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EVALUATION OF THE NUTRITIVE VALUE OF WHOLE CASSAVA PLANT MEAL (WCPM) AS A REPLACEMENT FOR MAIZE IN COCKEREL CHICKS DIETS IN THE HUMID TROPICS

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Abstract

This study was carried out to evaluate the nutritive value of whole cassava plant meal (WCPM) as a replacement for maize in the diets of cockerel chicks. Two hundred and four goldline strain day old cockerel chicks were used in the study, which lasted six weeks. The birds were randomly divided into three diets with each diet having three replications. WCPM that had crude protein value close to maize was developed. The developed WCPM was in the ratio of 2.5:1 of cassava tuber to cassava leaves and tender stems. The ratio of cassava leaves to tender stems was 5:1. Diet 1 was maize based and served as the control. Diet 2 had 50% of maize in diet 1 replaced with WCPM and diet 3 had 100% maize in diet 1 replaced with WCPM. The diets were formulated to meet the nutritional needs of the birds. The design of the study was completely randomized design. The results obtained showed that feed intake (37.40g/d/bird – 39.21g/d/bird), body weight gain (7.28g/d/bird -10.12g/d/bird) and feed to gain ratio (3.70 – 5.27) were significantly ($P<0.05$) affected by the increasing levels of WCPM in diets. Highest values occurred in all the performance characteristics (except feed intake and feed to gain ratio) with birds on diet 1, while lowest values occurred with birds on diet 3. The haematological indices showed highest values with birds on diet 1, ($P<0.05$) while lowest values occurred with birds in diet 3. The economics of production was best with birds on diet 2. From the results of this study, it can be concluded that WCPM can be incorporated into the diet of cockerel chicks to replace 50% of maize without any negative effect on the performance and haematological Indices. It also enhances better economics of production.

INTRODUCTION

In Nigeria, the production and supply of meat to meet the dietary demand for animal protein is of great importance. The shortage and high cost of cereals in Nigeria constitute a limiting factor to the economics of production of poultry products (Olubamiwa *et al.* 2002; Hossain *et al.* 2003). The quest for least-cost dietary formulations especially in poultry feeding had involved the replacement of the more expensive conventional feeding stuff like maize with cheaper alternative (cassava). The extremely high prices of conventional feed ingredients in Nigeria had increased the feeding cost to about 60 – 80% of the total cost of intensively reared livestock especially poultry and piggery (Tewe 1997; Ojewola and Longe 2001). There is paucity of information on the use of whole cassava plant meal in the diets of poultry. Besides, most feeding trials on the use of cassava in poultry diet report on biological responses with little emphasis on blood response. Most available literature on cassava utilization in poultry diet centered on either the use of cassava root or cassava leaf meal (Tewe and Egbunike 1992; Ogbonna and Oredein, 1999). Cassava is a multi purpose crop which grows everywhere in Nigeria. Available evidence showed that there is the under utilization of cassava because the peels, leaves and tender stems are under utilized as they are often left to rot away on farms and homesteads in cassava producing areas of Nigeria. The considerable positive information that had been generated on the use of either of these products (flour, peels and leaves) in feeds of simple-stomached animals stimulated the current investigation.

The study was therefore carried out in order to contribute to the solution of inadequate animal protein consumption of Nigeria populace, which is primarily due to cost. It looked at the effects of inclusion of whole cassava plant meal as a basal diet to replace maize in the diets of cockerels chicks.

MATERIALS AND METHODS

The unpeeled cassava tubers, tender leaves and stems of mixed varieties were obtained from matured cassava plant after harvesting at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. The unpeeled fresh cassava tubers were washed in water, cut into pieces with cutlass to hasten drying and spread on a concrete floor for sun drying. The sun drying lasted for between 4 - 5 days depending on the intensity of sun light, after which the dried tubers were milled and packed in sacks. The fresh tender leaves and stems collected after harvesting were sun-dried. The tender stems were chopped into smaller bits with cutlass to enhance faster drying. After sun drying for about 3 days depending on the intensity of the sun light, the leaves and tender stems were milled separately and packed into sacks. Whole cassava plant meal (WCPM) was developed from the combination of tuber + tender leaves + tender stems. The ratio of tuber to tender leaves and stems was 2.5:1 while the ratio of tender leaves to tender stems was 5:1. These ratios were considered so that the crude protein level of the WCPM would be about 9.0%.

