Nutritional Evaluation of Processed Cassava Root Meal using Albino Rats

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ABSTRACT

A twenty-one day experiment was carried out using thirty-two Wistar strains of white albino rats to determine the energy level of cassava root meal. Four diets were formulated. Diet 1 contain corn-starch based diet (basal diet), Diets 2-4 contain (sun dried, fermented and rumen ensiled-digesta cassava root meal) as a sole energy source. The experimental diets were offered to the rats *ad libitum* while clean water was supplied on a daily basis. Thirty –two albino rats were used in the study in which eight rats were allotted to different dietary treatment.

The result showed that the diet has significant (P< 0.05) effect on growth performance with the value of 95.00- 76.5(g/birds) live weight. Rats fed corn based meal has significantly better growth performance compared with rats fed diet 2-3.The hematological indices and serum metabolites parameter rats fed fermented cassava root meal has higher Hb numerical value 15.00±1.29 (g/dl) while rat fed RDECRM had the least value of 12.5±2.6 (g/dl). Rats fed basal diets had least glucose value while rat fed fermented cassava root meal had the highest value of 81± 1.69-65±1.70 (mg/dl).Total protein of rat fed sun-dried cassava root meal were higher compared to rats fed fermented cassava root meal 8.6±0.42-7.4±0.28 (mg/dl).The result indicated that cassava root meal could replace maize at 10% of replacement without any deleterious effect on the performance characteristics and blood parameters of albino rats.

(Keywords: cassava meal, process, broiler, fermented ensiled, nutritive value, *Manihot esculenta* Crantz)

INTRODUCTION

Cassava (*Manihot esculenta* Crantz), a shrubby tree of the Euphorbiaceous family, is an extensively cultivated plant in many tropical countries. Annual production estimates in Nigeria were 34 million tonnes in 2009 (FAO, 2009). Cassava root is a major source of dietary carbohydrates for humans and livestock. It is widely accepted that plants grown in various locations produce different quality and quantity of substances. Cassava products had been in use for a long time as an energy source in place of cereal grains for livestock (Eruvbetine, 2003). There is thus the likelihood of continued use of cassava in animal feeding in the 21st century and beyond.

Known cases of acute HCN poisoning from the consumption of cassava are rare, probably because preparation process of cassava for consumption can destroy the linamarase and remove much of the free HCN. Due to the toxic cyanogenic glucoside several processing methods have been used to process fresh cassava root in order to reduce the cyanide content. These methods include grating, sun drying, oven drying, and boiling (Osei and Duodu, 1988). Previous studies reported that ensiling and fermentation are the most effective ways to eliminate cyanogenic substances whereas oven drying method is the least effective way (Tewe, 1986). The residual level of cyanogenic glucoside in processed cassava would therefore depend upon the processing method used. Thus, this study is designed to determine the energy level of cassava root meal on the performance, hematology, and serum metabolite of albino rats.

MATERIAL AND METHODS

Experimental Site

The feeding trial was carried out at the Directorate of University farms (DUFARMS) of the Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State.

Experimental Rats and Design

A twenty-one (21) day experiment was carried out using thirty-two (32) Wistar strains of white albino rats with average weight of 40g, sourced from Veterinary Pathology University of Ibadan. The rats were housed individually in stainless steel metabolic cages and allotted on weight equalization basis into four dietary treatments consisting of 8 rats per treatments. The treatments consist of a standard corn-starch based diet (basal diet) and 3 other experimental diets where each of the processed cassava roots (SDCRM, FCRM and RECRM) were used as a sole energy source. The experimental diets were offered to the rats *ad libitum* while clean water was supplied on a daily basis.

Preparation of Test Ingredients

Freshly harvested matured cassava tubers (TMS-30573) were purchased from local farmers within Abeokuta metropolis, Ogun State. Harvesting and processing was done during dry season (September – December) to enhance proper drying. The whole cassava tubers were washed in clean water to remove dirt and subjected to the following processing methods:

Sun-Drying

The freshly unpeeled cassava tuber were chipped manually into smaller sizes using a sharp knife, washed in clean water and spread thinly on a clean polythene sheets for 3-4 days until it was dried to a constant weight (10-11%MC). This was achieved by turning at intervals to enhanced dried cassava chips, the cassava chips were milled to yield sun-dried cassava root meal (SDCRM)

Fermentation

Freshly unpeeled cassava tuber were manually chipped into smaller sizes using a sharp knife, washed in clean water and soaked in water (at a ratio of 1:2 kg cassava tuber/Lt water) in an air tight, plastic container drum for 3 days. At the end of 3 day fermentation period, the fermenting liquid was drained and fermented tuber masses were carefully collected in jute sacs. This was screw-pressed overnight under a manually operated cassava screw-press; clogs of the pressed fermented tubers were sun-dried by manually crushing the hard crumbs and spreading on polyethylene sheets for 3-4 days. These were turned at intervals to enhance proper drying. The dried tuber was milled (2.5mm sieve) to yield the fermented cassava root meal (FCRM).

