

Influence of dietary fortification of cassava peel meal with *Calapogonium mucunoides* on performance of broiler chickens

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Abstract

The use of cassava peel meal (CPM) in broiler diets is not popular due to its negative effects. Hence an experiment was conducted to determine its dietary effect when fortified with *Calapogonium mucunoides*. One hundred and forty-four (144) one day-old 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. Treatments 2, 3, 4, 5 and 6 contained CPM fortified with 0, 10, 20, 30 and 40% *C. mucunoides* respectively. The CPM was fortified by substituting it for equal amount of *C. mucunoides*, mixed, ground, dried and sieved. Starter phase lasted for 28 days and finisher phase 21 days. The birds were fed and water given *ad libitum* for 49 days. At the starter phase fortified and non-fortified CPM did not improve performance compared to the control treatment. Non-fortified, 10% and 40% fortified CPM reduced live weight and feed intake. However, 20 and 30% *C. mucunoides* fortified CPM improved these parameters compared to the non-fortified group. Feed: gain ratio and protein efficiency ratio of the control and 20% fortified treatment were similar ($P>0.05$). Except protein efficiency ratio which was improved by 20% over the control treatment, fortification did not improve performance at the finisher phase. Live weight was better in 20% than in non-fortified. Feed and protein intakes were similar in non-fortified and fortified CPM. It was concluded that fortification of CPM with 20% *Calapogonium mucunoides* improved protein efficiency in broiler chickens.

Keywords: broiler chickens, *calapogonium mucunoides*, cassava peel meal, fortified, growth performance.

Introduction

It has been established that poultry performance in terms of live weight and efficiency of feed utilization and carcass leanness is clearly related to quality and intake levels of particular nutrients, particularly energy and protein (Nwakpu *et al.*, 1999). However, other feedstuff and ingredients used in poultry ration formulation such as maize, soya bean meal and groundnut cake have continued to be scarce and costly due mainly to their low production and competition as food by human in developing countries like Nigeria. Thus the poultry industry in the developing countries is facing some challenges which include high feed: grain ratio and increase

in the cost of feed because of the high price of feed ingredients. Nevertheless, the potential of many industrial by-products such as palm kernel cake, brewers dried grains, and wheat offals to serve as alternative, cheaper and readily available nutrient sources for poultry has been recognized (Zafar *et al.*, 2005). However, these industrial by-products are currently becoming expensive due to high overhead cost associated with their production. Manufacturers now use them to increase their revenue thereby improving their gross margin. It is in this realization that farmers and feed manufacturers are now changing their operation toward greater reliance on readily available local feedstuffs (Bratte *et*

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al., 2011). It is worthy of note that the feed ingredients should not only be readily and locally available, but should have little or no industrial value, and be a waste but with livestock feeding values. Cassava peel falls within this category of feedstuff.

Cassava peel is one of the solid waste produced as a consequence of cassava processing. It is low in protein but contains an appreciable amount of carbohydrate. However, fresh cassava peel is hazardous due to presence of cyanide. In order to add value to this major cassava processing waste, it is dried and milled into a meal. Drying has been reported to reduce the cyanide content to a safer level according to Okike *et al.* (2015). Despite the value addition by drying and milling, cassava peel meal has not competed favourably with palm kernel cake, brewer's dried grains and wheat offals in poultry nutrition. Hence famers and feed millers are still sceptical to use it. Nevertheless, 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. This could be achieved by fortifying or enriching it with natural bioactive compounds like carotenoids, flavonoids and protein. This could be achieved by using a forage that is rich in these compounds and known to be palatable. The value of forage in poultry diet has received new emphasis (Ndelekwute *et al.*, 2018). It has been recognized for centuries that green feeds were paramount in poultry diet if birds were to be kept in good health (Ndelekwute *et al.*, 2018). Hence cassava peels could be fortified with a natural bioactive substance to command the respect of nutritionist, feed millers and farmers. Enrichment of cassava peel meal could avail it a status that could be acceptable by farmers and feed millers alike. The natural and abundant bioactive

compounds that most qualified are obtained from legumes like *Calapogonium mucunoides*, that contains carotenoids, flavonoids and also crude protein. Therefore, the objective of this study was to determine the dietary effect of cassava peel meal fortified with *C. mucunoides* on growth performance of broiler chickens.

Materials and methods

Experimental site

The experiment was carried out at the Poultry Unit of Teaching and Research Farm of the Department of Animal Science, University of Uyo, Uyo, Akwa Ibom 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). The mean temperature during the experimental period was 30°C and the rainfall was 2,500mm according to University of Uyo Meteorological Station (UUMS, 2019).

