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Nutritional Effect of Cassava Peel Meal Enriched with *Calapogonium mucunoides* as Source of Bioactive Compounds on Meat Yield and Physiology of Broiler Chickens

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Abstract

An experiment was conducted to determine the dietary effect of enrichment of cassava peel meal (CPM) with *Calapogonium mucunoides* (CM) on carcass yield, internal organs, digestibility and blood profile of broilers. One hundred and forty four (144) Hubbard chicks were used. There were six dietary treatments (T1, T2, T3, T4, T5, T6) containing 24 birds each. Each treatment was replicated three times with 8 birds each on completely randomized design (CRD). T1 was the control diet containing no CPM, T2 had unenriched CPM, T3-T6 contained (CPM) enriched with 10, 20, 30 and 40% CM respectively. Feed and water were given ad libitum for 49 days. Results indicated that control had better digestibility followed by diets enriched with 30 and 40% CM compared to diet with CPM not enriched. Dressed percentage was improved above 10% of enrichment and breast weight above 20% compared to control and non-enrichment. Liver and heart were enlarged by CPM but was improved by enrichment.Kidney and pancreas were reduced ($p<0.05$) by CPM but improved by 40% enrichment. There was no significant difference ($p>0.05$) in white blood cells. Red blood cells and haemoglobin were improved by 30 and 40% enrichment. Enrichment improved aspartate transferase and alanine transferase. In conclusion, 30%-40% of *C. mucunoides* could be used to enrich CPM in cassava peel meal based diets for better health, digestibility and carcass yield of broiler chickens.

Keywords: Broilers; Carcass; Digestibility; Enrichment; Blood profile

Introduction

Poultry production entails proper utilization of resources for profit maximization. The most critical unit of the resources is finance. Accordingly cost of feed was reported to form greater percentage of total cost of poultry production [1]. This was collaborated by [2]. More also, currently this cost

Effect of enriched cassava peel meal on meat and physiology of broilers has continued to soar due to high prices of feed ingredients especially those ingredients that have direct competition with man, like maize, soya bean and sorghum. Increase in human population, climate change have negative impact on the economically availability of these agricultural inputs for the livestock industry. Hence there should be a way to manage this situation so that farmers could maximize profit.

The most strategic way to ameliorate this is by use of feed ingredients that are not expensive but nutritionally beneficial to birds. Nevertheless, price of any feed ingredient depends among other factors on the level and quality of nutrients the ingredient contained especially protein, starch and oil [3]. According to expensive feedstuffs are known to contain high level of any of these nutrients, for instance maize, soya bean meal and palm oil contain high level of starch, protein and oil respectively. Thus any less expensive feedstuff will fall short of these nutrients. Such feedstuffs especially emanate from agricultural wastes and byproducts. Hence agricultural wastes and byproducts have been advocated for use in poultry feed production in order to reduce cost of feed and invariably total cost of production [4]. Many agricultural wastes and byproducts abound such as plantain peels, palm kernel cake, wheat offals, brewer's dried grains, rice bran, rice husk and maize offals. However they are limited by poor and low level of essential nutrients, characterized by low energy, high fibre and in some cases contain silica like in rice husk.

Cassava peel meal fall under this category of feed ingredients. It is one of the solid waste produced as a consequence of cassava processing. It is low in protein with appreciable amount of carbohydrate, but hazardous due to presence of cyanide especially the fresh type and poor nutrient digestibility [3,5]. Drying has been reported to reduce the cyanide content to a safer level according to [5]. Despite the drying, according to cassava peel meal has not competed [3].

Effect of enriched cassava peel meal on meat and physiology of broilers favorably with some agricultural and industrial byproducts such as palm kernel cake, wheat offal, brewer's dried grains and maize offal in poultry nutrition and hence famers and feed millers are skeptical to use it. Based on this fact Ndelekwute et al., had suggested that, it could be possible to add more value to cassava peel meal considering its other shortcomings like low and poor protein, poor digestibility and lack of bioactive compounds [3]. They posited that this could be done by enriching it with natural bioactive compounds like carotenoids, flavonoids and protein found in forage especially legumes like *Calapogonium mucunoides*. In the same report, Ndelekwute et al., noted that enrichment of cassava peel meal with *C. mucunoides* has resulted to improved live weight of broiler chickens [3]. Therefore the objective of this research was to determine the effect cassava peel meal enriched with *C. mucunoides* on apparent nutrient digestibility, carcass yield, internal organs, blood profile and liver enzymes of broiler chickens.