Three experimental diets were formulated to contain about 20% crude protein and metabolisable energy (ME) of 2,600 - 2,800 kcal/kg. Diet 1 was maize based and served as the control. Diet 2 had 50% of maize in diet 1 replaced with WCPM while diet 3 had 100% of maize in diet 1 replaced with WCPM (Table 1).

Two hundred and four Goldline day old cockerel chicks randomly distributed into the three diets were used in this study. The study was conducted for six weeks. Each dietary treatment had 68 birds and three were three replicates per treatment with an average of 22 birds per replicate. The birds were raised on deep litter. Water and feed were supplied for the birds *ad libitum*. Routine management practices were carried out. Vaccinations and medications programmes were administered accordingly.

Table 1 : Gross Composition of Experimental Diets

Ingredients (%)	Experimental Diets 1	2	3
Maize	50.00	25.00	-
Whole Cassava Plant Meal	-	25.00	50.00
Groundnut Cake	10.00	10.00	10.00
Soyabean Meal	9.00	9.00	9.00
Palm Kernel Cake	15.00	15.00	15.00
Wheat offal	9.00	9.00	9.00
Fish Meal	3.00	3.00	3.00
Bone Meal	1.30	1.30	1.30
Oyster Shell	2.00	2.00	2.00
Methionine	0.10	0.10	0.10
Lysine	0.10	0.10	0.10
Salt	0.25	0.25	0.25
Premix*	0.25	0.25	0.25
Total	100	100	100
Calculated			
Metabolisable Energy (Kcal/kg)	2,800	2,700	2,600
Crude protein (%)	19.67	19.88	19.92
Crude fibre (%)	4.68	5.53	6.31

Vitamin/Mineral Premix supplied the following Vitamins and Mineral elements per kg of feed: Vit A, 5,000IU, Vit D3 1,000,000 IU; Vit E, 15,000mg, Vit K3, 1,000mg; Vit B1, 1,200mg; Vit B3, 2,400mg; Biotin 32mg; Vit B12, 10mg; folic acid, 400mg; cholinechloride 120,000mg; Manganese 40,000mg; Iron 20,000mg; Zinc 18,000mg; Copper 800mg; Iodine 620mg; Cobalt 100mg; Selenium 40mg.

Data were collected on daily basis for six weeks on feed intake. The body weight was determined forthnightly. Average values for performance characteristics were determined at the end of the study. The cost of production of birds on each treatment was calculated based on the cost of the birds, feed consumed, money spent on medication and vaccination, housing and labour cost and other exigencies.

Table 2 : Proximate Composition of Whole Cassava Plant Meal, (WCPM), Cassava tuber, Cassava tender leaves and Cassava tuber stems

Parameter (%)	WCPM	Unpeeled Cassava Tuber	Cassava Leaves	Cassava Tender Stems
Dry Matter	92.01	93.01	92.74	93.85
Crude protein	9.10	4.72	18.03	10.68
Crude Fibre	4.94	2.08	14.10	20.92
Ether extract	3.40	2.52	9.4	3.64
Ash	3.32	8.43	7.9	10.03
Nitrogen free extract	7 1.25	75.26	43.31	48.58

Table 3 : Proximate Composition of Experimental Diets

	Diets		
Parameters (%)	1	2	3
Dry Matter	93.67	93.78	93.15
Crude protein	20.67	21.33	21.92
Crude Fibre	3.80	4.05	4.25
Ether extract	4.40	3.48	2.56
Ash	6.72	8.75	8.79
Nitrogen free extract	58.08	56.17	55.63

At the end of the six weeks of growth trial, six birds were randomly selected per diet and blood samples were collected from individual bird with the aid of sterilized 10 – guage needles via wing veins on the inner side of elbow joints. The blood samples meant for haematological studies were collected into ethylene diamine tetra acetic acid (EDTA) bottles and analysed for packed cell volume (PCV), haemoglobin (Hb), Red blood cell counts (RBC) and White blood cell counts (WBC), using the ADVIA 60 Haematology analyzer. The ADVIA 60 Machine cannot count high WBC in the film hence, manual count using Leish mann stain method was used for WBC count.

Proximate analysis of the test ingredients (Table 2) and diets (Table 3) was carried out using the methods outlined by the Association of Official Analytical Chemists (AOAC, 1995). All data obtained were analysed using statistical software package (SAS, 2000).

