

Effect of Supplementation of Animal Feed with Dried Cassava (*Manihot esculenta*) Peels, and Stems of *Vernonia amygdalina* and *Pennisetum purpureum* on Some Biochemical Parameters in Pigs

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Abstract

This study examined the effects of pig feed supplementation with dried cassava peels, *Vernonia amygdalina* and *Pennisetum purpureum* stems, which are readily available, on pigs' body weights and some biochemical parameters. Twelve large White x Dunroch weaner pigs with an average body weight of 5.85 ± 0.70 kg were used for the study. The pigs were randomly divided into 4 treatment groups and were fed with formulated experimental diet twice daily for 21 days. In addition, pigs in groups 2, 3 and 4 received dried *V. amygdalina* stems, cassava peels, and *P. purpureum* stems ad libitum, respectively, as food supplement in the afternoon daily. At the end of the feeding trial, the animals were weighed and bled. Serum obtained from the blood samples was used for biochemical analysis. Pigs fed only the formulated diet had the lowest weight gain (0.47 ± 0.29 kg) while those that received cassava peels as food supplement had the highest weight gain (1.67 ± 0.82 kg). There was no significant difference ($P > 0.05$) in serum creatinine, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) values in the pigs, but serum glucose, cholesterol, albumin, calcium, urea and urea nitrogen differed significantly ($P < 0.05$) among the experimental groups. The results indicate that pig feed supplementation using dried cassava peels, *V. amygdalina* and *P. purpureum* stems can provide growing pigs with additional nutrients. They also show that pig feed supplementation with dried cassava peels, *V. amygdalina* stem and *P. purpureum* can increase the weight of growing pigs on the short term without any toxic effects to the liver and kidney.

Key words: Pig feed, cassava (*Manihot esculenta*) peels, *Vernonia amygdalina* stem and *Pennisetum purpureum*.

Introduction

In recognition of the potential of pigs as a prolific and fast growing animal, as well as a good converter of feed to meat, many Nigerian farmers have embarked upon intensive production of pigs. This is an effort geared towards increasing animal protein supply¹ but the major constraint has been the high cost of feeding due to high cost and inconsistent availability of conventional energy and protein sources. This could be as high as 75-80% in the fattening herd and 60-65% in the breeding herd². Thus, there is need for alternative feedstuffs. The alternative feedstuff, therefore, must be ingredients with less competition by other secondary industrial users and producers which are readily available in commercial quantities and affordable prices¹. Also, pigs should be capable of converting these alternative feedstuffs (which will normally be discarded by humans) into wholesome animal protein³.

Fibrous feed ingredients are abundant and cheap. It has been documented by several authors that dietary fibre has some beneficial effects in non-ruminant animals. Cassava (*Manihot esculenta*), leaves and tender stems are under-utilized in Nigeria because they are often left to rot away on farms and homesteads after harvesting the roots⁴. Cassava peels continue to constitute waste in the cassava processing industry. It accounts for 10 to 13% of the tuber by weight⁵. This is in spite of the potential of the by-product as an animal feedstuff⁶. Cassava peel meal has therefore been one feed ingredient that is consistently incorporated into the diets of pigs as alternative energy source^{1,7,8}.

Vernonia amygdalina, also known as bitter leaf is a tropical shrub. It belongs to the family Asteraceae. The plant is a widely used local plant in Nigeria for both therapeutic and nutritional purposes. It is the leaves that are used for cooking after thorough crushing and washing to remove most of the bitter taste, while the stems are often discarded. Bitter leaf grows in a wide range of ecological zones in Africa and produces large mass forage and is drought tolerant⁹. Its bitter taste is due to its anti-nutritional factors such as alkaloids, saponins, tannins and glycosides¹⁰. *V. amygdalina* Del. has been shown to contain significant quantities of lipids^{11,12}, proteins^{11,12,13,14}, carbohydrates¹¹ and fiber^{11,12,14}. Various micro- and macro-nutrients have also been reported to be present in this plant^{11,12,14}.

Pennisetum purpureum, also known as elephant grass, is a deep-rooted high yielding perennial bunch grass that is native to eastern and central Africa¹⁵. It grows in tropical and sub-tropical regions with a wide range of annual moisture from 750 to 2,500 mm rainfall and in altitudes ranging from sea level to altitudes of over 2100 m¹⁶. Elephant grass can withstand considerable periods of drought¹⁷, produces greater dry matter (DM) yields than other tropical grasses¹⁶, and is of high nutritive value for dairy cattle particularly when supplemented with high quality feeds such as legumes^{18,19}. The species is an important forage and pasture grass in its native Africa and throughout the Tropics.