Materials and Methods

Experimental site

The experiment was carried out at the Poultry Unit of Teaching and Research Farm of the University of Uyo, Uyo, Akwalbom State, Nigeria. The area falls within the tropical rainforest zone of Nigeria. The area has two distinct seasons: wet season (March-mid November) and dry season (November-March). It has an average annual rainfall range of 2200 mm to 3500 mm. The mean altitude is 38.1 m above sea level. Relative humidity is from 71% to 88% annually (University of Uyo Meteorological Station).

Processing of enriched cassava peel meal

Processing was done according to Ndelekwute et al. [3] Fresh Cassava peels were collected from a cassava processing factory. The peels were washed and sun dried. Fresh and non-lignified leaves of *Calopogoniummucunoides* were harvested from fallowed farm land in the University. The leaves were washed, cut into pieces with a sharp knife and used to replace the dry cassava peel weight to weight at different proportions (10, 20, 30 and 40%) in a mixture as thus: 100 g of *C. mucunoides* was added to 900 g of cassava peel; 200 g to 800 g; 300 g to 700 g and 400 g to 600 g of dry cassava peel. The mixture was then ground with grinding machine. The ground material was then dried under the sun. After drying, it was sieved to reduce the crumbs into small particle sizes. The sieving also was to reduce the fibre level.

Experimental design and management of experimental birds

One hundred and forty four (144) day old Hubbard chicks were used. There were six dietary treatments (T1, T2, T3, T4, T5, T6) each having 24 birds. Each treatment was replicated three times with 8 birds per replication. The experiment was carried out on completely randomized design (CRD). T1 was the control diet with palm kernel cake and no cassava peel which was regarded as the positive control. T2 had unenriched cassava peel meal (negative control) and T3-T6 were diets which contained cassava peel meal enriched with 10, 20, 30 and 40% fresh leaves of *C. mucunoides* respectively. The enriched cassava peel meal was included in the feed at the same level (10%) for starter and 15% for finisher as palm kernel cake in the control diet.

T1=Control diet without cassava peel meal, but with palm kernel cake.

T2=Diet with unenriched cassava peel meal.

T3=Diet with cassava peel meal enriched with 10% *C. mucunoides*.

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T4=Diet with cassava peel meal enriched with 20% *C. mucunoides*.

T5=Diet with cassava peel meal enriched with 30% *C. mucunoides*.

T6=Diet with cassava peel meal enriched with 40% *C. mucunoides*.

Table 1: Ingredient composition of experimental starter broiler diets.

Ingredients	T1Control	T2(0%)	T3(10%)	T4(20%)	T5(30%)	T6(40%)
Maize	52.0	52.0	52.0	52.0	52.0	52.0
Soya bean meal	30.0	30.0	30.0	30.0	30.0	30.0
Palm kernel cake	10.0	-	-	-	-	-
Cassava peel meal	-	10.0	-	-	-	-
ECPM	-	-	10.0	10.0	10.0	10.0
Fish meal	4.0	4.0	4.0	4.0	4.0	4.0
Bone meal	3.0	3.0	3.0	3.0	3.0	3.0
Salt	0.25	0.25	0.25	0.25	0.25	0.25

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Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Premix	0.35	0.35	0.35	0.35	0.35	0.35
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient composition						
Crude protein (%)	22.94	21.47	21.50	21.82	22.14	22.46
Ether extract (%)	3.85	3.85	4.01	4.15	4.29	4.42
Crude fibre (%)	4.11	4.46	3.99	4.02	4.05	4.08
Ash (%)	7.89	8.04	7.71	7.72	7.70	7.68
Energy (KcalME/kg)	2893	2880	2878	2874	2872	2870

*Premix supplied per Kg starter diet: vitamin A 15,000 i.u., vitamin D3 13,000 i.u., thiamine 2 mg, riboflavin 6 mg, pyridoxine 4 mg, cobalamine 0.05 g, biotin 0.08 mg, choline chloride 0.05 g, manganese 0.096g, iron 0.024 g, copper 0.006 g, iodine 0.014 g, selenium 0.24 mg, cobalt 0.024 mgand antioxidant 0.125 g. ECPM: enriched cassava peel meal

The brooding house and the rearing house were thoroughly swept, washed, disinfected and fumigated. Kerosene stove was used to supply heat to provide warmth for three weeks. The birds were reared in an open sided deep litter house. Starter and finisher diets were formulated to meet the nutrient requirement of broiler chickens in the tropical environment (Tables 1 and 2). The diets and water were offered ad libitum throughout the experimental period which lasted for 49 days. Normal veterinary procedures were observed throughout the duration of the experiment.

