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ZOOTECHNICAL RESPONSE, PROFITABILITY INDICES, BLOOD PARAMETERS, ORGAN WEIGHT, CARCASS CHARACTERISTICS AND ORGANOLEPTIC PROPERTIES OF PIGS FED PROCESSED CASSAVA ROOT MEAL

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Abstract. Forty (40) weaned pigs (Large white x Landrace, 10 week old, 14.9±0.18 kg body weight) were used to assess the effect of processed cassava root meal on the zootechnical response, profitability, blood parameters, organ weight, carcass characteristics and organoleptic properties of the pigs. The pigs were randomly allotted into four treatments with ten pigs serving as replicates in a completely randomized design. The experiment lasted for forty-nine (49) days. The feed had 0.00%, 32.50%, 48.80% and 65.00% processed cassava root meal in the diets tagged D1, D2, D3 and D4 respectively. The final weight, total weight gain, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio were significantly different ($P<0.05$). There were significant differences ($P <0.05$) in the profitability indices except the feed cost per kg weight gain. All the hematological parameters were significantly affected ($P<0.05$) except for the mean corpuscular hemoglobin concentration and platelet. All the serum biochemical parameters were significantly ($P<0.05$) affected except aspartate aminotransferase, urea, total protein, glucose and triglyceride. The weight of the empty stomach, pancreas and heart were not significantly influenced ($P>0.05$) across the treatments while others were significantly influenced ($P<0.05$). All the carcass parameters were significantly influenced by processed cassava root meal ($P<0.05$) except the bled weight, trotter, picnic shoulder and spare rib. The color and juiciness of the meat were also significantly influenced by processed cassava root meal ($P<0.05$). In conclusion, up to 48.8% is considered favorable in the diet of weaned pigs.

Keywords: *Cassava, pig, growth, economic indices, blood, sensory properties*.

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1. Introduction

One of the common problems in developed and developing nations is inadequate food supply, particularly in tropical areas (Pawlak & Kołodziejczak, 2020). The need for animal protein has increased due to the current and rapidly increasing global human

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population (Henchion *et al*., 2017), making it a great concern. In addition to being a major cause of poor prognosis in the elderly, protein-energy malnutrition has also been related to over 45% of mortality in children under the age of five each year in poorer nations (WHO 2021). Efforts to overcome the aforementioned protein need issues with the consciousness of maintaining environmental stability have increased the demand for animal-source proteins (Boland *et al*., 2013; Weindl *et al*., 2020; Ismail *et al*., 2020; Langyan *et al*., 2022).

To meet the ever-increasing need for animal-source protein, it is crucial to consider "short-cycled" animals like rabbits, poultry and pigs (Ironkwe & Amefule, 2008). Pigs, when compared to ruminants, are good feed converters, prolific, fast-growing and have a short life cycle (Underwood *et al*., 2015; Wealleans *et al*., 2021). In human diets, meat from pigs (pork) is an excellent source of animal protein (Bügel *et al*., 2004; Ahmad *et al*., 2018). Pig production, being one of the livestock productions with the ability to ease the protein intake deficiency, is hampered by a lack and high cost of feed (Tekle *et al*., 2013; Uddin & Osasogie, 2016). Adding to this limitation, there has been intense competition for cereals between man, industry and animals (Erenstein *et al*., 2022).

Cassava (*Manihot esculenta*) is a nutritious perennial woody shrub native to the tropics and subtropics (Enesi *et al*., 2022; Carvalho *et al*., 2023). It has the ability to adapt to poor soils, minimal rainfall due to its perennial nature and can be harvested as needed (Anikwe & Ikenganyia, 2018; Ikuemonisan *et al*., 2020; Olusola Sanusi *et al*., 2023). Cassava is one of the world's major food and feed plants (Waisundara, 2018). Cassava tuber contains crude protein (3.66g/100g), crude fiber (9.40g/100g), and ether extract (1.37g/100g) (Oladimeji *et al*., 2022). Cassava root prices fall during harvest time, especially during the rainy season and a lot goes to waste on the farm and market. Because of their substantial energy content, these could be valuable as feed for livestock such as pigs, thus, raising the questions on the quantity and effect in weaned pigs. The aim of this study was to determine the nutrient composition of processed cassava root meal and to evaluate its effect on the growth performance, economic indices, organ weight, carcass characteristics, serum biochemistry, hematological profile and organoleptic properties of weaned pigs.