The present study aims to examine the effects of pig feed supplementation with dried cassava peels, *V. amygdalina* stems and *P. purpureum* stems on pigs' body weights and biochemical parameters.

Materials and Methods

Plant materials

Dried cassava peels were obtained from the African Research Laboratory, Otorho-Agbon, Delta State, Nigeria. Fresh *P. purpureum* gotten from a farm land in Otorho-Agbon, Delta State, Nigeria, were cut in pieces to feed the animals, while stems of *V. amygdalina* gotten from Abraka, Delta State, Nigeria, were dried and cut in pieces before being fed to the experimental animals.

Animals

Twelve large White x Dunroch weaner pigs (5 males, 7 females) of 85–95 days old, with an average body weight of 5.85±0.70 kg were used for the study. They were injected with Ivomec® (Ivermectin) subcutaneously against endo- and ecto-parasites and weighed before the experiment began.

Experimental design

The pigs were randomly divided into 4 treatment groups. Each treatment group had 3 pigs in a complete randomized design. All groups were fed with the same quantity of the experimental diet twice daily. Table 1 shows the composition of the feed given to the experimental animals. Also, pigs in groups 2, 3 and 4 received dried *V. amygdalina* stems, cassava peels, and *P. purpureum* stems, respectively, as food supplement in the afternoon, daily for 21 days. Group 1 served as control. The pigs were allowed *ad libitum* access to the diets and water throughout the duration of the study. The feeds were weighed and grounded together at the African Research Laboratory. At the end of the feeding trial, the animals were weighed and bled. Serum obtained from the blood samples were used for biochemical analysis.

Biochemical assays

Glucose concentration estimation was done by the glucose oxidase method as described by Trinder²⁰. Urea concentration estimation was by the method of Weatherburn²¹. Urea in serum was hydrolysed to ammonia in the presence of urease, then, the ammonia was measured photometrically by Bethelot's reaction. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were assayed by the method of Reitman and Frankel²². α -Oxoglutarate receives an amino group from L-aspartate and L-alanine in a reaction catalysed by aspartate and alanine aminotransaminases yielding glutamate and pyruvate and oxaloacetate respectively. While ALT was measured by monitoring the concentration of pyruvate hydrozone formed with 2, 4-dinitrophenyl hydrazone, AST was measured by monitoring the concentration of oxaloacetate hydrazone formed with 2,4-dinitrophenylhydrazine. Estimation of serum creatinine was done by the principle of Bartels and Bohmer²³. Creatinine in alkaline solution reacted with picric acid to form a coloured complex which is directly proportional to the creatinine concentration. Serum albumin concentration was determined²⁴ and serum calcium level was also estimated²⁵. All the assays were carried out in accordance with the instructions in their respective RANDOX assay kits. The proximate analysis of the compounded feed and the plant materials was carried out using standard laboratory methods²⁶.

Calculation and data analysis

Metabolizable energy was calculated from the proximate chemical composition data²⁶:

$$\text{Metabolizable energy (Kcal/kg)} = (37 \times \text{CP}) + (81.8 \times \text{CF}) + (35.5 \times \text{NFE})$$

Where CP = crude protein (%), CF = crude fat (%) and NFE = nitrogen free extract (carbohydrate, %).

The values obtained from the different experiments were reported as mean ± SD. The significant differences between mean values were obtained by using analysis of variance (ANOVA) and least significance test (LSD)²⁷.

Results

Proximate analysis of the formulated feed and the plant materials are shown in Table 1. Percentage protein composition of the feed materials and the compounded diet ranged from 4.15±0.5% in cassava peels to 20.6±1.8% in the compounded feed. In terms of percentage fat content, cassava peels also had the least (1.34±0.26%), followed by palm kernel cake (PKC) (9.0±0.2%). The compounded diet had percentage fat content of 12.7±1.6%. PKC had fiber content of 184.5±0.28%; brewer's spent grain (BSG) 3.3±0.1%, while the compounded diet had fiber content of 21.4±1.3%. The percentage ash content recorded

for the feed materials and the compounded diet was highest in the compounded diet ($11.8 \pm 0.8\%$) and lowest in the PKC ($4.5 \pm 0.1\%$). Average weight gain of the pigs used for the research is as shown in Figure 1. Pigs fed only the compounded feed (Group 1) had average body weight gain of 0.47 ± 0.29 kg; Group 2 had average weight gain of 0.63 ± 0.55 kg, Group 3 had 1.67 ± 0.82 kg while Group 4 had average body weight gain of 0.83 ± 0.54 kg. Although there was no significant difference in the weight gain between groups, pigs in the control group (Group 1) had a lower weight gain than the pigs in the other experimental groups.

