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Carcass characteristics and organ weights of broiler chickens fed varying inclusion levels of cassava (*Manihot esculenta* Crantz) peel products-based diets

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Target audience: *Cassava processors, Feed-millers, Farmers, Poultry producers and Animal Nutritionists*

Abstract

The effect of feeding four cassava peel products -based diets on carcass characteristics and organ weights of broiler chickens were investigated with 455, 10-day old Ross 308 broiler chickens randomly divided into thirteen groups of 35 birds each. Each group was replicated five times and a replicate comprised seven chicks. The design was 1+ (4 x 3) augmented factorial arrangement in a completely randomized design. The experimental diets were sundried cassava peel meal (SCPM), coarse cassava peel mash (CCPM), whole cassava peel mash (WCPM) and fine cassava peel mash (FCPM) each at three dietary inclusion levels to replace maize at 20, 40 and 60%, while the control diet was a maize-based diet. The diets were fed ad libitum to the respective grower (10-24 days) and finisher (25-46 days) experimental chickens. Results showed no significant effect (p>0.05) of feeding chickens with cassava peel-based diets on carcass primal cuts and internal offals except breast meat and spleen. Breast meat yield (24.90%) of chicks on maize-based diet was significantly higher (p<0.05) than others. Effect of interaction of cassava peel products and inclusion levels on eviscerated weight and breast weight was significant (p<0.05). The eviscerated weight (80.86%) and breast meat yield (24.90%) of chickens on control were higher (p<0.05). In conclusion, replacement of up to 60% dietary maize with cassava peel products had similar effect on broiler carcass yield and productivity but breast yield. Also, further processing of WCPM to FCPM and CCPM did not confer any advantage on chick productivity.

Keywords: *Cassava peel, Internal offal, External offal, High-Quality Cassava Peel, Carcass yield*

Description of Problem

The demand for livestock products is increasing due to growing human population (1). Poultry products particularly broiler meat has a great potential to meet this demand due to its low feed conversion ratio (FCR) and short rearing period.

Maize remains an integral component of broiler chickens feed and its inclusion in normal diets could be as high as 60% (2). The availability of maize all year round for poultry feed has reduced and this could be attributed to competition for maize by humans and animals, irregular rainfall pattern and high cost of maize. These have resulted in search for alternatives during these periods.

An alternative feed resource that could be used is cassava (*Manihot esculenta* Crantz) peels since it is relatively less competed for by humans. Cassava peels is obtained from generous peeling of cassava tuber and it account for 10-13 percent of the tuber weight and when dried it could be suitably used to replace maize in broiler diets (3).

Cassava peels could not be used when wet and has to be utilised in dried form for poultry. Researchers has adopted different methods of processing cassava peel for monogastric diets with profound success but sun-drying is commonly adopted (3,4,5,6). Observations showed it was practically impossible to sun-dry fresh cassava peel during the wet season as it requires 2-3 days to reduce the moisture content of cassava peel to 20% or less for marketing (7). A new processing method has been suggested which is similar to garri processing but without fermentation. That could be by sun drying to constant weight in less than six hours (7). This method involves combination of different physical methods such as grating, dewatering, pulverizing and sun-drying.

Previous works on cassava peel products for broiler chicken production were limited to the performance characteristics and blood profile without any significant focus on carcass characteristics and weights of organ (3, 5, 6, 11). The goal of farmers in broiler chicken production is to achieve quality chicken with good dressing and carcass percentage (8). Information is therefore needed on the effect of the different cassava peel products- based diets on carcass characteristics and organ weights of broiler chickens which was investigated in this study.

Materials and Methods

Test Material

Fresh cassava peel from white varieties of cassava was obtained from cassava processing plant in Ajegunle, Oyo, Oyo State. The cassava peel was then transported to International Livestock Research Institute for processing into various products. The cassava peels were sorted for stomp or foreign materials. Portion of the sorted cassava peel was sundried for 3-5 days, milled and labelled sundried cassava peel meal (SCPM). Other products namely whole cassava peel mash (WCPM), fine cassava peel mash (FCPM) and coarse cassava peel mash (CCPM) were obtained using the earlier documented processing methods (7). Briefly, the fresh cassava peel was processed using the similar processing method employed in garri processing factory, the fresh cassava peels were grated and dewatered using a hydraulic press. The caked obtained was pulverized and sieved into fine and coarse fraction using a sieve screen of 2.5mm while whole fraction was the unsieved pulverized cake. The fine, coarse and whole fraction were sundried to obtain fine cassava peel mash (FCPM), coarse cassava peel mash (CCPM) and whole cassava peel mash (WCPM)

Experimental Animal and Dietary Layout

A total 455, 10-day old Ross 308 chicks were randomly allocated to 13 treatment groups of 35 birds. Each group was replicated five times and comprised seven chicks.

