MINERAL UTILIZATION BY WEANLING AND GROWING PIGS FED DIFFERENT CASSAVA PLANT MEAL PRODUCTS AND MAIZE

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ABSTRACT
The study aimed at evaluating the apparent mineral digestibility of weaning and growing pigs fed cassava plant meal (CPM) and maize-based diets to determine its utilization. Three Cassava plant meal products (CPMPs) were developed comprising of tender stem harvested 5 cm from the top of the plant, unpeeled cassava root (UCRM), and cassava leaves collected after the roots were harvested. They were sundried for 5–7 days and milled. The CPMP I contained 66.67 % UCRM, 27.78 % cassava leaf meal (CLM), and 5.63 % tender stem meal, CPMP 2 contained 71.43 % UCRM, 23.80 % CLM and 4.77 % tender stem meal while CPMP 3 contain 75 % UCRM, 20.83 % CLM and 4.17 % tender stem meal. Sixteen weaner pigs and sixteen growing pigs weighing (9.70±0.57 kg) and (18.50 ±1.30 kg) were randomly allotted to developed CPMPs and maize. The animals were kept in metabolic cages for 7 days and fed 100 % experimental diets. Water was supplied ad libitum while feed was supplied at 4% of their weight. The fecal samples were collected daily, weighed, oven-dried, and analyzed for proximate composition. The sexperiment lasted 21 days. The result of mineral digestibility by weaning pigs showed significant differences (P < 0.05) for all minerals except copper. Mineral digestibility of growing pigs showed significant differences (P < 0.05) for all the minerals while CMP 3-fed pigs showed superiority in the utilization of calcium (51.83 %), Mg (53.97 %), and Manganese (97.15 %) compared to other CPMPs. The study concluded that CPM product 3 minerals such as Ca, Mn, Cu, Mg and P are best digested and utilized by weaner and grower pigs compared to CPM Products 1 and 2.
Keywords: ***Cassava Plant meal, digestibility, tender cassava stem meal, unpeeled cassava root meal, large white***

INTRODUCTION

Pig farmers in the tropics have adopted alternative means of feeding their animals with solely or combinations of agro-industrial by-products such as palm kernel cake, wheat offal, and other alternative feedstuffs such as cassava root meal, cassava plant meal which are readily available, less expensive and competitive due to increased price of conventional feedstuffs and competition with animals (Amaefule *et al.,* 2009).

Cassava has long been documented by Nigerian researchers as an appropriate animal feed used as a cheap alternative feedstuff despite its limitations (Adekanye *et al*.,2013). Cassava root meal is deficient in protein and essential amino acids, carotene, and other carotenoids (Akinfala *et al.,* 2011). Hence, there is a need to improve the nutrient composition of cassava meal through the development of Cassava plant meal comprising of unpeeled tubers, tender stems, and leaves to replace maize in diets of growing pigs (Akinfala *et al.,* 2011 and 2019 and Adeyemi and Akinfala, 2019, Ogundeji and Akinfala, 2020). The use of the whole cassava plant could therefore go a long way in reducing costs of production, by reducing direct competition for feedstuffs and possible development of the sustainable crop-livestock farming system in Nigeria (Akinfala and Tewe, 2001). The cassava plant meal minimized the use of flour by adding peels, leaves, and tender stems, which are less utilized in Nigeria (Akinfala *et al.,* 2011). Despite substantial research efforts in Nigeria to formulate appropriate diets for feeding pigs and poultry, there has not been adequate information on the digestibility of minerals contained in the products. Hence this study evaluated the minerals composition and digestibility of the products when fed to growing pigs.

MATERIALS AND METHODS

Site of Experiment: The experiment took place at the Swine Units of the Obafemi Awolowo University Teaching and Research Farm. The laboratory analyses were carried out at the Poultry Meat

Research Laboratory, Department of Animal Sciences, Obafemi Awolowo University, Ile–Ife, and Department of Animal Science laboratory, University of Ibadan, Ibadan.