Table 2 shows the serum parameters of the experimental pigs. Significant differences ($P < 0.05$) were observed in the respective values of serum calcium ion, urea and urea nitrogen concentrations in the various treatment groups.

Table 1. Experimental feed composition.

Ingredients	Pig Feed (Kg)
Brewer's spent grain	24.25
Palm kernel cake	45
Cassava peels	20
ARL Pig GF Supermix*	10.75

* PIG FEED (GF) SUPERMIX = [Methionine 1 kg, lysine 3 kg, grower premix 10 g, salt 30 kg and enzyme 0.1 kg]

Table 2. Proximate analysis of formulated feed and plant materials.

S/N	Parameter	<i>P. purpureum</i>	Cassava peels	<i>V. amygdalina</i>	Compounded feed
1	Protein (%)	12.51 ± 1.5	4.15 ± 0.5	20.64 ± 2.3	20.6 ± 1.8
2	Fat content (%)	14.7 ± 0.2	1.34 ± 0.26	9.05 ± 0.03	12.7 ± 1.6
3	Fiber (%)	28.6 ± 2.6	33.96 ± 0.4	12.08 ± 0.27	21.4 ± 1.3
4	Ash (%)	18.8 ± 2.0	6.44 ± 0.36	9.56 ± 0.22	11.8 ± 0.8
5	Moisture (%)	9.4 ± 0.7	6.76 ± 0.2	5.6 ± 0.15	2.6 ± 0.24
6	Carbohydrate (%)	25.8 ± 2.0	46.7 ± 2.4	8.65 ± 0.5	54.6 ± 1.4
7	Dry matter (%)	90.6 ± 2.7	94.24 ± 0.1	94.40 ± 0.24	97.4 ± 0.8
8	Metabolizable energy (kcal/kg)	2581.23	2551.69	1811.05	3739.36

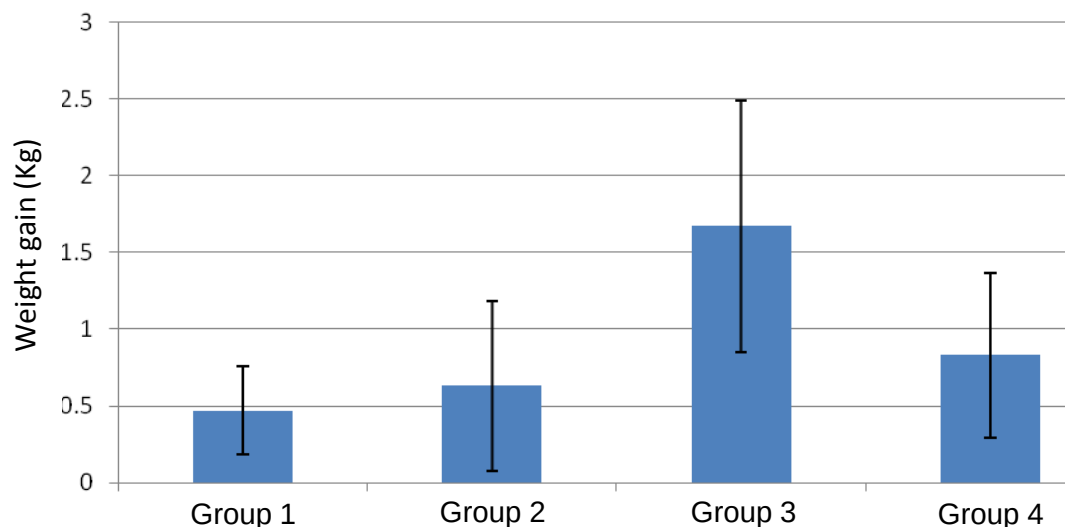


Figure 1. Body weight gain (kg) of experimental pigs. Group 1, Control; Group 2, pigs fed *Vernonia amygdalina* stems as supplements; Group 3, pigs fed *Pennisetum purpureum* stems as supplement; Group 4, pigs fed dried cassava peels as supplement.

A slight variation in the serum albumin concentration of the experimental groups was also observed (Table 3). Albumin concentration in Groups 2 and 4 differed significantly from the control, but there was no significant difference between the values obtained for the control and the *Vernonia amygdalina* fed groups. The total cholesterol concentration obtained from the various groups ranged from 67.61 mg/dl in the control group to 105.65 mg/dl in Group 4 (*P. purpureum*). There was significant difference in the values obtained for the control group and the other experimental groups. There were, however, no significant differences in serum ALT and AST activities between the control and the other experimental groups.