2. Materials and methods

2.1. Study site

The experiment took place at the Piggery unit of the Ladoke Akintola University of Technology Teaching and Research Farm, Ogbomosho, Oyo state, Nigeria. The site is located at latitude 18°15'N of the equator and longitude 4°5'E of the Greenwich meridian (Ojediran *et al*., 2020).

All procedures employed in this study were sanctioned by the Animal and Research Ethics Committee of the Ladoke Akintola University of Technology with approval number ANB/20/20/145939U.

2.2. Sample preparation

Fresh cassava (*Manihot esculenta*) roots were harvested from Ladoke Akintola University of Technology Farm, Ogbomosho. The roots were processed as described by Ojediran et al. (2023) and incorporated into the diet as indicated in Table 1.

Table 1. Gross formulation of the diets

Ingredients	D1 (%)	D2 (%)	D3 (%)	D4 (%)
Maize	13.00	5.00	5.00	0.00
Soy bean meal	2.00	0.00	0.00	0.00
Blood Meal	1.00	9.00	10.00	15.00
Full Fat Soya	2.00	3.00	3.00	0.00
Groundnut Cake	5.00	5.00	5.00	5.00
Palm Kernel Cake	65.00	32.50	16.25	0.00
Processed Cassava Root Meal	0.00	32.50	48.80	65.00
Corn Bran	10.00	11.00	10.00	13.00
Lysine	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25
Bone Meal	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated nutrients				
Metabolizable Energy(kcal/kg)	2686.42	2843.57	2983.01	3011.75
Crude Protein	19.26	20.11	18.29	18.90
Ether Extract	5.42	3.60	2.72	1.24
Crude Fibre	9.43	6.72	5.32	4.03
Calcium	0.66	0.60	0.57	0.53
Lysine	0.76	2.34	2.93	3.73
Methionine	0.36	0.32	0.27	0.25

2.3. Chemical analysis

Samples of the processed roots were taken to the Department of Animal Nutrition and Biotechnology laboratory, for the analysis of their nutritive composition using AOAC (2002) standard technique. The dry matter was determined after oven-drying the samples at 100°C for 24 hours. The cyanide composition was analysed using the procedure described by Maranna et al. (2018). Each analysis was done in triplicate to ensure accuracy and precision. The metabolizable energy (M.E. (kcal/kg) = 37 % CP + 81 % EE + 35.5 % NFE) was thereafter calculated using the Pauzenga equation.

2.4. Data collection

Feed was offered around 8:00 and 14:00hr on a daily basis, *ad libitum*. The leftover feed from the previous day was packed and recorded. The feed and leftovers were weighed using a kerro (BL 30001E) digital scale. The growth parameters were calculated as described by Ojediran et al. (2017). Economic indices (Feed cost/kg, Feed cost/kg weight gain, Income/kg weight gain, Profit/kg weight gain and Economic efficiency of growth) as described by Ojediran et al. (2017).

At the end of the experiment, four pigs (4) per replicate were slaughtered at the piggery unit slaughter slab of the Teaching and Research Farm, following the proper hygienic practises. The pigs were mechanically immobilized as described by Riaz et al. (2021) before the jugular veins were severed. Following that, the carcasses were cut into primal cuts alongside the visceral organs. They were thereafter weighed on a kerro electronic compact scale, model BL30001E.