RESULTS AND DISCUSSION

The proximate composition of the whole cassava plant meal (WCPM) and the test ingredients is shown in Table 2, while Table 3 showed the proximate composition of experimental diets. Whole Cassava Plant Meal (WCPM) had 9.10% crude protein. The diets had a similar proximate analysis with only slightly higher levels of Crude protein, Crude fibre and Ash as the proportion of WCPM increased in the diets.

The crude protein value obtained from whole cassava plant meal (WCPM) (9.1%) is similar to the 9 – 10% reported for maize in literature. The WCPM had higher crude fibre (4.94%) than maize (2.0%). The metabolisable energy (ME) value of the diets reported for this study was slightly higher than the one reported for chicks by Okosun (1986). The slight variations in crude protein and energy values of the experimental diets may be due to differences in the chemical composition among samples of ingredients in relation to differences in cultivars, climatic factors and processing methods (Oluyemi *et al.* 1976). Proximate analysis of the experimental diets showed that the total ash and crude fibre contents increased with increasing level of WCPM in the diets.

The results of the performance of the birds fed the experimental diets are shown in Table 4. The results obtained showed significant difference (P<0.05) on all growth parameters monitored. Birds in diet 1 record highest value for final body weight (600g) and weight gain (10.12g/day) while least value was recorded by birds on diet 3 for final body weight (440g) and weight gain (7.28g/day). The weight gain decreased significantly (P<0.05) among the treatments with increasing level of whole cassava plant meal (WCPM) in the diets. The feed intake also increased significantly (P<0.05) with increasing level WCPM in the diets. Birds on diet 3 had the poorest feed/gain ratio (5.27) while those of diet 1 had the best (P<0.05) feed/gain ratio (3.70).

The decrease in body weight and deteriorating feed to gain ratio (P<0.05) of the birds with the increasing level of WCPM observed in this study may be due to fibre and ash content which appeared to be higher in WCPM diets. This is in agreement with Akinfala *et al.* (2002) when they fed WCPM to Broiler chicken at starter phase. Presence of residual cyanide, which had been implicated to affect the pattern of protein utilization in animals (Iyayi and Tewe 1992) may also be responsible for the observed performance characteristics. Cyanide causes reduction in growth rate by inhibiting intra-thyroidal uptake of Iodine, causing increase in secretion of thyroid stimulating hormone (TSH) and thereby causing a reduction in thyroxine level, which is necessary for growth (Tewe, 1991). Though the birds consumed more with the increasing level of WCPM in the diet, birds on diet 2 recorded highest feed intake value compared to diet 3. This did not agree with Osei and Duodu (1988) who reported a significant increase in feed intakes as levels of sun-dried cassava peal meal increased in the rations. However, comparing the control diet with the diets that had the test ingredient, the observed trend in feed intake in this study agreed with Osei and Duodu (1988). The lowest feed intake values recorded for birds on the control diet in this study may be due to the fact that birds receiving low fibre diet feed less to conserve energy and those on high fibre diets consume more in attempt to cancel out energy deficit (Ogbonna and Oredein, 1998). Besides, fibre is a non-sugar carbohydrate which is not easily digested by monogastrics. Once the glucose units of the fibre are not readily available for the various biochemical reactions, its use to provide the needed energy required by the birds becomes impaired. This may be the reason for the observed trend in the performance of the birds in this study. Diet 1 was more efficiently utilized in this study. Since poultry birds do not have the full complement of enzymes which could digest dietary fibre efficiently, (Olubamiwa *et al*, 2002), it is apparent that as WCPM replaced maize, dietary fibre increased and utilization efficiency was lowered.

Table 4 : Performance Characteristics of Cockerel Chicks Fed Experimental Diets

Parameters	Experimental Diets			
	1	2	3	SEM
Average Initial Body Weight/Bird (g)	33.50	32.48	32.30	0.65
Average Final Body Weight/Bird (g)	600.00^{a}	546.67^{b}	440.00^{c}	15.05
Average Weight Gain/Bird/Day (g)	10.12^{a}	9.18^{b}	7.28^{c}	0.02
Average Feed Intake/Bird/Day DM (g)	37.40^{bb}	39.21^{aa}	38.39^{ab}	0.82
Feed/Gain ratio	3.70^{c}	4.27^{b}	5.27^{a}	0.18

a, b, c = Means on the same row having different superscript differ significantly at P<0.05