Serum glucose level (mg/dl) was highest in the control group (group 1) with 119.37 mg/dl, followed by group 2 (91.5 mg/dl). Pigs fed *Pennisetum purpureum* and cassava peels had 53.76 and 52.57 mg/dl of serum glucose, respectively. There was significant difference between the glucose values obtained for the control group and the test groups, but there was no significant difference in the blood glucose level of pigs given dried cassava peels and *P. purpureum* as supplement. Similarly, the serum creatinine concentrations of the pigs in the test groups were also not significantly different ($P < 0.05$) from those of the control group.

Table 3. Serum biochemical parameters of experimental pigs feed with pig feed supplemented with dried cassava peels, *Vernonia amygdalina* stem and *Pennisetum purpureum*.

S/N	Parameter	GROUP 1	GROUP 2	GROUP 3	GROUP 4
1	Calcium (mg/dl)	20.37 ^a ±0.145	18.30 ^b ±0.125	14.72 ^c ±0.0112	19.34 ^d ±0.115
2	Urea (mg/dl)	109.4 ^a ±0.83	151.84 ^b ±0.72	105.75 ^c ±0.82	117.68 ^d ±0.71
3	Urea Nitrogen (mg/dl)	51.11 ^a ±0.39	70.91 ^b ±0.29	49.35 ^c ±0.35	54.96 ^d ±0.31
4	Albumin (g/dl)	3.10 ^a ±0.01	3.33 ^b ±0.22	3.12 ^a ±0.21	3.84 ^b ±0.15
5	Total Cholesterol (mg/dl)	67.61 ^a ±0.48	83.59 ^b ±0.48	69.53 ^c ±0.48	105.65 ^d ±0.16
6	ALT activity (u/l)	14.5 ^a ±2.51	14.5 ^a ±2.51	14.5 ^a ±6.52	12.5 ^a ±4.51
7	AST activity (u/l)	11.5 ^a ±1.50	10.0 ^a ±3.00	11.5 ^a ±1.50	11.5 ^a ±1.50
8	Glucose (mg/dl)	119.37 ^a ±0.79	91.5 ^b ±0.99	53.76 ^c ±0.80	52.57 ^c ±0.79
9	Creatinine (mg/dl)	2.81 ^a ±0.75	4.03 ^a ±0.47	2.91 ^a ±0.85	1.97 ^a ±0.47

Values are presented as mean ± SEM. Values on the same row with different superscript differ significantly ($P < 0.05$). Group 1, Control; Group 2, *Vernonia amygdalina* stems; Group 3, *Pennisetum purpureum* stems; Group 4, dried cassava peels; ALT, alanine aminotransferase; AST, aspartate aminotransferase.

Discussion

The increase in the body weight of pigs fed with supplements suggest that the lysine and other amino acids (AA) levels available in the diets and supplements are adequate for the pigs as evidenced by the weight gains of the pigs. The increase in weight obtained with the supplementation of control diet with dried *V. amygdalina* stem, *P. purpureum* stem and cassava peels shows that the formulated diet and feed supplements were able to meet the requirements of this class of pigs. The efficiency of protein and feed utilization was reported to decrease with increased fibre content in diets²⁸ resulting from reduced digestibility and leading to low availability of AAs and energy of the diets. This was expected, taking into consideration the increased fibre contents of the test diets but the efficiencies of feed and protein utilization observed in this study (as reflected by values of serum creatinine and urea determined) were not significantly ($P > 0.05$) affected by the dietary treatments. This is in agreement with earlier findings in related works^{28,29} where no adverse effect was recorded in dry matter intake, body weight gains and feed efficiency as a result of the addition of PKC to the diets of the growing crossbred pigs.

The use of cassava in commercial livestock feeding has been limited by some factors, notably, dustiness, low protein content, hydrocyanic acid and economics of its mixture into the commercial livestock feeds³⁰. However, its use in this study in combination with PKC and BSG, two relatively higher protein and fats feeds ingredients, may be responsible for the enhanced performance of the pigs. Iyayi and Tewe⁷ had reported adequacy of cassava peel supplemented with protein sources in place of maize for growing pigs.

Blood biochemistry is routinely used in veterinary medicine to evaluate the health status of animals and poultry. The influence of diets on haematological and serum biochemical variables has been established. Nutrition, especially, dietary protein intake is known to affect the live weight and haematological parameters of animals^{31,32,33}.

The observed values of urea, urea nitrogen and creatinine are comparable to those earlier obtained²⁸ but vary slightly from those of Adesehinwa³⁴.