5 ml of blood was obtained in two sets of four sterilized glass bottles. Blood taken for hematology was collected in sterile bottles containing Ethylene Diamine Tetra-acetic

Acid (EDTA) while samples for serum biochemical tests were taken using plain bottles (without anticoagulant) for serum separation. Centrifugation was used to generate the serum, which was then stored in a deep freezer (at -100℃) until needed for analysis. The selected hematological parameters and serum biochemical markers were analysed as described by Polizzi et al. (2023).

The ham sample was cut into pieces and prepared for panelists to evaluate the organoleptic qualities of the meat as outlined by Ojediran et al. (2019). It had ten trained panelists who were also regular meat eaters. They were distributed to the panelists in the form of coded samples. The description was evaluated on a 9-point hedonic scale, with 1 indicating ‘dislike strongly’ and 9 indicating ‘like excessively’ according to Válková (2012).

2.5. Statistical analysis

Statistical package for social science, SPSS, version 16 was used for the analysis. All the data obtained from the experiment were subjected to statistical analysis using one-way analysis. The treatment means were presented with group standard errors and the statistics were compared using the Duncans Multiple Range (DMR) test procedure of test with a probability of 5% (P level = 0.05). The statistical model used was:

$$Y_{ij} = \mu + PCRM_i + e_{ij}$$

Y_{ij} = Individual observation,

μ = population mean,

$PCRM_i$ = effect of ith processed cassava root meal diets,

e_{ij} = random error.

3. Results and Discussion

3.1. Results

The nutrient composition of processed and unprocessed cassava root is presented in Table 2. Fresh cassava root meal had 1.93% crude protein, 8.81% ether extract, 7.29% moisture content, 8.87% crude fiber, 9.94% ash, pH of 5.68, metabolizable energy of 3002.67kcal/kg and hydrocyanide composition was 5.40 mg/kg. However, PCRM had 1.31% crude protein, 4.96% ether extract, 5.42% moisture content, 5.05% crude fiber, 9.87% ash, pH of 5.72, metabolizable energy of 3022.85 kcal/kg and hydrocyanide content was 3.46mg/kg.

Table 2. Proximate composition of raw cassava root mean and processed cassava root meal

Chemical composition	Raw cassava root (%)	Processed cassava root (%)
Crude protein	1.93	1.31
Ether extract	8.81	4.96
Moisture content	7.29	5.42
Crude fibre	8.87	5.05
Ash	9.94	9.87
Metabolizable energy (kcal/kg)	3002.67	3022.85
Cyanide (mg/kg)	5.40	3.46
pH	5.68	5.72

Table 3 shows the growth performance of weaned pigs fed PCRM. The final weight, total weight gain, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio were significantly different (P<0.05). The final weight varied in all the treatments with pigs fed diet D2 having the highest (38.12kg) while pigs fed diet D4 had the lowest (24.16kg). Furthermore, the total weight gain was observed to be significantly different ($P<0.05$) across all the treatments, the pigs fed diet D2 had the highest total weight gain (23.12kg) while pigs fed diet D4 had the least (9.06kg). The result also shows that the pigs fed diet D2 gained the highest average daily weight (ADWG) of (0.47 kg/p/d) while the pigs fed diet D4 had the lowest ADWG of 0.19 kg. The feed intake of pigs fed diet D2 was the highest (74.37 kg), followed by diet D3 (71.84 kg), diet D1 (51.18 kg) and D4 (48.74 kg). The average daily feed intake of the pigs fed diet D2 was the highest followed by D3, D1 and D4. The feed conversion ratio of the pigs fed D4 was significantly different from others ($P<0.05$).

