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Growth Performance, Haematological Indices and Cost Benefits of Growing Pigs Fed Cassava Peel Meal Diets Supplemented With Allzyme® SSF

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Abstract

Effect of replacing dietary maize with cassava peel meal (CPM) supplemented with Allzyme® SSF (SSF) on the growth performance, haematological indices and cost benefits of growing pigs was investigated. Chemical composition of CPM and diets used were determined using standard procedures. Twenty-four growing pigs with average weight of 14.0±0.25kg were allotted to 6 dietary treatments whereby CPM replaced maize at 0, 50 and 100% levels with SSF supplementation at 0g/100kg and 20g/100kg of diet. Each treatment was replicated 4 times while the experiment lasted 8 weeks. Data were collected on daily feed intake (DFI), daily weight gain (DWG) and feed conversion ratio (FCR); feed cost/weight gain and feed cost/day were calculated. Blood samples collected through jugular vein puncture were analyzed for haematological indices such as white blood cells (WBC), red blood cell and platelet count. The CPM diets with or without SSF gave comparable (P>0.05) pigs' growth performance to what was obtained for pigs on the maize based diets in terms of DFI (1.26 – 1.33kg), DWG (0.32 – 0.40kg) and FCR (3.13 – 4.03). Values for WBC were within normal range, though they had significant (p<0.05) variations. Other haematological parameters were not influenced (p>0.05) by CPM inclusion. Feed cost/kg diet (₦54.11 – ₦74.39) and feed cost/weight gain (₦195.33 – ₦244.65) reduced insignificantly (P>0.05) with CPM inclusion in the diets of pigs. It was concluded that cassava peel meal can totally replace maize with or without enzyme supplementation in the diets of growing pigs for optimal performance at reduced cost.

Keywords: Cassava Peel Meal, Growth Performance, Growing Pigs, Allzyme® SSF, Haematological Indices and Cost Benefits

Introduction

In Nigeria, the livestock sector has not been able to meet the demand for animal protein at affordable prices (Irekhore *et al*., 2011). The animal protein intake/head/day in the nation is still a far cry from the recommended level. It was estimated to be 8.4g by FAO in 1972, about 5 – 6g by Adebambo in 2003, 7.4g by FAO in 2006 and 8g by Egbewande in 2010 against the FAO (2006) recommended level of 35g. The increasing human population and feed constraint, among other factors have contributed to the shortage of animal protein. For instance, the Nigerian population was estimated to be 174,507,539 (CIA, 2013) and is projected to have reached 440million by year 2050.

Feed constraint could be as a result of inadequate agricultural excesses and residues which can be used to feed the animals. As such, there is a high level of competition between man and his livestock for the conventional feed resources thereby making them too expensive for use in animal production. Feed cost accounts for about 70 – 80% of total cost of livestock production in Nigeria and other developing countries (Ekenyem *et al*., 2008). Maize constitutes the largest proportion of the feed ingredients that supply the energy component of feed for monogastric animals in Nigeria and is in short supply. It is therefore very expensive and uneconomical to feed monogastrics (particularly pigs) with maize. Furthermore, as opined by Irekhore *et al*. (2011), the global quest to use maize, other cereal grains and plant products as bio-fuel coupled with other competitive demands has caused frequent fluctuations in their prices. It therefore becomes imperative, to provide sustainable solutions which could optimize feed utilization in a cost effective way (Steiner, 2013). Exploitation of various kinds of non-traditional feed resources has been recommended as the most obvious way to address the issue (FAO 2002). The problem can also be partly overcome by making maximum use of crop by-products, waste feeds and grains of no dietary value for man (Holness, 1991). The use of locally available cheap alternative feed ingredients to feed livestock species that are adapted for their utilization with optimal growth and high rate of turn-over could help to bring down the cost of production, animal products and consequently boosting the supply of animal protein for the teaming populace.