Source and Processing of Collected Test Ingredients: A 2-year-old cassava root (TMS 30572) was sourced from a commercial farm at Ile–Ife. The cassava leaves were harvested from the cassava plant stem while the tender cassava stems were harvested at 5 cm (4 – 5 nodes) from the top of the plant. The harvested unpeeled cassava roots (UCR) were washed, chopped into small pieces, and sun-dried for 6 days. They were milled after drying and packed into jute sacks at a commercial feed mill. The leaves and tender cassava stem were sun-dried for 5 days after which they were milled using a rotatory fine grinder and packed separately into different sack bags.

Development of Cassava Products and Nutrient Determination

Three cassava products were developed following the techniques of Akinfala *et al.*(2002). Cassava Plant Meal Product 1 (CPMPI) was formulated by mixing sundried samples containing 66.67 % unpeeled cassava root meal (UCRM) with 27.78 % cassava leaf meal and 5.63 % tender stem meal. The CPMP 2 was formulated by mixing sundried 71.43 % Cassava root meal with 23.80 % leaf meal and 4.77 % tender cassava stem meal while the CPMP 3 contained 75 % Cassava root meal, 20.83 % leaf meal, and 4.17 % tender cassava stem meal.

Apparent Nutrient Digestibility of Weaning and Growing Pigs Fed Cassava Plant Meals and Maize

Experimental Animals and Diets

Sixteen (16) growing pigs with an average weight of 18.50 ± 1.30 kg and sixteen weaning pigs with an average weight of 9.70 ± 0.57 kg were used. The pigs were distributed randomly into four (4) experimental diets as shown in Table 1 below. Diet 1 contained solely maize while diets 2, 3, and 4 are the three differently formulated CPM products. The pigs were housed individually in a locally fabricated metabolic cage (107 cm x 60 cm x 50 cm) for seven days. The animals were starved for 12 hours before the commencement of the study to clear the gut of previous meals. The animals were fed 4 % of their body weight as recommended by Norachack *et al.* (2004) while water was supplied *ad libitum*. Total faeces were collected daily for the last 4 days of the trial. The faeces were weighed, oven-dried at 60 °C daily, packed in a labeled plastic bag, and stored in a deep freezer. The oven-dried faeces were mixed, and milled and representative samples were analyzed. The experiment lasted for twenty-one (21) days.

The nutrient digestibility was determined using this formula:

$$\textbf{Apparent Nutrient Digestibility} = \frac{\text{Nutrient in feed} - \text{Nutrient in Feaces}}{\text{Nutrient in feed}} \times \frac{100}{1}$$

Table 1: Composition of Experimental Diet

Ingredients (%)	Diets			
	Maize	**CPMP 1**	**CPMP 2**	**CPMP 3**
Maize	99.75	-	-	-
Unpeeled Cassava Root meal	-	66.57	71.33	74.90
Cassava Leaf meal	-	27.68	23.70	20.73
Tender Cassava stem meal	-	5.50	4.72	4.12
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100. 00**	**100.00**	**100.00**

CPMP: Cassava Plant Meal Products source: Ogundeji *et al.* (2022)

Mineral determination of Feaces and Feed Samples: The mineral composition of the feed and fecal samples were analyzed after dry–ashing at 550°C in a muffle furnace and dissolution in deionized water to standard volume. The sodium and potassium composition were determined using flame photometry while phosphorous was determined using the Varnado – Molybdate Method (Bray and Kurtz, 1945). Other minerals were determined after wet digestion with a mixture of nitric acid, sulphuric, and hydrochloric acid and evaluated using an Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSION

Apparent Mineral Digestibility of Weaning Pigs Fed Maize and Cassava Plant Meal Products

The apparent minerals digestibility by weaning pigs fed maize and cassava plant meal products is shown in Table 2. There were significant differences ($P < 0.05$) in the apparent calcium (Ca), magnesium (Mg), Manganese (Mn) and Phosphorous (P) digestibility of weaning pigs fed cassava plant meal products and maize with no significant difference ($P > 0.05$) in potassium (K) and copper (Cu). The Ca digestibility of CPM products decreased ($P < 0.05$) with an increase in the UCRM of the products. The apparent Mg, P, and Mn digestibility ($P < 0.05$) was poor with the highest Mg (53.80 %) P (56.42 %) and Mn (53.80 %) found in CPM product 3 fed pigs. The poor utilization of P may lower energy metabolism and P deposition into the skeletal system while poor Mn utilization may result in reduced fat deposition in muscles (McDonald *et al.,* 2010). The apparent P and Mg digestibility of CPM products increased with an increase in the UCRM of the products. The apparent potassium (K) digestibility ($P < 0.05$) ranged from 55.15 % to 64.73 %.