Table 3. Zootechnical response of weaned pigs fed PCRM

Parameters	D1	D2	D3	D4	SEM	P-value
Initial Weight (kg)	14.98	15.00	15.06	15.10	0.51	1.00
Final Weight (kg)	30.92^{bc}	38.12^{a}	35.38^{ab}	24.16^{c}	1.60	0.00
Total Weight Gain (kg)	15.94^{b}	23.12^{a}	20.32^{a}	9.06^{c}	1.35	0.00
Average Daily Weight Gain (kg)	0.33^{b}	0.47^{a}	0.42^{a}	0.19^{c}	0.03	0.00
Total Feed Intake (kg)	51.18^{c}	74.37^{a}	71.84^{b}	48.74^{d}	2.67	0.00
Average Daily Feed Intake (kg)	1.04^{c}	1.52^{a}	1.47^{b}	0.99^{d}	0.06	0.00
Feed conversion ratio	3.23^{b}	3.23^{b}	3.61^{b}	6.40^{a}	0.42	0.01

$^{a, b, c}$ and ^{d} values with different superscripts are significantly different; SEM – standard error of the mean

The economic indices of pigs fed PCRM are shown in Table 4. There were significant differences ($P <0.05$) in the economic indices parameters except the feed cost per kg weight gain. The feed cost per kg decreased linearly ($P<0.05$) with the increase in the inclusion level of PCRM from ₦69.65 to ₦36.10. The cost of producing a kilogram of the control diet (D1) ₦69.65 was the most expensive while that of D4 (₦36.10) was the least costly. Pigs on diet D4 had the highest income per weight gain (₦1078.80) while those on D2 had the least (₦626.91) comparable to those fed D1 (₦736.35) and D3 (₦665.11). The same progression was observed with the profit per kg weight gain of the pigs, where the pigs fed diet D4 had the highest value (₦845.55) while those fed D2 had the lowest value (₦447.94) comparable to those fed D1 (₦511.35) and D3 (₦491.52). The economic efficiency of growth of the pigs ranges from 229.90 – 428.28 which increases linearly from D1 to D4.

Table 4. Economic indices of weaned pigs fed PCRM

Parameters	D1	D2	D3	D4	SEM	P-value
Feed cost per kg (₦)	69.65^{a}	55.53^{b}	47.89^{c}	36.10^{d}	2.81	0.00
Feed cost per kg weight gain (₦)	225.00	178.97	173.58	233.23	13.00	0.24
Income per weight gain (₦)	736.35^{b}	626.91^{b}	665.11^{b}	1078.80^{a}	47.18	0.00
Profit per kg weight gain (₦)	511.35^{b}	447.94^{b}	491.52^{b}	845.55^{a}	39.56	0.00
Economic efficiency of growth	229.90^{b}	250.70^{b}	292.35^{ab}	428.28^{a}	28.31	0.04

$^{a, b, c}$ and ^{d} values with different superscripts are significantly different; SEM – standard error of the mean; ₦ - naira.

The hematological parameters of weaned pigs fed PCRM are shown in Table 5. All the parameters were significantly different ($P<0.05$) except for the mean corpuscular hemoglobin concentration and platelet. The values of the white blood cell (WBC) showed a significant difference ($P<0.05$) in the dietary treatments. Numerically, the

WBC values of the pigs fed diet D1, D2, D3 and D4 were 19.80×10^3/µl, 15.25×10^3/µl, 16.65×10^3/µl and 18.50×10^3/µl respectively. The red blood cell (RBC) and haemoglobin (HGB) values were significantly (P<0.05) higher in the pigs fed diet D3 with corresponding values of 7.78×10^6/µl and 14.05 g/dl respectively, while the lowest value for the RBC was in the pigs fed diet D2 (6.95×10^6/µl) and for HGB was in pigs fed diet D2 and D4 (12.30 g/dl). The hematocrit (HCT) was recorded to be highest in the pigs fed D3 (60.95%) and lowest in those fed D2 (51.75%) but the pigs fed D2 varied comparable to those fed D1 (53.45%) and D4 (52.30%). The highest mean corpuscular volume (MCV) values were observed in pigs fed diet D3 (78.35 fl) and lowest in pigs fed D2 (54.50 fl) while the value for those fed D1 was comparable (72.90 fl). Mean corpuscular hemoglobin (MCH) was least observed in the pigs fed D4 (15.90 pg), followed by those fed diet D1 (17.10 pg), D2 (17.75 pg) and D3 (18.05 pg). The values of the platelet for the pigs fed D2, D3 and D4 were very comparable (247.00×10^3/µl, 265.00×10^3/µl and 236.50×10^3/µl) but significantly different from those fed D1 (403.50×10^3/µl). The lymphocyte of the pigs was comparable across the four treatments with the lowest value found in those fed D2 (62.80%) and the highest in those fed D1 (69.85%).