The experiment was a 1+ (4 x 3) augmented factorial arrangement in a completely randomized design. There were four cassava peel products sundried cassava peel meal (SCPM), coarse cassava peel mash (CCPM), whole cassava peel mash (WCPM) and fine cassava peel mash (FCPM) and three levels of % replacement of maize (20, 40 and 60%) augmented with a maize-based diet (control). The experimental diets were formulated and fed to the grower (10- 24 days) and finishers (24-46 days) chickens *ad libitum.* Details of the experimental grower and the finisher diets for chickens are shown in Tables 1 and 2, respectively.

Carcass analysis

At day 46 of feeding, two chicks of the group average weights were selected per replicate and were properly tagged. All the selected chicks were deprived of feed over-night. The tagged chicks were sacrificed, bled, defeathered and properly dissected into parts and their weights recorded. The different cut parts were related to the percentage of the chick live weight.

Table 1: Gross composition (g/100g DM) of the experimental diets fed to grower broiler chicken (Day 10-24)

		Inclusion levels of cassava peel products											
		20%				40%				60%			
Ingredients	**Control**	**SCPM**	**CCPM**	**WCPM**	**FCPM**	**SCPM**	**CCPM**	**WCPM**	**FCPM**	**SCPM**	**CCPM**	**WCPM**	**FCPM**
Soya oil	2.70	3.10	3.00	2.80	2.70	3.50	3.40	3.10	2.70	4.00	3.90	3.20	2.70
Maize	50.00	40.00	40.00	40.00	40.00	30.00	30.00	30.00	30.00	20.00	20.00	20.00	20.00
FCPM	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	30.00
WCPM	0.00	0.00	0.00	10.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	30.00	0.00
CCPM	0.00	0.00	10.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	30.00	0.00	0.00
SCPM	0.00	10.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	30.00	0.00	0.00	0.00
Wheat bran	7.68	5.22	4.92	5.12	5.22	2.47	2.07	2.87	3.07	0.00	0.00	0.30	0.60
Soyacake	30.30	30.30	30.30	30.30	30.30	30.30	30.30	30.30	30.30	30.30	30.30	30.30	30.30
Full fat soya	5.00	7.10	7.50	7.50	7.50	9.50	10.00	9.50	9.70	11.50	11.60	12.00	12.20
$CaCO_3$ (35%)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DCP	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Lysine	0.42	0.38	0.38	0.38	0.38	0.33	0.33	0.33	0.33	0.3	0.3	0.3	0.3
Dl-methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Toxin binder	0.10	0.10	0.10	0.10	0.10	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	100.00	100.00	100.00	100.00	100.00
Price/Kg	122.76	119.34	120.51	121.01	121.76	116.20	118.43	119.10	120.34	112.99	115.71	117.44	119.42
Calculated Nutrient													
Crude Protein	20.90	20.91	20.91	20.90	20.92	20.92	20.88	20.92	20.89	20.81	20.64	20.91	20.91
M.E.	3050.50	3050.17	3047.37	3053.37	3048.69	3049.82	3049.91	3048.6	3052.56	3047.6	3051.06	3049.69	3050.89
Methionine	0.51	0.51	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.49	0.50	0.50
Calcium	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Av. Phosphorus	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.48	0.48	0.48	0.48
Lysine	1.40	1.40	1.40	1.40	1.40	1.41	1.41	1.41	1.41	1.39	1.39	1.41	1.41