Table 2: Ingredient and nutrient composition of experimental finisher diets.

Ingredients	T1 Control	T2 (10%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)
Maize	51	51	51	51	51	51
Soya bean meal	28	28	28	28	28	28
Palm kernel cake	15	-	-	-	-	-
Cassava peel meal		15	-	-	-	-
ECPM	-	-	15	15	15	15
Fish meal	2	2	2	2	2	2
Bone meal	3.3	3.3	3.3	3.3	3.3	3.3
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.1	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1	0.1
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Nutrient Composition						
Crude protein (%)	20.09	18.89	19.14	19.37	19.59	19.82
Ether extract (%)	3.98	3.3	3.2	3.43	3.65	3.9
Crude fibre (%)	5.24	5.69	2.69	2.79	3.01	3.43
Ash (%)	8.01	7.98	7.89	8	7.96	8.02
Energy (KcalME/kg)	2891	2871	2868	2866	2864	2862

*Premix supplied per Kg finisher diet: vitamin A 10,000 i.u., vitamin D3 12,000 i.u., vitamin E 20 i.u., vitamin K 2.5 mg, thiamine 2.0 mg, riboflavin 3.0 mg, pyridoxine 4.0 mg, niacin 20 mg, cobalamin 0.05 mg, pantothenic acid 5.0 mg, folic acid 0.5 mg, biotin 0.08 mg, choline chloride 0.2 mg, manganese 0.006 g, zinc 0.03 g, copper 0.006 g, iodine0.0014 g, selenium 0.24 g, cobalt 0.25 g and antioxidant 0.125 g. ECPM: enriched cassava peel meal

Data collection and analysis

Carcass and internal organs analysis: At the end of the feeding experiment, 36 birds, two from each replicate of a treatment were used for carcass analysis. The birds were fasted for 18 hours. The birds were slaughtered by severing the throat with a sharp knife after recording the weight. The killed birds were immersed in 60°C hot water for 30 seconds according to Scott et al., as reported by Ndelekwute et al. [6,7]. The feathers were plucked by hand. Carcass processing was done as detailed by [7]. The legs, head and the neck were cut and the crop gently removed. The abdomen was cut open and holding the gizzard the viscera was pulled out. The abdominal fat was removed. The different carcass parts (breast, thigh, drumstick, wing and back) were separated. The internal organs were separated. Weights of the carcass parts, abdominal fat and internal organs were noted. Dressed carcass weight, internal organs and abdominal fat were expressed as percentage live weight while cut-parts were expressed as percentage dressed weight as reported by Abaza, et al [8].

Digestibility studies: Total collection method was used using metabolism cages which were thoroughly washed and disinfected. The procedure reported by was adopted as describe thus: At the end of the feeding experiment, one bird from each of the three replicates of a dietary group giving a total of 15 birds were randomly assigned to a metabolism cage each [7]. Male birds were used and weight of the birds used were similar to reduce possible effect of sex and weight on digestibility. They were acclimatized for four days during which each treatment group was fed its diet. At the end of the acclimatization period, during which the birds had mastered the act of feeding and drinking in the new cage environment, a known quantity of the feed was given daily to each bird. To minimize feed wastages, feeding was done in the morning by 8.00 hours GMT in the afternoon by 1.00 hours and in the evening by 6.00 hours making sure the birds did not lack feed at any point in time. Each morning before feeding commenced, leftover feeds were recorded and feed intake noted. Faeces was collected and weighed for four days. Collected faeces were immediately taken to the laboratory where they were oven dried at 60°C to constant weight. Dry faecal samples were ground to pass 1 mm sieve. The four days faecal collection was pooled and thoroughly mixed together. A portion was taken from each treatment, stored in a refrigerator from which proximate analysis was carried out according to [9].

Blood collection and analysis: Blood was collected and both haematological and serum chemistry analyses were carried out according to Fawole, et al. [10]. Blood collection was through the jugular vein by the use of hypodermic syringe. The samples were poured into a 10 ml capacity clinical Mackartney bottles which contained dipotassium salt of ethelene-diamine-tetra-acetic acid (EDTA). The EDTA served as anticoagulant. Containers containing blood samples for serum biochemistry had no EDTA.

Statistical data analysis: Data collected were subjected to two way Analysis of Variance (ANOVA). Where significant effects were detected between treatment means they were compared using Duncan's Multiple Range Test [11].