Table 5. Hematological parameters of weaned pigs fed PCRM

Parameters	D1	D2	D3	D4	SEM	P-value
White blood cell (×10^3/µl)	19.80^a	15.25^c	16.65^{bc}	18.50^{ab}	0.61	0.01
Red blood cell (×10^6/µl)	7.33^{ab}	6.95^b	7.78^a	7.75^a	0.12	0.02
Haemoglobin (g/dl)	12.50^b	12.30^b	14.05^a	12.30^b	0.26	0.01
Haematocrit (%)	53.45^b	51.75^b	60.95^a	52.30^b	1.33	0.02
Mean corpuscular volume (fl)	72.90^{ab}	54.50^b	78.35^a	67.55^{ab}	3.70	0.01
Mean corpuscular hemoglobin (pg)	17.10^b	17.75^a	18.05^a	15.90^c	0.25	0.00
Mean corpuscular hemoglobin concentration (g/dL)	23.45	23.75	23.05	23.60	0.18	0.62
Platelet (×10^3/µl)	403.50^a	247.00^b	265.50^b	236.50^b	21.81	0.00
Lymphocyte (%)	69.85^a	62.80^b	69.45^a	66.30^{ab}	0.99	0.01

$^{a, b}$ and ^{c} values with different superscripts are significantly different; SEM – standard error of the mean

Serum biochemical parameters of weaned pigs fed CRM are shown in Table 6. All the parameters were significantly (P<0.05) affected except Aspartate aminotransferase (AST), Urea, Total protein, glucose and triglyceride. Alanine aminotransferase (ALT) values were observed to be highest in the pigs fed D4 (45.46 U/L) and least in those fed D2 (28.10 U/L). Alkaline phosphatase (ALP) values were 71.05 U/L, 62.42 U/L, 128.39 U/L and 91.38 U/L as the dietary inclusion level increased. The creatinine values were 0.82 mg/dl, 1.49 mg/dl, 1.30 mg/dl and 1.15 mg/dl as the dietary inclusion level increased. The highest albumin was recorded in the pigs fed D2 (3.43 mg/dl) which was significantly different (P<0.05) from other treatments. The cholesterol recorded in pigs fed D4 (107.65 mg/dl) was the highest while the lowest cholesterol value was observed in those fed D2 (67.71 mg/dl). The values were significantly different (P<0.05) while the values for the pigs fed D3 and D4 were 67.71 mg/dl and 73.65 mg/dl respectively are comparable.

Table 6. Serum biochemical parameters of weaned pigs fed PCRM

Parameters	D1	D2	D3	D4	SEM	P-value
Aspartate aminotransferase (U/L)	103.95	71.85	72.90	71.06	6.53	0.21
Alanine aminotransferase (U/L)	35.55^{ab}	28.10^{b}	43.00^{a}	45.46^{a}	2.61	0.04
Alkaline phosphatase (U/L)	71.05^{c}	62.42^{c}	128.39^{a}	91.38^{b}	7.90	0.00
Urea (mg/dl)	7.83	5.81	6.42	6.64	0.37	0.29
Creatine (mg/dl)	0.82^{b}	1.49^{a}	1.30^{a}	1.15^{ab}	0.09	0.04
Total protein (mg/dl)	4.58	5.19	4.06	4.66	0.19	0.25
Albumin (mg/dl)	3.11^{b}	3.43^{a}	3.06^{b}	2.85^{b}	0.08	0.02
Glucose (mg/dl)	1.48	1.76	1.00	1.82	0.17	0.35
Triglyceride (mg/dl)	142.86	113.27	103.07	110.21	7.96	0.34
Cholesterol (mg/dl)	86.97^{b}	67.71^{c}	73.65^{c}	107.65^{a}	4.84	0.00