Note: All calculated nutrients are in (%) except for M.E (Kcal/Kg), SCPM= Sundried cassava peel meal, CCPM=Coarse cassava peel mash, WCPM=Whole cassava peel mash, FCPM= Fine cassava peel mash, DCP= Di calcium Phosphate, M.E. =Metabolisable Energy, Av. Phosphorus = Available Phosphorus. Premix= Vitamin Mineral premix*Each 2.5 kg vitamin/mineral premix contain: vitamin A -12,500,000 I.U., vitamin D3 2,500,000 I.U., vitamin E-40,000 mg, vitamin K3-2,000, Folic Acid-1000 mg, Niacin -55,000 mg, Calpan -11,500 mg, vitamin B2 -5,500 mg, vitamin B12 -25 mg, vitamin B1-3000 mg, vitamin B6 -5000 mg, Biotin -80 mg,

Table 2: Gross composition (g/100g DM) of the diets fed to experimental broiler finisher (Day 24-46)

		Inclusion levels of cassava peel products											
		20				40				60			
Ingredients	**Control**	**SCPM**	**CCPM**	**WCPM**	**FCPM**	**SCPM**	**CCPM**	**WCPM**	**FCPM**	**SCPM**	**CCPM**	**WCPM**	**FCPM**
Soya oil	1.50	2.20	2.20	2.00	1.80	3.00	2.90	2.50	2.20	3.70	3.60	3.00	2.60
Maize	52.00	41.60	41.60	41.60	41.60	31.20	31.20	31.20	31.20	20.80	20.80	20.80	20.80
FCPM	0.00	0.00	0.00	0.00	10.40	0.00	0.00	0.00	20.80	0.00	0.00	0.00	31.20
WCPM	0.00	0.00	0.00	10.40	0.00	0.00	0.00	20.80	0.00	0.00	0.00	31.20	0.00
CCPM	0.00	0.00	10.40	0.00	0.00	0.00	20.80	0.00	0.00	0.00	31.20	0.00	0.00
SCPM	0.00	10.40	0.00	0.00	0.00	20.80	0.00	0.00	0.00	31.20	0.00	0.00	0.00
Wheat bran	8.91	6.35	6.05	6.45	6.65	3.68	3.38	4.08	4.38	1.11	0.71	1.51	2.01
Soycake	13.80	15.70	16.00	15.80	15.80	17.60	18.00	17.70	17.70	19.50	20.00	19.80	19.70
Full fat soya	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
$CaCO_3$ (35%)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
DCP	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
Salt	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Lysine	0.19	0.15	0.15	0.15	0.15	0.11	0.11	0.11	0.11	0.07	0.07	0.07	0.07
Dl-methionine	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Toxin binder	0.10	0.10	0.10	0.10	0.10	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	100.00	100.00	100.00	100.00	100.00
Price/Kg (₦)	120.19	116.59	117.86	118.21	118.75	113.39	115.49	116.29	117.63	109.94	113.13	114.56	116.59
Calculated Nutrients													
Crude Protein	19.51	19.53	19.55	19.52	19.53	19.52	19.53	19.50	19.50	19.54	19.50	19.54	19.50
M.E.	3103.90	3100.0	3104.53	3103.80	3100.00	3103.56	3102.7	3102.40	3102.43	3099.53	3100.88	3103.36	3106.03
Calcium	0.85	8.55	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Av. Phophorus	0.49	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.46
Lysine	1.16	1.15	1.16	1.16	1.16	1.15	1.16	1.16	1.16	1.15	1.16	1.16	1.16
Methionine	0.48	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.48	0.48	0.48	0.48

Note: All calculated nutrients are in (%) except for M.E (Kcal/Kg), SCPM= Sundried cassava peel meal, CCPM=Coarse cassava peel mash, WCPM=Whole cassava peel mash, FCPM= Fine cassava peel mash, DCP= Di calcium Phosphate, M.E. =Metabolisable Energy, Av. Phosphorus = Available Phosphorus. Premix= Vitamin Mineral premix *Each 2.5 kg vitamin/mineral premix contain: vitamin A -12,500,000 I.U., vitamin D3 2,500,000 I.U., vitamin E -40,000 mg, vitamin K3 -2,000, Folic Acid -1000 mg, Niacin-55,000 mg, Calpan -11,500 mg, vitamin B2 -5,500 mg, vitamin B12 -25 mg, vitamin B1 -3000 mg, vitamin B6 -5000 mg, Biotin -80 mg, antioxidant -120,000mg, selenium-300 mg, iodine -1500 mg, iron -100,000 mg,cobalt 300 mg, manganese -120,000 mg, copper -8500 mg, Zinc -80,000 mg, choline chloride 500,000 mg