Some attributes of pigs such as ability to utilize a wide range of feedstuffs including those that are not of direct use to human and the pigs' ability to multiply extensively in order to combat protein shortages make them a good species of animal (Ezeibe, 2010). Pigs are recognized as one of the most effective livestock for promoting health and economy of poor people in the developing countries of the world (Paul *et al*., 2007). Although there are some regions with cultural and religious reservations regarding consumption of pork, pork is the world's most consumed meat and its production is global (FAO 2016). Over the years, pig production has gained popularity and relevance in providing animal protein for the ever increasing population of Nigeria as well as being sources of income to the pig farmers. The meat (pork) is well accepted by both rural, peri-urban and urban dwellers whose religious edict do not go against its consumption. This is particularly so because it is cheaper to obtain and serves as a source of both protein and energy.

Cassava peel which is the ultimate waste product of cassava processing has been reported (Sonaiya and Omole, 1977; Shipton and Hecht, 2001; AllAboutFeeds, 2013) to serve as an alternative energy source for pigs and other animals depending on the level of its inclusion. The reports on the incorporation of CPM in the diets of monogastrics revealed that this potentially valuable feedstuff is still grossly underutilized in Nigeria as large quantities are left to rot away after peeling (Akinfala and Tewe, 2004). Its use as energy source particularly in the diet of monogastrics has been limited largely due to its high fibre (Adesehinwa *et al*., 2008) and partly due to its low protein content and the presence of anti-nutrient (hydrogen cyanide). This is certainly because fibrous portion of feed, being fairly indigestible to pigs, influences the digestibility of other constituents by exerting a protective action, encasing these constituents in a digestion-proof shield, thereby obstructing the access of digestive enzymes (Sauer *et al*., 1991). This research sought to improve utilization of cassava peel as energy source by growing pigs using Allzyme® SSF. Allzyme® SSF is a commercial multi-enzyme complex produced by a carefully selected strain of non-genetically modified *Aspergillus niger*, which is capable of increasing the release of phytate-bound phosphorus, energy and protein from pig and poultry feeds (Alltech, 2009).

Materials and Methods

The research was carried out in the Piggery Unit of the Directorate of University Farms (DUFARMS) of the Federal University of Agriculture, Abeokuta, Nigeria. The area lies on latitude 7013'N and longitude 3025'E, 76m above sea level and located in the tropical rainforest vegetation zone with an average temperature of 34.7^{0}C.

Fresh cassava peels were collected from cassava processing units in Odeda Local Government Area of Ogun State, Nigeria, sundried and milled to form the cassava peel meal (CPM). Allzyme® SSF was purchased from Alltech Distributor in Lagos, Nigeria. The CPM was then used to formulate 6 experimental diets such that CPM replaced 0, 50 and 100% of maize components while Allzyme® SSF (SSF) was added at two levels (0g/100kg and 20g/100kg) for each of the three CPM inclusion levels. This resulted in six (6) dietary treatments (Table 1), using a 3 x 2 factorial arrangement, in a completely randomized design (CRD). Representative samples of the cassava peel meal and each diet were taken and analyzed using the method of Association of Official Analytical Chemists (AOAC, 2012). Gross energy values were determined using bomb calorimeter while ADF and NDF were determined using fibretec hot and cold extraction unit apparatus following standard procedures of Van Soest (1994). Hydrocyanide content was determined using the method of Essers *et al*. (1993).

Twenty- four large white male growing pigs about 10 weeks old with average initial live weight of 14.0±0.75 kg were used for the experiment. They were held in quarantine and treated with ivomectin injection at the rate of 1ml/50kg body weight before placing them on the experiment. They were randomly assigned to any of the 6 dietary treatments with 4 pigs per treatment, each pig being a replicate. The pigs were housed and fed individually in concrete pens equipped with shallow concrete feeders and drinkers. Feed was supplied *ad libitum* and fresh clean water was made available daily throughout the experimental period of 8 weeks.

At the end of the experiment, blood was collected before feeding in the morning from each of the pigs in each treatment, through the jugular vein puncture using sterilized needle and syringes into EDTA bottles. Haematological parameters were estimated in whole blood just after bleeding, using standard procedures (Jain, 1986), for haemoglobin (Hb), red blood cells (RBC), packed cell volume (PCV) and white blood cells (WBC) contents i.e. the eosinophil, neutrophil, lymphocytes, monocytes and basophil as described by Makinde *et al.* (1991), Mafuvadze and Erlwanger (2007) and Tripathi *et al.* (2008). The mean corpuscular volume (MCV), mean corpuscular haemo-globin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated from the values of RBC, PCV and Hb.