$^{a, b}$ and ^{c} values with different superscripts are significantly different; SEM – standard error of the mean

Table 7 reveals the organ weight of weaned pigs fed PCRM. It shows that the weight of the empty stomach, pancreas and heart were not significantly influenced (P>0.05) in their weights across the treatments while others were significantly influenced (P<0.05). Pigs fed D4 had the highest whole stomach weight (3.50) followed by those fed D1 (2.98), D2 (2.50) and D3 (1.57). The weights of the liver of the pigs fed D1 and D2 were similar (2.56 and 2.73 respectively). The weights of the kidneys and lungs of the pigs fed D1 and D3 were comparable. The weights of the spleen of the pigs fed D1, D2 and D4 were similar.

Table 7. Organ weight of weaned pigs fed PCRM expressed as percentage live weight

Parameters	D1 (%)	D2 (%)	D3 (%)	D4 (%)	SEM	P-value
Whole stomach	2.98^{ab}	2.50^{b}	1.57^{c}	3.50^{a}	0.24	0.01
Empty stomach	1.10	1.00	0.96	1.11	0.04	0.47
Liver	2.56^{a}	2.73^{a}	2.30^{b}	2.21^{c}	0.07	0.00
Kidney	0.39^{ab}	0.42^{a}	0.38^{ab}	0.35^{b}	0.01	0.04
Lungs	1.09^{ab}	0.92^{b}	1.01^{ab}	1.19^{a}	0.04	0.13
Pancreas	0.14	0.13	0.14	0.13	0.004	0.87
Spleen	0.04^{a}	0.04^{a}	0.03^{b}	0.04^{a}	0.002	0.02

$^{a, b}$ and ^{c} values with different superscripts are significantly different; SEM – standard error of the mean

Table 8 shows the carcass characteristics of weaned pigs fed PCRM. The result shows that all the carcass parameters were significantly influenced by PCRM (P<0.05) except the bled weight, trotter, picnic shoulder and spare rib. The eviscerated weights of the pigs fed D2, D3 and D4 were similar. The table also shows that the carcass weight was observed to be highest in the pigs fed D2 and lowest in those fed D4. It also shows that the highest weight of the belly and ham was observed in the pigs fed D3 while the least weight was observed in those fed D4. Furthermore, the pigs fed D1, D2 and D3 recorded similar head weights, which differ from those fed D4. The weight of the jowl of the pigs fed D2 was similar to those fed D4, while the pigs fed D1 had the lowest value and those fed D3 had the highest. The weight of the buston butts decreased as the inclusion level increased. There were similarities (P<0.05) in the weight of the loin of the pigs fed D1, D2 and D4 (9.75, 10.00 and 9.73 respectively). The pigs fed D3 had the highest weight of belly followed by those fed D2, D1 and D4. The pigs fed D3 had the highest value for the weight of the ham while the weight of the ham of the pigs fed D1 and D2 were comparable (P<0.05). The abdominal fat was significantly different

(P<0.05) across all treatments with the fed D1 having the highest while those fed D2 having the least.