Statistical analysis

The design is completely randomized design. Data were subjected to analysis of variance using the procedure of SAS (2002) and means were separated by least significant difference test of the same software at $\alpha_{0.05}$. Regression analyses between breast meat yield and inclusion levels of cassava peels products was also done at $\alpha_{0.05.}$

Results and Discussion

The main effects of cassava peel products and inclusion levels on primal cuts of broiler chickens are shown in Table 3 The eviscerated weight, carcass weight, shank, head, neck, intestinal weight, thigh, drum stick, back and wings were not significantly affected (p>0.05) by either cassava peel types or the inclusion levels. The breast meat, though significantly (p<0.05) influenced by cassava peel products, was not influenced (p>0.05) by the inclusion levels. Chicks on maize based diet (control) had higher breast meat (24.90%) compared those on diets based on cassava peel products (22.79-23.06%). Drumstick, thigh and wings ranged from 10.04-10.80%, 10.98-11.87% and 8.10-8.48%, respectively were similar to values obtained by (2), they noted that drumstick, thigh and wings of broiler chickens fed cassava based diets were similar to maize based diet.

The main effect of dietary cassava peels products on breast meat yield showed that meat from chicks on control (maize based diet) was significantly higher (p<0.05) than those on dietary cassava peel products. The sieving stage in the processing of FCPM and CCPM from the un-pulverised whole cassava peels cake do not conferred any advantage in chicks breast muscle observed (p>0.05). Particle size of cassava peels products could be responsible for lower breast meat yield when compared to control, as noted (18). Methionine is considered as a limiting amino acid in cassava based diets and is required for the detoxification of cyanide known to be present in cassava based diet (9). Positive correlations have been indicated between breast muscle and higher dietary methionine in broiler chickens (10). The lower breast muscle obtained in chicks on cassava peel based diets could be attributed to relatively lower available methionine in the diets required for the generation of breast muscle as part of the dietary methionine would have been deployed for detoxification.

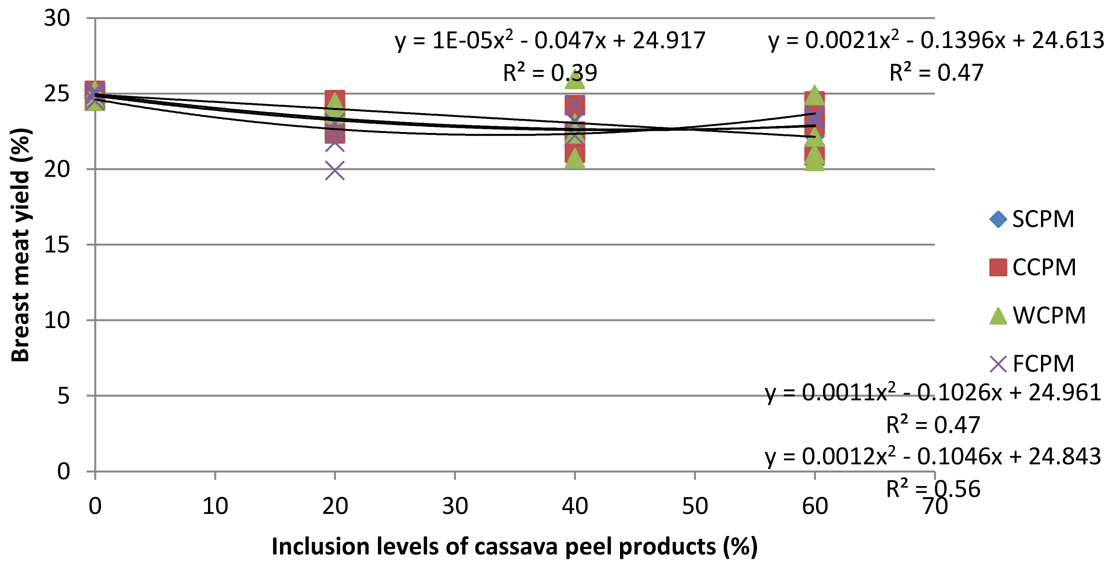
The effects of interaction of dietary cassava peel products and inclusion levels on the primal cuts of broiler chickens are shown in Table 4. Eviscerated, breast and wings relative weights were significantly influenced (p<0.05) with no consistent pattern while others were not significantly affected (p>0.05) by the dietary maize replacement with cassava peel products. Chicks on control diet had the highest eviscerated yield (80.86%) while the least yield was recorded by chicks on 20% SCPM (73.33%). Breast yield was highest in chicks on Control diets (24.90%) while the lowest was in those on 20% FCPM (21.77). Wing yield was highest in chicks on 60% SCPM (8.89%) while the lowest were in those on 60% FCPM (7.55%). The breast yield range of 21.77 – 24.90% in this study conforms to 23.04-24.73% earlier reported for broiler chickens fed beta carotene bio-fortified cassava grit based diets (2). However, the observed wing yield contradicted the report of other authors (11) who observed similarity in the wing yield of broiler chickens when fed cassava based diets. Observed deviation could however be due to lower dietary inclusion of cassava products by the authors (11) compared to the levels used in the present study.