Data were collected on initial weight, final weight, daily feed intake, daily weight gain,and feed conversion ratio, cost per kilogramme of feed, feed cost per kilogramme weight gain and feed cost per daywere calculated. All data obtained were subjected to one- way analysis of variance (CRD) in a 3 x 2 factorial arrangement. Minitab Analytical Computer Package (Minitab Inc. 2000) was used for all statistical analyses.

Results and Discussion

Chemical composition and the energy value of cassava peel meal (CPM) used in this experiment are presented in Table 1 while the composition of the experimental diets are presented in Table 2. The dry matter for the CPM used was 88.3% while the crude protein content was 5.51%. The crude fibre was 9.70% and crude fat value was 1.42%. The values obtained for ash and nitrogen free extract were 4.87 and 66.80%, respectively. Values obtained for fibre fractions of the experimental CPM were 10.44 and 13.24%, for neutral detergent fibre and acid detergent fibre, respectively. The gross energy value determined was 3577.70Kcal/kg while the value for hydrogen cyanide content was 0.03mg/100g.The nutrient compositions of the experimental diets were within the recommended levels for growing pigs.

Table 1: Chemical Composition and Gross Energy Value of Experimental Cassava Peel Meal

Parameters	Value
Dry matter (%)	88.30
Crude protein (%)	5.51
Crude fibre (%)	9.70
Neutral detergent fibre (%)	10.44
Acid detergent fibre (%)	13.24
Fat (%)	1.42
Nitrogen free extract (%)	66.80
Ash (%)	4.87
Gross energy (kcal/kg)	3,577.70
Hydrogen cyanide (mg/100g)	0.03

Table 2: Gross and proximate Composition of Cassava Peel Meal basal Diets Supplemented with Allzyme® SSF Fed Growing Pigs

Parameters	Cassava peel meal inclusion					
	0%		50%		100%	
Allzy®SSF	-	+	-	+	-	+
Maize	40.00	40.00	20.00	20.00	0.00	0.00
Cassava peel meal	0.00	0.00	20.00	20.00	40.00	40.00
Soybean meal	10.00	10.00	10.00	10.00	10.00	10.00
Groundnut cake	15.00	15.00	15.00	15.00	15.00	15.00
Wheat offal	18.00	18.00	18.00	18.00	18.00	18.00
Palm kernel cake	13.60	13.60	13.60	13.60	13.60	13.60
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50
Bone meal	1.00	1.00	1.00	1.00	1.00	1.00
Vit/Min premix	0.40	0.40	0.40	0.40	0.40	0.40
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Analysed Composition						
Dry matter(%)	91.10	91.10	90.80	90.80	90.00	90.00
Crude protein (%)	18.49	18.49	17.82	17.82	16.84	16.84
Crude fibre (%)	7.67	7.67	8.54	8.54	9.96	9.96
Fat (%)	5.86	5.86	5.49	5.49	4.81	4.81
Ash (%)	7.09	7.09	9.36	9.36	9.24	9.24
Nitrogen free extract (%)	53.64	53.64	49.59	49.59	48.50	48.50
Gross energy (Kcal /kg)	3,922.50	3,922.50	3,877.10	3,877.10	3,855.00	3,855.00
Neutral detergent fibre (%)	21.63	21.63	31.10	31.10	24.93	24.93
Acid detergent fibre (%)	9.24	9.24	15.43	15.43	19.37	19.37
Hydrogen cyanide (mg/100g)	0.00	0.00	0.01	0.01	0.01	0.01

+: Allzyme® SSF was included at 20g/100kg of feed.

-: No Allzyme® SSF inclusion (0g/100kg).