Table 8. Carcass characteristics of weaned pigs fed PCRM expressed as a percentage live weight

Parameters	D1 (%)	D2 (%)	D3 (%)	D4 (%)	SEM	P-Value
Bled weight	94.58	94.88	95.13	95.74	0.22	0.33
Eviscerated weight	71.0^{b}	75.00^{a}	74.66^{a}	73.95^{a}	0.57	0.02
Gastrointestinal tract	21.90^{a}	19.61^{b}	19.01^{b}	20.39^{ab}	0.43	0.04
Carcass weight	57.76^{b}	60.23^{a}	59.07^{ab}	55.61^{c}	0.57	0.00
Trotter	1.87	2.29	1.75	1.83	0.10	0.25
Head	8.06^{b}	8.93^{b}	8.89^{b}	10.84^{a}	0.35	0.00
Jowl	1.54^{b}	1.75^{ab}	2.50^{a}	2.04^{ab}	0.15	0.00
Picnic shoulder	10.08	10.13	11.55	13.70	0.65	0.15
Buston butt	8.83^{a}	8.15^{b}	6.60^{c}	7.77^{b}	0.25	0.00
Loin	9.75^{a}	10.00^{a}	8.24^{b}	9.73^{a}	0.27	0.04
Spare rib	7.20	7.00	7.17	6.48	0.28	0.84
Belly	6.76^{c}	7.53^{b}	8.39^{a}	5.66^{d}	0.31	0.00
Abdominal fat (cm)	0.87^{a}	0.50^{c}	0.73^{b}	0.74^{b}	0.04	0.00
Ham	16.88^{ab}	17.06^{ab}	17.88^{a}	15.76^{b}	0.33	0.15

$^{a, b}$ and ^{c} values with different superscripts are significantly different; SEM – standard error of the mean

Table 9 shows the organoleptic properties of the pigs. Only the color and juiciness of the meat were significantly influenced by PCRM (P<0.05). The pigs fed D4 had the highest value for the color followed by those fed D1 while those fed D2 and D3 were comparable (P<0.05). The meat of the pigs fed D1 had the highest value for juiciness while those fed D2 had the least while the pigs fed D3 and D4 were comparable (P<0.05).

Table 9. Organoleptic properties of weaned pigs fed PCRM expressed as percentage live weight

Parameters	D1	D2	D3	D4	SEM	P-Value
Color	6.30^{b}	7.00^{ab}	6.70^{ab}	7.40^{a}	0.15	0.01
Flavor	5.90	4.90	5.00	6.10	0.32	0.45
Tenderness	4.80	4.90	5.70	5.90	0.29	0.43
Juiciness	6.60^{a}	5.20^{b}	6.50^{ab}	6.30^{ab}	0.23	0.02
Texture	5.30	5.00	6.70	6.40	0.32	0.17
Overall Acceptance	7.20	7.00	7.50	7.50	0.19	0.75

$^{a, b}$ and ^{c} values with different superscripts are significantly different; SEM – standard error of the mean

3.2. Discussion

The nutritional composition of processed cassava root reduced when compared with the raw cassava, except for the metabolizable energy. The reduction shows the significance of the processing, thus, it agrees with the report of Ojediran et al. (2023). Subjecting cassava root to various processing processes is associated with a decrease in HCN content (Olafadehan *et al*., 2011). The result of this study shows that processing resulted in a greater reduction in the HCN.

The best growth performance was observed in the pigs fed up to 48.8 % PCRM. This finding agrees with the observation of Akapo et al. (2014) where 10% PCRM was fed to broiler chicks. The effect of PCRM on feed intake and weight gain could be due to the increase in the energy of the diets thereby lowering the protein level. Feed intake has been observed to increase or decrease as dietary energy intake falls or increases, accordingly (Ahiwe *et al*., 2018). The worst performance of pigs fed 65.00% PCRM could be because the PCRM in the diet resulted in lower dietary crude protein and higher HCN consumption, which will result in worse nutrient utilization, amino acid imbalance and poorer animal growth (Akapo *et al*., 2014).

The cost-benefit analysis revealed that feed cost per kg of diet reduced while the income per weight gain, profit per kg weight gain and economic efficiency of growth increased as the inclusion of PCRM increased. This observation agrees with the findings of Adesehinwa et al. (2011) and Akapo et al. (2014).