The replacement levels of cassava peel products were related to the broiler breast yield and the result is presented in Figure 1. The relationships for all the cassava peel products were quadratic and significant (p<0.05). The effects are represented by the regression.

equations:

$y = 0.0012x^2 - 0.1046x + 24.843$ (R^2=0.56) 1
$y = 0.0011x^2 - 0.1026x + 24.961$ (R^2=0.47) 2
$y = 1E\text{-}05x^2 - 0.047x + 24.917$ (R^2=0.39) 3
$y = 0.0021x^2 - 0.1396x + 24.613$ (R^2=0.47) 4
for SCPM (1), CCPM (2), WCPM (3) and FCPM (4).

Figure 1: Relationship between replacement levels of cassava peel products and broiler breast yield



The main effects of dietary cassava peel products and inclusion levels on internal offals of broiler chickens are presented in Table 5. The full gizzard, liver, heart, kidney, intestinal fat and intestinal weights were not significantly affected (p>0.05) by cassava peel product or the inclusion levels. The spleen weight, which was influenced (p<0.05) by dietary cassava peel products had chicks on maize based diet recording higher spleen yield and least were observed for those on whole cassava peel mash. The empty gizzard was also influenced p<0.05) by inclusion levels and was higher at 20% inclusion level (2.20%) while lowest at 0% inclusion level (1.88%). Liver and heart have been noted to play important roles in *in vivo* detoxification processes (12), similarities in liver yield is an indication that the cassava peels products or the inclusion levels do not pose challenge on the birds.

The main effect of dietary cassava peel products and inclusion level on heart and liver weights were not significantly different (p>0.05). This indicated that cassava peels products or the inclusion levels did not pose any toxic threat on the health of the fed chickens. Spleen condition is an index of immunity and adequacy in supply of oxygen to the tissue (13). The values obtained (0.07-

0.11%) for spleen weight in this study conforms to a range of 0.061 – 0.117% body weight reported (14) for healthy broiler chicken fed yeast beta-glucan and virginiamycin. The lower gizzard weight observed in chicks on control diets (no cassava included) could be due to lower fibre in maize compared to cassava peel which will promote faster passage rate of the diets relative to cassava peel mash based diet. This agrees with the earlier submission (15) that reduced transit time results in higher gizzard weight. However, lower gizzard weight may not always suggest better broiler performance as observed (16).

The effect of interaction of cassava peel products and inclusion levels on internal offal weights of broiler chickens are shown in Table 6. All the weights of internal offals assessed were not influenced (p>0.05) except for the heart. Earlier authors (11) however, observed no significant differences (p>0.05) when broiler chickens were fed diets containing 5, 10 and 15% cassava peels. This observation may be due to lower inclusion levels of cassava peel in the diets. The variations observed were not consistent with the cassava peel products or inclusion levels used; this could be due iso-caloric and iso-nitrogenous diets employed in this study. Balancing for nutrient differences helps to reduce challenges posed by nutrients imbalance. Also, the heart weights were within the range reported (17).