Results and Discussion

Effect of enriched cassava peel meal on apparent nutrient digestibility of broilers

The effect of enriched cassava peel meal on apparent nutrient digestibility of the broilers is indicated in Table 3. There were no significant differences on crude fibre and ash digestibility. However, significant differences occurred in dry matter, crude protein and ether extract, all having similar trend. Birds that consumed diet without cassava peel meal which was the control performed better in dry matter, crude protein and ether extract digestibility. Nevertheless, birds that consumed diets that contained cassava peal meal enriched with 30 and 40% C muccunoides produced better digestibility of the three parameters compared to the diet not enriched and the diets that contained cassava peel meal enriched with 10 and 20%. There were no significant differences between non-enrichment, 10 and 20% enrichment of the cassava peel meal. This result clearly indicates the poor nutritional quality and digestibility of cassava peel meal earlier reported by Okike et al.[5].

Table 3: Effect of cassava peel meal enriched with *c. mucunoides* on the apparent nutrient digestibility of broiler chickens.

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	SEM
Dry matter	72.03^{a}	55.10^{c}	56.21^{c}	57.32^{c}	62^{b}	65^{b}	5.48
Crude protein	68.55^{a}	54.06^{c}	53.45^{c}	55.08^{c}	60.08^{b}	61.52^{b}	6.05
Ether extract	78.08^{a}	62.11^{c}	63.09^{c}	62.21^{c}	70.32^{b}	68.08^{b}	8.76
Crude fibre	46	40	41	43	41	44	3.67
Ash	56	54	55	56	54	56	4.54
abc means along the same row with different superscripts are significantly ($p<0.05$)							

This was attributed to high level of fibre in cassava peel meal [5]. High fibre ingredients are poorly utilized by chickens and other monogastric animals. It also unveiled the need to enrich or fortify cassava peel meal with natural bioactive compound to improve its quality and utilization as advocated by [3].

Effect of enriched cassava peel meal on carcass yield of broilers

Table 4 is indicating the effect of enriched cassava peel meal on the carcass yield of broiler chickens. There were no

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significant (p>0.05) differences in thigh, drumstick and wing. Significant (p<0.05) differences were observed in dressed percentage, breast and back-cut. It was observed that dressed percentage was improved above 10% of enrichment. That is 20, 30 and 40% of enrichment improved dressed percentage over non-enrichment. It was also noted that the dressed percentage of control, 20, 30 and 40% enrichment were similar. Similar scenario occurred in breast weight where 20, 30 and 40% enrichment produced similar breast weight as the control, but higher than the breast weight produced by non-enrichment. The scenario in dressed percentage and breast weight is an indication that *C. mucunoides* is a vital forage for meat yield. This could not effect of enriched cassava peel meal on meat and physiology of broilers

Table 4: Effect of cassava peel meal fortified with *c. mucunoides* on carcass yield of broiler chickens.

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	SEM
Dressed percentage	71.33^{a}	63.00^{c}	66.51b^{c}	68.14^{ab}	68.04^{ab}	67.96^{ab}	4.75
Breast weight (%)	34.99^{d}	36.48^{cd}	36.65^{cd}	38.56^{b}	41.79^{a}	38.63^{b}	3.86
Thigh (%)	16.24	15.22	15.56	15.56	15.12	16.61	2.46
Drumstick (%)	12.67	12.80	13.06	13.45	12.30	11.96	2.58
Back-cut (%)	25.93^{a}	24.27^{a}	22.03^{b}	22.91^{b}	23.41^{b}	21.46^{b}	2.89
Wing (%)	10.11	11.23	10.70	10.80	9.38	11.34	1.96
abc means along the same row with different superscripts are significantly (p<0.05)							

Be unconnected with its content of carotenoids and flavonoids according to Stephen T [12]. Back-cut was bigger in control and non-enriched group which were similar.

Effect of cassava peel meal fortified with *c. Mucunoides* on the internal organs of broilers

Table 5 is indicating the effect of enriched cassava peel meal on the internal organs of broiler chickens fed enriched cassava peel meal. From the result, all the parameters indicated significant (p<0.05) differences. In comparison with the control, feeding of both non-enriched and enriched cassava peel meal increased the weight of proventriculus, liver, pancreas, kidney, small intestine and caeca. Specifically, in comparison with non-enrichment, 20, 30% and 40% enrichment gave bigger proventriculus. There was no difference between 10% level of enrichment and non-enrichment.