This study's blood hematology and serum biochemistry are within the normal range for weaned pigs. The reduction in the white blood cell and lymphocyte count could be attributed to nutritional imbalance. Nutritional deficiency particularly that of protein will reduce the WBC count and its components (Babatuyi *et al*., 2020). The trend in the RBC and HGB in this study could be ascribed to the direct relationship between RBC and HGB. PCRM itself is not typically associated with increasing RBC count, the overall diet of the pigs, including any supplements or ingredients, may play a role (Cho *et al*., 2017), thus the result of this study may be due to nutritional imbalance. The MCV, MCH and hematocrit are related to the size and content of red blood cells (Yavorkovsky, 2021). Dehydration could have caused the increase in MCV, MCH and hematocrit of the pigs because the blood becomes more concentrated when the animal is dehydrated (Sharma, 2013). Exposure to toxic or harmful substances in the environment, food or water sources can adversely affect platelet production and function (Bao *et al*., 2020), this could have been the reason for the decreased platelet value.

Although the ALT and ALP value falls within the normal range, the observed values could be a result of the toxin concentration. Hydrogen cyanide in PCRM can be toxic to animals, including weaned pigs and may adversely affect the liver (Babatuyi *et al*., 2020), leading to increased ALP and ALT levels due to liver damage. Elevated creatinine levels are often a sign of kidney dysfunction (Kellum *et al*., 2021). Cassava meal consumption is not a common cause of kidney dysfunction, but other factors such as dehydration and stress could be the cause of the elevated creatinine (Guerra *et al*., 2021). Albumin is a major blood protein (Van de Wouw & Joles, 2021). The reduced albumin level of the pigs could be attributed to the low protein composition of the diets. The overall diet of weaned pigs, including the inclusion of PCRM, can impact their cholesterol levels. Diets high in saturated fats and cholesterol can contribute to elevated cholesterol levels (DiNicolantonio & O'Keefe, 2018). If the diet is unbalanced or contains other components high in cholesterol, it could lead to increased cholesterol levels.

The effect of PCRM on the liver could be attributed to the hydrogen cyanide (HCN) composition of PCRM. The liver converts toxic substances such as HCN into harmless or less toxic variants that can be used by the body (Nyirenda, 2021). The kidneys are responsible for filtering waste products from the blood (Dybiec *et al*., 2022). An imbalance in the diet or the presence of toxins could potentially affect kidney function and weight (Fevrier-Paul *et al*., 2018). The weight of the lung increased while the weight of the spleen reduced. This agrees with the report of Adesheinwa *et al*. (2011).

The result of this study with regard to the carcass characteristics contradicts the findings of Adesehinwa et al. (2011) where growing pigs were fed cassava peel with and without enzymes. The increase in the eviscerated weight, carcass weight and weight of the jowl, head and belly could be attributed to the energy level of the diet. Kang et al. (2022) stated that diets with adequate energy can contribute to good growth and potentially result in heavier carcasses. However, the reduction in the weight of the loin and buston butt could be attributed to the reduced protein level in the diet. PCRM is a starchy root crop and is relatively low in fat content (Ayetigbo *et al*., 2018). This could have been the cause of the reduction in abdominal fat as the inclusion level of PCRM increased.

The composition of the diet can influence the presence of dietary pigments. Some natural pigments in certain foods might impact the color of meat, fat or skin (Singh *et al*., 2023). However, cassava itself is not known for containing pigments that significantly affect meat color (Mnisi *et al*., 2023).

4. Conclusions

It can be concluded that the use of PCRM in pig diets is considered favorable up to 48.80%. The result of this study also showed that PCRM, an economically cheaper feedstuff in conventional pig enterprise did not have a detrimental effect on the hematological profile and serum biochemistry of the pigs. Up to 48.80% inclusion level of PCRM in the diet of weaned pigs is recommended. Further experiments can be conducted on the use of exogenous enzymes.

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