Table 3: Main effect of dietary cassava peel products and inclusion levels on carcass primal cuts of broiler chickens (%)

Cassava peel product	Evi	Carc	Shank	Head	Neck	IntWt	Thigh	Drum Stick	Breast	Back	Wings
None	80.87	74.02	4.02	2.71	4.49	4.95	10.98	10.76	24.90[a]	14.06	8.14
Sundried	77.92	71.76	4.22	3.17	4.49	6.04	11.87	10.80	22.88[b]	12.75	8.48
Coarse	78.84	71.54	4.38	2.88	4.27	5.44	11.35	10.73	22.97[b]	13.45	8.24
Whole	79.19	71.85	4.43	2.95	4.36	5.72	11.53	10.04	23.06[b]	12.86	8.15
Fine	78.54	71.19	4.34	3.04	4.37	5.94	11.33	10.63	22.79[b]	13.65	8.10
SEM	1.02	0.99	0.21	0.17	0.25	0.36	0.37	0.31	0.50	0.49	0.14
Inclusion level											
0	80.87	74.02	4.02	2.71	4.49	4.95	10.98	10.76	24.90	14.06	8.14
20	77.40	71.18	4.29	3.07	4.33	5.62	11.53	10.59	23.09	12.90	8.24
40	79.51	72.13	4.22	2.98	4.49	5.67	11.77	10.40	22.87	13.57	8.32
60	78.96	71.46	4.50	2.98	4.29	6.06	11.26	10.67	22.82	13.07	8.17
SEM	0.89	0.87	0.18	0.15	0.21	0.32	0.32	0.27	0.43	0.42	0.12

[abc]Means with the same superscripts in the same column are not significantly different (P>0.05) SEM= Standard error of mean; Evi= % Eviserated weight relative to liveweight, Carc= %Carcass weight relative to live weight, IntWt= %Intestinal weight relative to live weight.

Table 4: The interactive Effect of interactions of cassava peel products and inclusion levels on carcass primal cuts of broiler chickens %

Cassava Peel Products	Inclusion level	Eviscerated	Carcass	Shank	Head	Neck	Thigh	Drum Stick	Breast	Back	Wings
Control	0	80.86^{a}	74.02	4.02	2.71	4.49	10.98	10.76	24.90^{a}	14.06	8.14^{abc}
Sundried	20	73.33^{b}	70.63	4.31	2.96	4.57	11.85	10.95	23.05^{ab}	12.15	8.18^{abc}
	40	80.22^{a}	72.39	3.65	3.28	4.73	12.85	10.64	22.77^{ab}	12.09	8.36^{abc}
	60	80.22^{a}	72.26	4.68	3.25	4.17	10.91	10.81	22.83^{ab}	14.00	8.89^{a}
Coarse	20	79.67^{a}	72.39	4.30	2.85	3.96	11.26	10.81	23.53^{ab}	14.14	8.14^{abc}
	40	80.23^{a}	72.76	4.50	2.99	4.60	11.52	10.69	22.48^{ab}	14.51	8.33^{abc}
	60	76.62^{ab}	69.48	4.34	2.80	4.25	11.28	10.68	22.90^{ab}	11.71	8.24^{abc}
Whole	20	79.03^{ab}	72.06	3.90	3.14	4.47	11.63	10.16	24.02^{ab}	12.27	8.27^{abc}
	40	78.85^{ab}	71.68	4.51	2.79	4.25	11.18	9.45	23.01^{ab}	13.97	8.18^{abc}
	60	79.68^{a}	71.81	4.87	2.92	4.36	11.78	1051	22.15^{ab}	12.35	8.01^{bc}
Fine	20	77.57^{ab}	69.63	4.64	3.32	4.34	11.37	10.43	21.77^{b}	13.06	8.36^{abc}
	40	78.75^{ab}	71.68	4.23	2.86	4.37	11.55	10.80	23.21^{ab}	13.70	8.40^{ab}
	60	79.30^{ab}	72.27	4.12	2.93	4.40	11.06	10.67	23.39^{ab}	14.20	7.55^{c}
	SEM	0.51	0.44	0.097	0.07	0.10	0.17	0.14	0.23	0.25	0.07

^{abc} Means with the same superscripts in the same column are not significantly different (P>0.05) SEM= Standard error of mean; All values are in % of live weight.

