85[b]	0.233
Drumstick	10.11	10.30	9.33	9.96	10.22	0.434
Thigh	18.89	19.21	16.56	20.31	18.62	0.550
Breast	26.79	27.07	25.84	27.14	26.29	0.801
Back	4.42[b]	4.45[b]	4.32[b]	8.42[a]	4.56[b]	0.512
Neck	3.20[ab]	2.90[ab]	2.41[b]	4.63[a]	3.50[b]	0.229
Liver	1.92	1.90	1.72	2.20	2.16	0.082
Gizzard	1.64	1.75	1.67	2.04	1.71	0.073
Intestine	4.23	4.62	4.70	4.51	4.73	0.200
Heart	0.45	0.38	0.47	0.81	0.39	0.071
Abdominal fat	0.90[b]	0.67[c]	1.04[b]	0.96[b]	1.63[a]	0.089
Gallbladder+bile	1.62[b]	1.65[b]	1.64[b]	2.62[a]	1.54[b]	0.124

[a,b,c] Means with different superscripts within a row are significantly different (p<0.05)

High- density lipoprotein (HDL)

There were no significant differences (P > 0.05) among the treatment groups in HDL value. The highest value was recorded by the group on 20 kg SCPM+POS diet (65.67 mg/dl) while the group on the 20 kg FCPM diet recorded the least value (49.00 mg/dl).

Low density lipoprotein (LDL)

There were no significant differences (P > 0.05) in low density lipoprotein among the treatment groups. Birds on 20kg SCPM diet recorded the highest value (65.67 mg/dl) while the group on 20kg FCPM+POS diet recorded the least value (49.33 mg/dl).

Meat Quality

Results on meat quality assessment are shown in Table 3. Drip loss showed significant differences (P<0.05) with the 20% SCPM+POS group being the highest while the 20% SCPM group was the least. Cooking loss and water holding capacity showed no significant differences among the treatments. Differences in appearance score was not significant (P>0.05), and none of the organoleptic quality parameters showed diet related statistical significant differences (P>0.05).

Table 2: Effect of processed cassava peel meal blended with palm oil sludge on the blood lipid profile of broiler chicks.

Parameters	CONTROL	SCPM	FCPM	SCPM+POS	FCPM+POS	SEM
Cholesterol(mg/dl)	120.33	132.67	118.33	135.33	118.33	4.147
Triglyceride(mg/dl)	50.67	54.33	51.33	34.33	57.00	2.903
HDL(mg/dl)	58.33	56.33	49.00	65.67	57.33	2.380
LDL(mg/dl)	52.00	65.67	59.33	62.67	49.33	3.419

Table 3 Effect of processed cassava peel meal blended with palm oil sludge on the meat quality of broiler chicks

Parameters	Control	SCPM	FCPM	SCPM+POS	FCPM+POS	SEM
Drip loss (%)	0.89[b]	0.85[b]	0.91[b]	1.35[a]	0.91[b]	0.681
Cooking loss (%)	35.04	38.65	34.80	38.22	35.80	1.031
WHC (%)	25.00	44.44	40.00	46.66	36.66	3.337
+Appearance	7.17	7.50	7.17	7.67	7.00	0.912
+Colour	7.00	7.17	6.83	7.33	6.50	0.833
+Taste	6.83	7.17	7.17	7.33	6.83	0.953
+Flavour	6.50	7.17	6.33	7.50	6.33	0.794
+Tenderness	7.67	7.83	8.17	8.33	7.67	0.679
+Juiciness	6.83	7.17	7.17	8.00	7.00	0.393

[a,b]Means in the same row with different superscripts are significantly different (p<0.05)

+Parameter subjectively determined using the 9-point rating scale: 1 = extremely (tough, dry, unflavoured, unacceptable colour and appearance); 2 = very (tough, dry, unflavoured, unacceptable colour and appearance); 3 = moderately (tough, dry, unflavoured, unacceptable colour and appearance); 4

= slightly (tough, dry, unflavoured, unacceptable colour and appearance); 5 = neither (tough, dry, unflavoured, unacceptable colour and appearance) nor (tender, juicy, flavoured, acceptable colour and appearance); 6 = slightly (tender, juicy, flavoured, acceptable colour and appearance); 7 = moderately (tender, juicy, flavoured, acceptable colour and appearance); 8 = very (tender, juicy, flavoured, acceptable colour and appearance); 9 = extremely (tender, juicy, flavoured, acceptable colour and appearance).
WHC = Water holding capacity

DISCUSSION

Carcass characteristics of broiler chicks

The dressing percentage (83.08 – 86.16 %) did not differ across the various dietary groups ($p>0.05$). This implies that muscular growth and development was not impaired by any of the dietary treatments. In the same vein, the percentages of the more important carcass cuts, such as drumstick, thigh and breast were not significantly different ($p>0.05$). Therefore, a farmer would not encounter problems with carcass conformation when feeding diets containing cassava peal meal blended with palm oil sludge. No significant differences were observed in organ weights, though Okukpe (2019) and Addo (2002) observed an increase in organ weights in birds fed diets containing bitter leaf. This shows that the treatments administered in this study were well tolerated and assimilated by the birds. However, feeding fermented cassava peal meal blended with palm oil sludge (FCPM+POS) significantly increased the weight of abdominal fat ($p<0.05$), which is likely due to the inclusion of palm oil sludge. The significantly higher level of bile ($p<0.05$) observed among the broilers fed the sundried cassava peal meal blended with palm oil sludge (SCPM+POS) may be the result of the physiological necessity of producing more bile required for emulsification of dietary fat which would be higher among the diets containing POS. Since bile content was also significantly higher ($p>0.05$) in birds fed SCPM+POS diet than in birds fed FCPM+POS diet, it suggests that other factors apart from fat content in the diets may be contributing to variation in bile levels. Unpublished results on the fatty acid profile of fermented versus unfermented cassava peels from our study showed that fermentation increased the degree of saturation of fatty acids in cassava peels. This may also have influence on bile secretion. Neither the inclusion of palm oil sludge, nor fermentation of cassava peels had any significant effect ($p>0.05$) on serum lipid profile. The cholesterol level in the control group was slightly higher than in all the groups that were fed diets inclusive of cassava peels. This suppressive effect may be attributable to the presence of anti-nutritional factors in the other diets, and agreed with the findings of Michael (2005) who reported that anti-nutritional factors assert a physiological effect by also lowering the level of plasma cholesterol concentration in experimental animals. All meat quality parameters, except drip loss, were not affected significantly by dietary treatment. The panelists rated them between moderately good quality to very good quality. This showed that addition of palm oil sludge to poultry diets had no depreciating effect on organoleptic quality, especially meat flavour. The significant differences in drip loss ($p<0.05$) is indicative of differences in the rate of postmortem glycolysis. Rapid postmortem glycolysis results to rapid drop in muscle pH when the carcass temperature is still relatively high, which causes considerable muscle protein denaturation and subsequent increased drip and cooking losses (Lawrie, 1990; Okeudo & Moss, 2005). It is instructive that the birds on SCPM+POS, diet were significantly highest ($p<0.05$) in percentage bile content and also percentage drip losses compared to other dietary treatments which may be suggestive of underlying differences in physiological responses which obviously were diet related.

CONCLUSION

The different treatments resulted in little and inconsequential differences in carcass characteristics and meat quality, which means that based on these criteria a farmer can use any of the treatments for raising the birds (broilers). It can therefore be concluded that feeding broilers diets that contained fermented cassava peel meal blended with palm oil sludge would not compromise the carcass and meat quality attributes of the birds.

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