Serum urea and creatinine levels in animals are indicative of muscular wastage³⁵. Higher urea and creatinine values may be brought about by the inadequacy or unavailability of the dietary protein, poor digestibility or inefficient utilization of the protein³⁶, but this was not reflected in the overall performance of the pigs used in this study. The urea values observed were

comparable across the groups, except Group 2; as such, the animals could not have suffered muscular wastage but an efficient utilization of the diets, thereby resulting in high tissue deposition across the groups³⁷.

Urea is the main nitrogenous end product arising from the catabolism of amino acids that are not used for biosynthetic roles in mammals³⁷. Therefore its production reflects alterations in the dietary intake of protein and pattern of utilization. The higher urea and urea nitrogen values obtained with the test diets may be brought about by the inadequacy or unavailability of the dietary protein, poor digestibility or inefficient utilization of the protein³⁶.

The serum urea, which is an indicator of muscular wastage in animals³⁸, was not significantly affected by the dietary treatment. Instead, the diets seemed to have been efficiently utilized, resulting in high tissue deposition in spite of the high fibre content of the diet. Cassava peel is a highly fibrous feed ingredient, a nature common with most locally available agro-industrial by-products³⁹, which may affect its utilization. The physical bulk may affect the overall retention time of digestion in the gastrointestinal tract and consequently its utilization^{40,41}. High fibre diets were reported to be associated with some cardiovascular risks such as low density lipoprotein and total cholesterol and reduction in blood glucose and serum insulin concentration⁴² contrary to the results obtained in this study.

The serum albumin concentration recorded in this study are comparable with those earlier recorded growing pigs fed cassava peel based diets supplemented with avizyme® 1300³⁴. They however differ from the values observed growing pigs fed cassava peel based diet supplemented with or without Farmazyme 3000¹.

Dietary protein quality is dependent upon the adequacy and balance of the ten indispensable amino acids (IAA). A deficiency of 1 or more of the IAA will not only result in poor growth and other productive functions but may also lower disease resistance⁴³. A report had shown that a low albumin content is a consequence of dietary protein shortage⁴⁴. Proteins form the basic unit of cells and other substances that are necessary for body building, repairs and maintenance of homeostasis, regulation of vital body functions, energy source and defence against infectious agents³. Protein deficiency has been reported to reduce most haematological and serum parameters³¹ through reduced or impaired synthesis of the blood cells which are largely proteinaceous. This result showed that the protein levels in the diets were able to support normal protein reserves in the pigs resulting from efficient protein utilization²⁸. Thus, the nutrient profile of the formulated diet and feed supplements were adequate to support the performance of the pigs.

Glucose and total cholesterol concentration recorded in this study are comparable with that of other similar works^{1,34}, but differed from those of Adeschinwa et al⁴⁵. The observed reduction in glucose concentration in the test groups compared with the control is not surprising. Hypoglycaemic effect of *V. amygdalina* is well documented. The administration of aqueous leaf extract of *V. amygdalina* produced both hypoglycaemic, hypolipidaemic and antioxidant effect in animals^{46,47}. Their study showed that extract produced a marked decrease in blood glucose of diabetic rats. There are many bioactive constituents present in the extract and hence, at present, it is not certain, which of them is/are responsible for the observed effects. However, some reports have shown that flavonoids, tannins and saponins may play some roles in antioxidative and hypolipidaemic effect⁴⁸.

Both serum AST and ALT activities obtained in this study differed slightly from those earlier obtained⁴⁵ in which the utilization of sun-dried on-farm generated poultry litter as a feed resource for growing-finishing pigs was studied. It is however similar to the data obtained growing pigs fed cassava peel based diets supplemented with avizyme® 1300³⁴. High concentrations of these enzymes in the serum are indicative of hepato-cellular injury or damage, but this was not the case in this study. These results indicate that both the compounded feed and the test feeds can provide growing pigs with required nutrients without any toxic effect.

Conclusion

From the findings in this study, it is obvious that feeding dried cassava peels, *V. amygdalina* stem and *P. purpureum* stems has no adverse effect on the health status of the pigs, taking into consideration the results of the serum metabolites observed in this study. Rather it may be beneficial for waste and weed control as unused cassava peels and *V. amygdalina* stem constitute waste while *P. purpureum* growing on farm lands can be employed to feed pigs leading to significant increase in their weight. The results of this research thus show that, pig feed supplementation with dried cassava peels, *V. amygdalina* stem and *P. purpureum* can increase the weight of growing pigs. They also indicate that pig feed supplementation with dried cassava peels, *V. amygdalina* stem and *P. purpureum* can provide growing pigs with required nutrients without any toxic effects to liver and kidney.

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