Table 5: Main effect of cassava peel products and levels of inclusion on internal offals of broiler chickens

Cassava peel products	Full Gizzard (%)	Empty Gizzard (%)	Liver (%)	Heart (%)	Kidney (%)	Spleen (%)	Intestinal Fat (%)	Intestinal length (cm)
Control	2.88	1.88	2.16	0.50	0.00	0.11^{a}	0.25	236.67
Sundried	3.24	2.21	1.94	0.52	0.01	0.09^{ab}	0.34	219.22
Coarse	3.21	2.11	1.75	0.50	0.01	0.10^{ab}	0.17	221.33
Whole	2.85	1.99	2.11	0.42	0.01	0.07^{b}	0.33	191.67
Fine	3.01	2.01	1.73	0.49	0.01	0.11^{ab}	0.20	214.00
SEM	0.15	0.09	0.15	0.03	0.01	0.01	0.02	11.98
Inclusion level								
0	2.88	1.88^{b}	2.16	0.50	0.00	0.11	0.25	236.67
20	3.15	2.20^{a}	1.97	0.49	0.01	0.09	0.29	212.75
40	3.15	2.02^{ab}	1.82	0.48	0.02	0.10	0.29	218.17
60	2.94	2.02^{ab}	1.86	0.49	0.01	0.09	0.20	203.75
SEM	0.13	0.08	0.13	0.03	0.004	0.01	0.01	10.37

^{abc}Means with the same superscripts in the same column are not significantly different (P>0.05). Values in percentage are calculated from percentage of live weight. SEM= Standard error of mean

Table 6: The effect of graded level of cassava peel based diets on internal offals of broiler chickens (%)

Cassava Peel Products	Inclusion level	FG	EG	Liver	Heart	Kidney	Spleen	IL (cm)	IntWt	AFAT
Control	0	2.88	1.88	2.16	0.50[abc]	0.00	0.11	236.67	4.95	0.25
Sundried	20	3.41	2.35	1.85	0.52[abc]	0.01	0.08	216	5.77	0.00
	40	3.05	2.03	2.02	0.56[ab]	0.02	0.11	224.00	5.68	0.84
	60	3.25	2.26	1.96	0.49[abc]	0.01	0.10	217.67	6.66	0.17
Coarse	20	3.13	2.29	1.82	0.61[a]	0.01	0.09	209.67	5.23	0.00
	40	3.44	2.05	1.62	0.40[bc]	0.01	0.09	213.67	5.42	0.31
	60	3.06	2.00	1.80	0.48[abc]	0.01	0.10	240.67	5.65	0.20
Whole	20	2.71	1.94	2.24	0.36[c]	0.01	0.07	22.67	5.74	0.72
	40	3.12	2.06	2.02	0.44[abc]	0.02	0.09	214.00	5.37	0.00
	60	2.72	1.95	2.05	0.46[abc]	0.01	0.07	138.33	6.04	0.28
Fine	20	3.35	2.22	1.97	0.46[abc]	0.01	0.11	202.67	5.73	0.45
	40	2.97	1.96	1.61	0.51[abc]	0.02	0.12	221.00	6.19	0.00
	60	2.72	1.85	1.61	0.51[abc]	0.00	0.1	218.33	5.89	0.15
	SEM	0.07	0.04	0.07	0.02	0.00	0.004	6.13	0.16	0.07

[abc] Means with the same superscripts in the same column are not significantly different ($p>0.05$). All values were calculated from percentage of live weight. SEM= Standard error of mean; FG=Full gizzard, EG=Empty gizzard, IL= Intestinal length, AFAT= Abdominal fat Int wt= %Intestinal weight in live weight.

Conclusions and Applications

1. The breast meat yield of chickens on maize-based (control) diets had more breast weights (yield) compared to those on cassava peel products which had lower but similar weights (yield).
2. Cassava peel products can be used up to 60% in broiler diets to replace maize without negative effect on carcass primal cuts and internal offals' yield of broiler chicken except for breast weights (yield).
3. Further processing of WCPM to FCPM or WCPM do not confer any advantage on the carcass primal cuts and internal offals.

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