Processing of fortified cassava peel meal

Fresh cassava peels were collected from producers, washed and sun dried. Fresh leaves of *Calopogonium mucunoides* were harvested from fallowed land in the University farm. The *C. mucunoides* was used to replace the dry cassava peel weight to weight. The fresh leaves were mixed with the dry cassava peels at different proportions in a mixture (10, 20, 30 and 40%) of *C. mucunoides* as thus: 100g of *C. mucunoides* was added to 900g of cassava peel; 200g to 800g; 300g to 700g and 400g to 600g of dry cassava peel, which add up to 1000g (1.0kg) each. The fresh *C. mucunoides* leaves were cut into pieces and mixed with the dry cassava peel. The mixture was then ground with grinding machine. The ground material was then dried under the sun. After drying it was further ground and sieved to transform the crumbs into small particle sizes. Sieving the mixture was to reduce the fibre level.

Experimental design

The experiment was carried out on completely randomized design (CRD) with one hundred and forty four (144), one day old Hubbard chicks. 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 replicate. Treatment one was the control diet with no cassava peel but contained palm kernel cake, T2 had non-fortified cassava peel meal, T3, T4, T5 and T6 were diets that contained cassava peel meal fortified by substitution with 10, 20, 30 and 40% *C. mucunoides* respectively. The fortified 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 non-fortified cassava peel meal.

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

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

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

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

Management of experimental birds

The brooding house and the rearing house were thoroughly swept, washed, disinfected and fumigated. The Floor was covered with wood shavings to serve as bedding material. A day prior to the arrival of the chicks, feeding trays and drinkers were washed with soap and disinfected. On arrival, the day old chicks were weighed and the initial weight recorded. The chicks were given glucose via drinking water. Kerosene stove was used to supply heat to provide warmth. The heat was supplied till the third week. On the second day, antibiotics, vitamins and minerals were added to their drinking water for a week. Feed and water were offered *ad libitum* throughout the experimental period which lasted for 49 days.

Table 1: Ingredient composition of experimental starter broiler diets

Ingredients	T1 Control	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	-	-	-	-
FCMB	-	-	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
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 2mg, riboflavin 6mg, pyridoxine 4mg, cobalamine 0.05g, biotin 0.08mg, choline chloride 0.05g, manganese 0.096g, iron 0.024g, copper 0.006g, iodine 0.014g, selenium 0.24mg, cobalt 0.024mg and antioxidant 0.125g. FCPM = Fortified Cassava Peel Meal

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Experimental feed

Six experimental diets were compounded using maize (yellow maize), soya bean meal, crayfish dust meal, palm kernel cake, bone meal, table salt, lysine, methionine

and vitamin-mineral premix. The feeds (Tables 1 and 2) were formulated by trial and error method (Olomu, 1995), making sure that they conformed to the nutrients requirements of broiler chickens in the hot humid tropical environment.

Table 2: Ingredient and nutrient composition of experimental finisher diets

Ingredients	T1 Control	T2 (10%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)
Maize	51.0	51.0	51.0	51.0	51.0	51.0
Soya bean meal	28.0	28.0	28.0	28.0	28.0	28.0
Palm kernel cake	15.0	-	-	-	-	-
Cassava peel meal	-	15.0	-	-	-	-
FCPM	-	-	15.0	15.0	15.0	15.0
Fish meal	2.0	2.0	2.0	2.0	2.0	2.0
Bone meal	3.30	3.30	3.30	3.30	3.30	3.30
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition						
Crude protein (%)	20.09	18.89	19.14	19.37	19.59	19.82
Ether extract (%)	3.98	3.30	3.20	3.43	3.65	3.90
Crude fibre (%)	5.24	5.69	2.69	2.79	3.01	3.43
Ash (%)	8.01	7.98	7.89	8.0	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 2.5mg, thiamine 2.0mg, riboflavin 3.0 mg, pyridoxine 4.0mg, niacin 20mg, cobalamin 0.05mg, pantothenic acid 5.0mg, folic acid 0.5mg, biotin 0.08mg, choline chloride 0.2mg, manganese 0.006g, zinc 0.03g, copper 0.006g, iodine 0.0014g, selenium 0.24g, cobalt 0.25g and antioxidant 0.125g. FCPM = Fortified Cassava Peel Meal

Data collection and analysis

The live body weight was obtained weekly using a 20kg capacity Camry weighing scale. The weight gain was calculated by subtracting the initial weight from the final weight. The feed intake of each replicate was calculated by subtracting the quantity of the leftover feed from the quantity of feed fed the previous day. This was later divided by the number of birds in the replicate, to give the average feed intake per bird. The feed: gain ratio, protein intake and protein efficiency ratio were also calculated.