Table 2: Apparent Minerals Digestibility of Weaning Pigs fed Maize and Cassava Plant Meal Products

Minerals (%)		Cassava Plant Meal Products				
	Maize	1	2	3	SEM (±)	P value
Calcium	86.14^{a}	75.85^{b}	71.77^{b}	62.27^{c}	5.36	0.006
Magnesium	47.52^{b}	54.11^{b}	63.84^{a}	66.97^{a}	7.00	0.0084
Potassium	55.15	60.99	64.73	62.24	6.61	0.98
Copper	43.24	45.39	43.90	43.39	2.49	0.99
Manganese	48.82^{ab}	46.76^{b}	42.51^{c}	53.80^{a}	4.40	0.01
Phosphorus	48.47^{b}	54.98^{a}	55.46^{a}	56.52^{a}	5.18	0.01

Means bearing different superscripts in a row differ significantly ($P < 0.05$)

CPMP 1 encompasses a mixture of 66.67 % unpeeled cassava root meal (UCRM) with 27.78 % cassava leaf meal and 5.63 % tender stem meal. The CPM P 2 encompasses a mixture of 71.43 % Cassava root meal with 23.80 % leaf meal and 4.77 % tender cassava stem meal while the CPMP 3 encompasses a mixture of 75 % Cassava root meal, 20.83 % leaf meal, and 4.17 % tender cassava stem meal.

Apparent Mineral Digestibility of Growing Pigs Fed Maize and Cassava Plant Meal Products

The apparent minerals digestibility of growing pigs fed maize and cassava plant meal (CPM) product is shown in Table 3. There were significant differences ($P < 0.05$) in the apparent digestibility of calcium (Ca), Magnesium (Mg), Manganese (Mn), Phosphorus (P), copper (Cu), and Potassium (K). Ca digestibility ($P < 0.05$) was highest (71.60 %) in maize-fed pigs. The differences may be due to variations in vitamin D in the diet, synthesis of short-chain fatty acids, transit time, and gut motility or mineral precipitation (González-Vega *et al.,* 2015). The Mg and P digestibility of CPM products increased with an increase in UCRM of the products The low ($P < 0.05$) Cu digestibility may be due to the presence of phytate (Chavez *et al.,* 2000). The digestibility of the CPM products decreased with an increase in the UCRM of the products. The differences may be due to variations in the level of Mg and Ca.

Table 3: Apparent Mineral Digestibility of Growing Pigs Fed Maize and Cassava Plant Meal Products

Minerals (%)		Cassava Plant Meal Products				
	Maize	1	2	3	SEM (±)	P(value)
Calcium	71.60^{a}	43.72^{c}	38.77^{c}	51.83^{b}	5.69	0.016
Magnesium	67.84^{a}	40.86^{c}	51.59^{b}	53.96^{b}	4.64	0.024
Potassium	65.15^{d}	78.91^{a}	76.49^{b}	72.39^{c}	2.96	0.046
Copper	61.55^{b}	62.21^{b}	69.05^{a}	59.67^{b}	2.88	0.008
Manganese	87.59^{c}	96.26^{b}	94.98^{b}	97.15^{a}	1.90	0.030
Phosphorus	60.94^{a}	38.72^{c}	39.42^{c}	44.75^{b}	4.32	0.024

Means bearing different superscripts in a row differ significantly ($P < 0.05$)

CPMP 1 encompasses a mixture of 66.67 % unpeeled cassava root meal (UCRM) with 27.78 % cassava leaf meal and 5.63 % tender stem meal. The CPM P 2 encompasses a mixture of 71.43 % Cassava root meal with 23.80 % leaf meal and 4.77 % tender cassava stem meal while the CPMP 3 encompasses a mixture of 75 % Cassava root meal, 20.83 % leaf meal, and 4.17 % tender cassava stem meal.

CONCLUSION:

The study concluded that CPM product 3 minerals such as Ca, Mn, Cu, Mg and P are best digested and utilized by weaner and grower pigs compared to CPM Products 1 and 2.

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