The weight of the gizzard increased as the level of enrichment was increased above 10% and comparable to control. The liver was significantly enlarged by both cassava peel meal enriched

Table 5: Effect of cassava peel meal fortified with *c. mucunoides* on the internal organs of broiler chickens.

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	SEM
Proventriculus (%)	0.33^{d}	1.48^{b}	1.61^{b}	1.77^{a}	2.00^{a}	1.16^{c}	0.26
Gizzard (%)	1.75^{a}	1.48^{b}	1.61^{b}	1.87^{a}	2.00^{a}	2.10^{a}	0.41
Liver (%)	1.88^{c}	2.74^{a}	2.89^{a}	2.96^{a}	2.69^{a}	2.25^{b}	0.31
Heart (%)	0.33^{b}	0.40^{a}	0.46^{a}	0.47^{a}	0.45^{a}	0.33^{b}	0.06
Kidney (%)	0.25^{a}	0.11^{c}	0.17^{b}	0.18^{b}	0.19^{b}	0.17^{b}	0.05
Pancreas (%)	0.25^{a}	0.18^{b}	0.29^{a}	0.29^{a}	0.27^{a}	0.28^{a}	0.05
Spleen (%)	0.31^{a}	0.18^{b}	0.21^{b}	0.22^{b}	0.20^{b}	0.21^{b}	0.02
Bile volume (%)	0.04^{b}	0.06^{a}	0.07^{a}	0.03^{b}	0.04^{b}	0.03^{b}	0.002
Small intestine (%)	4.75^{a}	3.44^{b}	5.26^{a}	5.30^{a}	4.33^{a}	4.46^{a}	1.01
Caeca (%)	0.29^{c}	0.42^{b}	0.54^{a}	0.55^{a}	0.55^{a}	0.56^{a}	0.10
abc means along the same row with different superscripts are significantly (<0.05)							

With 10, 20 and 30% *C. mucunoides* and non-enriched meal. Result of liver also showed that 40% enrichment led to reduction of liver weight compared to other levels of enrichment followed by the control.

The heart was similar in control and 40% enrichment. Non-enrichment and enrichment at 10, 20 and 30% resulted to increased weight of the heart. Both non-enriched and enriched cassava peel meal at all levels shrink the weight of the kidney compared to control. However, shrinkage was more pronounced when cassava peel meal not enriched was fed. This is indicative that at certain level of enrichment cassava peel meal will not be deleterious to the kidney. Only cassava peel meal not enriched reduced the weight of pancreas and small intestine. There were no significant

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(p>0.05) differences in weight of pancreas and small intestine between the control and levels of enrichment.

In terms of the spleen, cassava peel meal whether enriched or not reduced the weight of the spleen. Enlargement of the caeca was observed by feeding non-enriched and enriched cassava peel meal which was more pronounced at all the levels of enrichment. This result showed that cassava peel meal was detrimental to the internal organs and *C. mucunoides* could be used to reduce this effect.The effect of the cassava peel meal was similar to that reported.Alsoreported that ensiling cassava peel with forage reduced its negative effect on internal organs of birds [13,14].

Effect of enriched cassava peel meal on haematological characteristics of broilers

The dietary effect of cassava peel meal enriched by *C. mucunoides* on haematological parameters of broiler chickens is shown in Table 6 [15]. There was no significant (p>0.05) differences in white blood cells, mean corpuscular volume, mean corpuscular concentration and mean corpuscular haemoglobin concentration which was in line.

Table 6: Effect of *Calapogonium. mucuniodes* fortified cassava peel meal on haematologyoffinisher broiler chickens.

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	- SEM
White blood cells	69.50	69.20	68.92	68.35	64.15	64.40	5.16
Red blood cells	2.40^{c}	2.30^{d}	2.30^{d}	2.40^{c}	2.50^{b}	2.60^{a}	0.09
Haemoglobin	2.40^{b}	2.30^{c}	2.31^{c}	2.33^{c}	2.61^{a}	2.60^{a}	0.08
Platelets	27^{b}	25^{b}	28^{b}	30^{b}	50^{a}	59^{a}	4.43
Lymphocytes	83^{b}	90^{a}	88^{a}	90^{a}	89^{a}	91^{a}	4.86
Monocytes	3.0^{b}	4.0^{a}	3.0^{b}	3.0^{b}	3.0^{b}	3.0^{b}	0.95
Neutrophils	12.0^{a}	5.0^{b}	4.0^{b}	5.0^{b}	4.0^{b}	4.0^{b}	2.05
Eosinophils	2.0^{a}	1.0^{b}	1.0^{b}	2.0^{a}	2.0^{a}	2.0^{a}	0.35
Packed cell volume	28^{b}	27^{b}	28^{b}	30^{a}	30^{a}	31^{a}	1.44
MCV	118	116	117	121	119	120	10.65
MCH	37	36	37	38	37	38	3.08
MCHC	31	31	32	31	32	33	2.75

abcd means along the same row with different superscripts are significantly (p<0.05)