$$\text{Feed: gain ratio} = \frac{\text{daily feed intake (g)}}{\text{daily weight (g)}}$$

Protein intake was calculated by multiplying the percentage crude protein (CP) in the feed by the daily feed intake. (Daily protein intake (DPI) = %CP in feed × Daily feed intake). The protein efficiency ratio (PER) was calculated based on the daily weight gain and daily protein intake.

$$\text{PER} = \frac{\text{daily weight gain (g)}}{\text{daily protein intake (g)}}$$

Data analysis

Data collected were subjected to Analysis of Variance (ANOVA). Where significant effects were detected from analysis of variance, treatment means were compared using Duncan's Multiple Range Test (Steel and Torrie; 1980).

Results and discussion

Chemical composition of Calopogonium mucunoides

The values of the chemical composition of Cassava peel is shown in Table 3. It showed very high crude fibre, low crude protein and

ether extract similar to that reported by Oyebimpe *et al.* (2006). This shows that cassava peel meal is a poor protein supplier but a good source of fibre. This also confirms its low patronage by poultry farmers and feed millers.

Table 3: Proximate composition of cassava peel meal

Parameters	%
Crude protein	3.25
Ether extract	2.98
Ash	5.16
Crude fibre	21.0

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The effect of Cassava Peel Meal fortified with *Calopogonium mucunoides* on starter broiler chicks is shown in Table 4. Significant differences ($P < 0.05$) were observed in final live weight, daily weight gain, total feed intake, daily feed intake, daily protein intake, feed: gain ratio and protein efficiency ratio. Control diet with palm kernel cake (PKC) performed better, but fortification at certain levels improved performance over non-fortification. Final live weight and daily weight gain followed similar trend. Fortification of cassava peel meal with 20% *C. mucunoides* improved both final live weight and daily weight gain over non-fortification (0%) followed by 30%, but the live weights were poor compared to control. Hence, the control had the highest final live weight and daily weight gain. Total feed intake also followed similar trend. Cassava peel meal without fortification (0%) gave the lowest total feed intake and daily feed intake compared to control, 10, 20 and 30%. It was however observed that the total feed intake and daily feed intake of non-fortified cassava peel meal and 40% fortified were the same ($P > 0.05$). Though fortification at 20 and 30% improved feed intake over non-fortification, it was not better than the control. The feed: gain ratio of 20% and control were similar and better, while those

of 10 and 40% were similar but the poorest. Also non fortification and 30% gave similar feed: gain ratio.

Fortification did not improve protein intake at all levels. However, there was no significant difference ($P > 0.05$) in protein efficiency ratio between control, non-fortified group and 20% fortification.

By the performance of the starter broiler chicks it could be affirmed that fortifying the cassava peel meal improved the quality of the cassava peel meal. This is in line with Aya (2016) that cassava peel meal ensiled with *Moringa*, *Gliricidia* and *Leucaena* leaves possessed more nutritional value and quality. Thus affirming the importance of green forages in poultry nutrition for good health and performance as reported by Ndelekwute *et al.* (2018).

Table 5 is indicating the dietary effect of fortified cassava peel meal on finisher broiler chickens. There were significant differences ($P < 0.05$) in all the parameters measured. Fortification at 20% improved the final live weight, daily gain and feed: gain ratio over non-fortification, but not the control. Fortification of cassava peel meal at 40% affected final live weight, daily weight gain and feed: gain ratio negatively followed by 30% compared to control and non-fortified cassava peel meal. However, the final live weight and daily weight gain of non-fortified cassava peel meal and 10% fortified were similar but inferior to the control. Both the total feed intake and daily

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Table 4: Effect of cassava peel meal fortified with *C. mucunoides* on starter broiler chickens

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	SEM
Initial live weight(g/bird)	40.70	40.90	40.30	39.60	42.30	39.60	3.75
Final live weight(g/bird)	1036 ^a	827 ^d	821 ^d	934 ^b	878 ^c	803 ^d	50.11
Daily weight gain (g/bird)	35.55 ^a	28.08 ^d	27.88 ^d	31.94 ^b	29.85 ^c	27.26 ^d	2.01
Total feed intake(g/bird)	1888 ^a	1586 ^c	1703 ^b	1728 ^b	1693 ^b	1644 ^{bc}	105
Daily feed intake(g/bird)	67.43 ^a	56.64 ^c	60.82 ^b	61.71 ^b	60.46 ^b	58.71 ^{bc}	3.88
Feed: gain ratio	1.90 ^c	2.02 ^b	2.18 ^a	1.93 ^c	2.03 ^b	2.15 ^a	0.11
Daily protein intake(g/bird)	15.47 ^a	2.16 ^b	13.08 ^b	13.47 ^b	13.44 ^b	13.19 ^b	1.88
Protein efficiency ratio	2.30 ^a	2.31 ^a	2.13 ^c	2.37 ^a	2.22 ^b	2.07 ^c	0.08

abc. Means along the same row with different superscripts are significantly (P<0.05) different.