Ensiling Process

Fresh rumen digesta (from cattle) was collected from a near-by abattoir at the point of slaughter in a plastic container. The fresh digesta was mixed with fresh cassava root manually (at a ratio of 2kg cassava root: 1kg rumen digesta) and carefully set in a black plastic drum for ensiling period. The mixtures were covered up using a polyethylene sheet, under an air tight condition, and left for 21 days ensiling period. At the expiration of 21 days, the ensiled mixture of cassava tuber and rumen digesta were removed from the plastic drum and sun-dried for 3-4 days until constant weight is obtained. This were milled and bagged to obtain the rumen- digesta ensiled cassava root meal (RDECRM).

Measurement of Parameters

Growth Performance: Daily intakes of feed were recorded by subtracting the amount of left- over feed from feed offered after 24 hours. Weekly weight gain was calculated by subtracting the initial weight from the final weight. The feed conversion ratio was calculated by computing the ratio of amount of feed intake to weight gain while the protein efficiency ratio was computed by finding the ratio of weight gain to protein consumed.

Blood Parameters: At the end of 21 days, blood samples were collected from 3 rats per treatment using hypodermic needle and syringe. Blood was drained into different carefully label bottles for hematological and serum biochemical investigation, the blood samples for hematological parameters was collected into bottles containing ethylene diamine tetra acetate (EDTA) an anticoagulant, while blood samples for bio chemical indices was collected into another sample bottles containing no anti-coagulant. Packed cell volume (PCV) was determined using Wintrobes micro-hematological method (Baker and Silverton, 1985). Hemoglobin (Hb) and red blood cell (RBC) concentration was determined by a cyanmethaemoglobin method (Benjamin, 1978). Total leukocyte counts was determined using Neubauer hemocytometer after appropriate dilution, and differential leukocyte counts was performed using the oil - immersion objective examination of blood films stained with the modified Romanovsky's Giemsa stain.

Serum Biochemical Determination: Biuret method of total serum protein determination was employed in this study as described by Kohn and Allen (1995). Serum albumin was determined using Bromocresol Green (BCG) method as described by Peter *et al*., (1982). The serum globulin concentration was obtained by subtracting albumin concentration from the total serum protein. The albumin/globulin ratio was obtained by dividing the calculated albumin value by the calculated globulin value. Aspartate amino transferase (AST) and alanine amino transferase (ALT) activities were determined using spectrophotometric methods as described by Hoder and Rej (1983). Serum creatinine (SC) was determined using the principle of Jaffe reaction as described by Bonsnes and Tausslay (1945) while the serum uric acid (SUA) was determined using the Kit (Quinica Clinica Spain) as described by Wootton (1964).

Statistical Analysis

Data generated were arranged in a Complete Randomized design and analyzed using one - way analysis of variance (SAS, 1990) statistical package. Duncan multiple range text was used to separate significant mean values (Duncan, 1955).
Result and Discussion

Table 1 showed the composition of experimental diets fed to albino rats. The table comprised of the basal diets (Treatment 1), SDCRM, (Treatment 2), FCRM, (Treatment 3) and RDECRM (Treatment 4).

Table 2 showed the effect of cassava processing methods on performance characteristics of rat fed the experimental diets. The cassava meal had significant ($P< 0.05$) effect on final live weight, weight gain average feed intake on weekly basis. Rat fed basal diets had the ($P< 0.05$) highest live weight gain and weight gain while birds fed rumen digesta –ensiled cassava had the least. Rat fed RDECRM had the ($P< 0.05$) highest average feed intake while rat fed sun dried cassava recorded the ($P> 0.05$) least average feed intake. Rats fed with basal diet gained more weight than those fed with cassava meal. This may be due to the high fibre content and low sulphur amino acids (lysine and tryptophan) in cassava root meal. This corroborates the reports of Umar *et al*, 2008 who reported that animal fed with proteins deficient diets tends to lost weight and growth.

Table 3 summarized the haematological indices of rat fed the experimental diets. There were significant ($P<0.05$) effect on PCV, HB, RBC, WBC, MCHC, heterophil and Lympocyte. The higher value of PCV recorded may be as result of the processing methods employed in this study. The WBC values of rat fed RDECRM diet groups shows significantly ($P<0.05$) different when compared to other diets. This shows that the rats developed higher immunity against any deleterious effect of HCN in the cassava root meal. The Hb level of rat on diets were still within range reported in the literature by Bucklan *et al.,*1981.The higher Hb level recorded by rat fed FCRM may be due to the higher content of iron in the processed cassava root meal.

The PCV value of rat fed FCRM were significantly ($P>0.05$) higher than those fed other diets. The values still fall within the range reported by Coles, 1986. This is in accordance with the report of Swenson (1990). The high MCHC which provides an index of the average hemoglobin value indicates sufficient hemoglobin synthesis (Endex, 2007). MCH gives an estimate of the average hemoglobin content of each red cell. The MCV value reflects the average volume of each red cell (Cheesbrough, 2003) but MCV showed no significant ($P<0.05$) value in this study.

Table 1: Gross Composition (%) of Experimental Diet for Rats.