Table 5 showed the haematological indices of cockerel chicks fed the experimental diets. The results of the study showed no significant difference (P<0.05) in the packed cell volume (PCV) and haemoglobin (Hb) of birds in diets 1 and 2, while PCV and Hb values from birds in diet 3 were significantly (P<0.05) different from those on diets 1 and 2. The red blood cell (RBC) count was significantly affected (P<0.05) by the dietary treatments and the highest value (1.53×10^6) was recorded with birds on diet 1. The white blood cell (WBC) count also decreased significantly (P<0.05) with increasing level of WCPM in the diets. This may be due to the varying dietary protein levels as reported by Aletor *et al.* (1998). The Hb values fell within the range recommended by Swension (1951) and while the PCV values fell below the range recommended by Duke (1970) for chickens. The observed haematological indices trend may be due to the presence of cyanide and microorganisms in the diets that contained WCPM. Both cyanide and microganisms have been implicated to cause reduced performance and induced haematological changes in monogastric animals rations (Tewe 1985).

Table 5 : Haematological Indices of Cockerel Chicks Fed Experimental Diets

Parameters	Experimental Diets			
	1	2	3	SEM
Packed Cell Volume (PCV) %	22.00^{a}	21.33^{a}	19.67^{b}	0.52
Haemoglobin (Hb) (g/dl)	8.82^{a}	8.78^{a}	8.03^{b}	0.59
Red Blood Cell (RBC) Count ($X10^6$)	1.53^{a}	1.36^{b}	0.94^{c}	0.28
White Blood Cell (WBC) Count ($X10^6$)	1.61^{a}	1.46^{b}	1.36^{b}	0.07

a, b, c = Means on the same row having different superscript differ significantly at P<0.05

Table 6 showed the economics of production of birds fed the experimental diets. The results showed that the replacement of maize with whole cassava plant meal in this study gave gross economics of production advantage on the total cost of feeding, feed cost/kg feed, total cost of production and cost of production/bird. These parameters were significantly influenced (P<0.05) by the dietary treatments. The dietary treatments had no significant effect (P<0.05) on the total revenue generated from birds on the control and diet 2 but significantly affected (P<0.05) revenue generated from birds on diet 3. Net returns were significantly affected (P<0.05). Birds on diet 2 had the highest values for net returns.

The economics of production justification for using cassava products in cockerel production is dependent on the relative cost of the alternative ingredient. The total cost of maize used in this study was 44.37% of the total cost of feed. The WCPM used in this study represented 61.2% of the price of maize and 19.10% of the total cost of feed. The feed cost/kg feed, and total cost of production/bird, decreased significantly (P<0.05) with increasing levels of WCPM in the diets while the revenue and net returns/bird indicated that it is more economical and cost effective to incorporate WCPM to replace 50% of maize in the diets of cockerel chicks. This study showed that beyond 50% WCPM replacement for maize, the growth performance and expected monetary gains may be sacrificed (Ogbonna 1991).

Table 6 : Economics of Production of Cockerel Chicks Fed Experimental Diets

Parameters	Experimental Diets			
	1	2	3	SEM
Average Initial Body Weight/Bird (g)	33.50	32.48	32.80	
Average Final Body Weight/Bird (g)	600.00^{a}	546.67^{b}	440.00^{c}	15.05
Total Feed Consumed/Bird (kg)	2.13^{c}	2.23^{a}	2.18^{b}	0.04
Total Cost of feed /bird (N)	71.53^{a}	67.37^{b}	58.49^{c}	5.44
Feed Cost /kg feed (N)	53.58^{a}	30.21^{b}	26.83^{c}	0.77
Cost of day old chicks (N)	25.00	25.00	25.0	0.00
Miscellaneous expenses**/bird (N)	41.37	41.37	41.37	0.00
Total Cost of Production/bird (N)	137.90^{a}	133.72^{b}	129.86^{c}	1.40
Revenue generated/bird (N)	250:00^{a}	250:00^{a}	200.00^{b}	23.57
Net returns / bird (N)	112.10^{b}	116.28^{a}	75.14^{c}	18.48

a, b, c = Means on the same row having different superscript differ significantly at P<0.05.

** Miscellaneous = Cost of labour, housing, vaccination and medication, transport etc.

CONCLUSION AND RECOMMENDATION

The results of this study showed that WCPM can be incorporated in the diets of cockerel chicks to replace 50% of maize without any adverse effect in the performance, haematological indices and economics of production. However, the comparatively slow growth rate and weight gain of birds on the WCPM diets may still be further investigated along the line of adding feed additives such as palm oil, enzymes, antibiotics, yeast etc.

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