Table 5: Effect of cassava peel meal fortified with *C. mucunoides* on finisher broiler chickens

Parameters	T1 Control	T2 (0%)	T3 (10%)	T4 (20%)	T5 (30%)	T6 (40%)	SEM
Initial live weight (g/bird)	1036 ^a	827 ^d	821 ^d	934 ^b	878 ^c	803 ^d	50.11
Final live weight (g/bird)	2700 ^a	2205 ^c	2113 ^c	2394 ^b	2042 ^d	1932 ^c	105
Daily weight gain (g/bird)	79.25 ^a	65.62 ^c	61.52 ^c	69.52 ^b	55.43 ^d	53.76 ^d	5.14
Total feed intake (g/bird)	3785 ^a	3264 ^b	3333 ^b	3341 ^b	3077 ^b	3307 ^b	211
Daily feed intake (g/bird)	180.24 ^a	155.40 ^b	158.71 ^b	159.11 ^b	157.48 ^b	157.48 ^b	20.86
Feed: gain ratio	2.27 ^d	2.37 ^c	2.58 ^b	2.29 ^d	2.84 ^a	2.93 ^a	0.09
Daily protein intake (g/bird)	38.01 ^a	29.36 ^b	32.59 ^b	30.81 ^b	28.70 ^b	31.21 ^b	2.46
Protein efficiency ratio	2.08 ^b	2.24 ^a	1.89 ^c	2.26 ^a	1.93 ^c	1.72 ^d	0.08

abcd. Means along the same row with different superscripts are significantly (P<0.05) different.

feed intake of non-fortified and fortified cassava peel meal groups were similar, but lower than the control. The control and 20% produced the best feed: gain ratio, while non-fortified cassava peel meal diet generated better feed: gain ratio than 10, 30 and 40%. The control group consumed more protein. Nevertheless, the daily protein intake was similar in non-fortified and fortified groups. Non-fortified and 20% fortified gave the best protein efficiency ratio followed by the control, while the poorest protein efficiency ratio was recorded by 40%.

The trend of the present result on growth performance is an indication of poor quality of cassava peel meal. Many records have shown this and attributed this to presence of anti-nutritional factors such as hydrogen cyanide, phytate, saponins, tannins and silica in cassava peel meal (Agbabiaka *et al.*, 2010; Habtamu and Ngusse, 2014; Abu *et al.*, 2015; Ukanwoko, 2017; Kalio *et al.*, 2018).

These authors generally opined that these factors affect nutrient utilization negatively resulting to poor growth performance. Though not comparable with the performance of the control, the observation made in 20% *Calapogonium mucunoides* fortification of cassava peel meal was better than those on cassava peel meal without fortification. This is an indication that *C. mucunoides* could have improved the quality of the cassava peel meal. It is a clear evidence that *C. mucunoides* could have added some beneficial factors to the cassava peel meal which were not detrimental at that level of fortification. *Calapogonium mucunoides* has been reported to contain some beneficial factors such as flavonoids and carotenoids which are bioactive compounds that could improve the health of animals (Norton, 1994). Norton (1994) also stressed the importance of feeding green forages to monogastric animals because they contain important nutrients such as vitamins and proteins. This result was in

consonant with the result of Iheukwumere *et al.* (2008) that green forages are essential natural feeding resources that could improve growth performance of broiler chickens.

Conclusion and recommendations

The purpose of the experiment was to investigate whether fortification of cassava peel meal with *Calopogonium mucunoides* by substitution will improve the productivity of broiler chickens. From the results obtained, it is concluded that 20% of *C. mucunoides* could be used to fortify cassava peel meal in diets for broiler chickens. It is recommended that more investigations be carried out where fortification should not be by substitution (i.e weight to weight), rather the different levels of the *C. mucunoides* should be added per kilogramme of the cassava peel meal

Acknowledgement

The authors are grateful to the management of Nekele Animal Nutrition, a division of Nekele Agriculture Services, Uli, Anambra State, Nigeria for their technical support.

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Received: 11th September, 2019

Accepted: 17th January, 2020