Ingredient	Basal	DCRM	FCRM	RECRM
Corn starch	54.64	0.00	0.00	0.00
Cassava	0.00	54.64	54.64	54.64
Casein	11.26	11.26	11.26	11.26
Glucose monohydrate	5.00	5.00	5.00	5.00
Sucrose	10.00	10.00	10.00	10.00
Non-nutritive cellulose	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00
Vit-min(premix)	1.00	1.00	1.00	1.00
Salt	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00

Table 2: Growth Performance of Rats Fed Maize Based Diets and Processed Cassava Root Meal Based Diets and Processed Cassava Root Meal.

Parameters	Basal diets	Sun-dried cassava	Fermented cassava	Rumen digesta – ensiled cassava
Initial weight(g/Bird)	40.00±0.01	40.00±0.01	40.00±0.01	40.00±0.01
Final liveweight (g/bird)	135.00± 3.2^{a}	126.00± 2.1^{b}	118.00± 2.2^{c}	116.50± 1.8^{d}
Weight gain (g/bird)	95.00± 1.19^{a}	86.00± 0.09^{b}	78.00± 1.20^{c}	76.5± 1.12^{d}
AVFI (g/bird)	50.2±0.10^{b}	40.04±1.3^{c}	44.00± 1.4^{d}	64.00 ± 0.28^{a}
1st week	62.33± 1.6^{b}	51.20± 1.0^{c}	54.45± 0.20^{d}	70.06±0.14^{a}
2st week	77.01± 0.51^{b}	54.45± 1.1^{c}	46±2.0^{d}	84±1.2^{a}
3st week	89.51± 1.8^{b}	70.06± 1.5^{c}	56.09± 3.0^{d}	98.70± 2.4^{a}

Table 3: Hematological Indices of Albino Rats Fed Maize.

Parameters	Basal diets	Sun-dried cassava	Fermented cassava	Rumen digesta –ensiled cassava
PCV (%)	43.00±4.9^{a}	40.10±4.0^{a}	49.00±3.9^{a}	38.2±2.7^{b}
Hb (%)	13.6±0.9^{b}	14.3±2.9^{a}	15.00±1.29^{a}	12.5±2.6^{b}
RBC(×10^{3})	9.10±0.8^{a}	8.60±0.8^{a}	6.60±0.5^{b}	7.90±0.6^{b}
WBC(×10^{12})	6.0± 0.2^{c}	5.4±0.01^{d}	7.5±0.3^{b}	9.6±0.8^{a}
MCV (fl)	45.05±3.9	44.71±4.5	43.59±2.7	43.59±3.4
MCH(pg)	14.95±0.05	14.71±0.66	14.07±1.2	13.81±0.01
MCHC(g/dl)	34.05±0.67^{a}	33.41±0.76^{a}	22.17±0.48^{c}	30.86±0.35^{b}
Heterophil (%)	43±1.2^{c}	48±1.4^{b}	45±1.5^{c}	55±1.9^{a}
Lympocyte (%)	50±0.42^{a}	48±0.22^{b}	46±0.24^{b}	39±0.3^{c}
Eosinophil (%)	3±0.01	3±0.01	4±0.02	3±0.01
Monophil (%)	1±0.01	2±0.01	2±0.01	1±0.01

Table 4: Serum Chemistry of Albino Rats Fed Maize Based Diets and Differently Processed Cassava Root Meal.

Parameters	Basal diets	Sun-dried cassava	Fermented cassava	Rumen digesta –ensiled cassava
Glucose(mg/dl)	81±1.69[a]	79±1.66[b]	65±1.70[c]	79±2.67[b]
Creatinine (mg/dl)	0.53±1.04	0.67±1.24	0.45±1.34	0.44±1.14
Uric acid (mg/dl)	2.2±0.22	2.2±0.20	2.1±0.11	2.4±0.13
Total protein (mg/dl)	8.3±0.61[b]	8.6±0.42[a]	8.4±0.31[a]	7.4±0.24[c]
Albumin (mg/dl)	5.6±0.34[b]	4.5±2.2[c]	5.9±3.5[b]	6.0±4.2[a]
AST (ui/L)	38±4.61[a]	24±3.41[c]	31±3.51[b]	22±2.33[c]
ALT (ui/L)	45±0.42	40±0.33	38±0.34	37±0.30
Cholesterol (g/dl)	102±5.6	99±3.5	87±4.7	83±3.7

SDCRM =sun –dried cassava root meal, FCRM =fermented cassava root meal, RDECRM = rumen digesta – ensiled cassava root mea

Table 4 showed the effect of cassava processing methods on serum metabolites of rat fed the experimental diets. The cassava meal had significant ($P < 0.05$) effect on glucose, total protein, albumin and ALT, rat fed basal diet had the highest glucose value while rat fed FCRM recorded the ($P < 0.05$) the least glucose value. Rat fed SDCRM and FCRM had the highest total protein compared to rat fed RDECRM. Rat fed basal diets had ($P < 0.05$) highest AST value compared to others. The increased in serum protein revealed that there is no indication of liver dysfunction on the rat fed the experimental diets Umar *et al*, 2008.

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