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Significant (p<0.05) differences were observed in other parameters measured. The red blood cells were reduced by meal not enriched and 10% of enrichment. Above 10% dietary inclusion of fortified cassava peal meal increased the red blood cells. The cells were observed to increase as the level of enrichment was increased above 10%, indicating the importance of *C. mucunoides* in ameliorating the negative effect of cassava peel meal.Cassava peel meal affected haemoglobin negatively except at 30 and 40% of enrichment at which the level of haemoglobin increased compared to that of the control.

While the platelets was increased by 30 and 40% of enrichment there was no difference between the control, 0, 10 and 20% of enrichment.

Looking at the white blood cells differentials, feeding of both enriched and non-enriched cassava peel meal generated higher lymphocytes and lower neutrophils, while only non-enriched cassava peel meal resulted to higher monocytes. Hence the monocytes of the control showed no difference (p>0.05) from 10, 20, 30 and 40% of enrichment. Eisonophils level in the blood was reduced by non-enriched and 10% enriched meals, while the values of control, 20, 30 and 40% of enrichment were equal (p>0.05). The opposite was noticed in packed cell volume. Enrichment at 20, 30 and 40% produced higher packed cell volume compared to both the control, non-enriched meal and 10% enriched meal which were similar (p>0.05).

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Reduction in level of haemoglobin by cassava peel meal has been attributed to development of anaemia [16]. Presence of anti-nutritional factors in cassava has also been attributed to its negative impact on haematological parameters [17]. Generally, enrichment of cassava peel meal with *C. mucunoides* especially above 20% improved the haematological status of the birds. This is in line

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With the reports it is also informative that *C. mucunoides* could be a blood builder considering the results red blood cells, haemoglobin and packed cell volume [7, 15].

Effect of enriched cassava peel meal on liver enzymes of broilers

The effect of enriched cassava peel meal on liver enzymes are shown in Table 7. Enrichment of cassava peel meal resulted to significant ($p<0.05$) differences in all the parameters measured. The value of alanine aminotransferase (ALT) was higher in 30 and 40% level of enrichment and smaller in non-enriched group. There was no difference between the ALT values of control, 10 and 20%.

Inclusion of the meal to the diet enriched or not, reduced the level of aspartate aminotransferase (AST) in the serum except at 40% which produced similar value with the control. It was closely observed that AST increased as the level of enrichment was increased. Non-enrichment produced the highest value of alkaline phosphatase (ALP) which was observed to significantly decrease as the level of enrichment was increased [18]. The ALT value (4.0 iu/l) of birds that consumed diet containing cassava peel meal not enriched was below the standard level (10 – 37 iu/l) reported. The values of AST and ALP in all the treatment groups fell within the normal range also reported by Banerjee and Tewe et al. [19,20].

Table 7: Effect of cassava peel meal fortified with *c. mucunoides* on the liver enzymes of broiler chickens.

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	SEM
ALT (iu/l)	8.0^{b}	4.0^{c}	9.0^{b}	8.0^{b}	10.0^{a}	12.0^{a}	1.33
AST (iu/l)	132^{a}	98^{c}	101^{c}	119^{b}	120^{b}	127^{a}	7.88
ALP (iu/l)	49^{bc}	60^{a}	51^{b}	46^{c}	32^{d}	27^{e}	4.67

abcde means along the same row with different superscripts are significantly (<0.05) different.
ALT:Alanine Transaminase; AST: Aspartate Transaminase; ALP: Alkaline Phosphatase

Conclusion

As reported poor nutritional quality of cassava peel meal has been a source of worry among monogastric animal nutritionists, feed millers and poultry farmers. In this research enrichment of cassava peel meal showed improvement in performance by the broiler chickens in the area of the apparent nutrient digestibility, dressing percent, breast cut, liver, kidney, pancreas, red blood cells, haemoglobin and packed cell volume. Therefore cassava peel meal could be enriched with *Calapogonium mucunoides* up to 40% to improve its nutritional value for better digestibility, good health and higher carcass yield.

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