Growth Performance and Cost Benefit of Growing Pigs

The effects of CPM and SSF on growth performance and cost benefits of the pigs are presented in Table 4. All parameters considered were not significantly (P>0.05) influenced by replacement of maize with CPM and enzyme supplementation of pigs' diets. Pigs' feed intake (1.29-1.33kg) did not follow any particular trend and was not influenced (P>0.05) by the dietary treatments. Results showed that the CPM based diets with or without enzyme supplementation gave similar (P>0.05) pigs' growth performance as the maize based diets with or without SSF in terms of daily weight gain (0.32 – 0.40kg), final body weight (32.13 – 37.25kg) as well as the feed conversion ratio (3.13 – 4.03). Numerical reduction in feed cost/kg diet with values ranging from ₦54.11 – ₦74.39 were not significant. In the same vein, values recorded for feed cost/kg weight gain (₦195.33 – ₦244.65) and feed cost per day (70.35 – 98.01) showed no significant (P>0.05) variations across the treatments. No mortality was recorded during the period of experiment.

Damisa and Bawa (2007) reported a trend of depressed weight gain as the level of CPM increased in pigs' diet. Supplementation of diets with Allzyme® SSF did not (P>0.05) improve growth performance as against the reports of Akintunde *et al.* (2011), Alltech (2009) and Kanto *et al.* (2009) who reported consequent increase in the average daily weight gain upon Allzyme® SSF supplementation of growing pigs' diets. Values observed for the feed conversion ratio (FCR) were similar (P>0.05) for all the pigs across the dietary treatments. The FCR as reported by Edwards *et al.* (1989) is an important determinant of profitability. Kanto *et al.* (2009) reported poor FCR values for pigs fed cassava-based diets despite Allzyme® SSF supplementation. The cost benefit analysis revealed that feed cost per kilogramme of diet reduced insignificantly (P>0.05) with inclusion of CPM and increased insignificantly (P>0.05) with enzyme supplementation of pigs' diets. Irekhore *et al.* (2006) reported a decrease in the cost of feed upon the inclusion of cassava peel meal in the diets of growing pigs. The work of Tewe and Oke (1983) and a review by Adesehinwa (2008) also affirmed that the inclusion of cassava peel meal in the diet of pigs will drastically reduce feed cost. Akinola *et al.* (2009) also reported that cassava by-products can be effectively utilized to reduce the feed cost for pigs.

Table 3: Effect of Dietary Cassava Peel Meal and Allzyme® SSF Supplementation on Performance and Cost Benefit of Growing Pigs

Parameters	Cassava peel meal inclusion						
	0%		50%		100%		
Allzyme® SSF	**-**	**+**	**-**	**+**	**-**	**+**	**SEM**
Initial body weight (kg)	14.75	14.25	14.00	14.50	14.75	14.25	0.58
Final body weight (kg)	37.25	36.88	34.00	35.25	35.50	32.13	1.12
Daily feed intake (kg)	1.33	1.26	1.28	1.33	1.30	1.29	0.03
Daily weight gain (kg)	0.40	0.40	0.35	0.37	0.36	0.32	0.01
Feed conversion ratio	3.32	3.13	3.59	3.59	3.61	4.03	0.15
Feed cost/kg (₦	73.69	74.39	63.89	64.42	54.11	55.00	1.57
Feed cost/weight gain ₦/kg)	244.65	232.84	229.36	231.26	195.33	221.65	8.95
Feed cost/day (₦)	98.01	93.73	81.77	85.67	70.35	70.96	2.81

SEM- Standard Error of Mean

+: SSF was included at 20g/100kg of feed.

-: No SSF inclusion (0g/100kg).

Effects of Cassava Peel Meal and Allzyme® SSF Supplementation on Haematological Parameters of Growing Pigs

Table 4 shows the effect of cassava peel meal (CPM) and Allzyme® SSF (SSF) supplementation on haematological parameters of growing pigs. Only white blood cell was observed to be significantly ($P<0.05$) affected by the interaction of CPM and SSF. The least value (8.92×10^9/L) was recorded for pigs fed diet containing 50% replacement of maize with CPM without SSF supplementation while pigs fed other test diets had similar values as those fed the control diet. Other parameters measured were not significantly ($P>0.05$) influenced by the interaction of CPM and SSF. Packed cell volume ranged between 33.00% for pigs fed diet in which CPM replaced the entire maize content without SSF supplementation and 39.25% for pigs fed diet in which CPM replaced 50% of the maize content with SSF supplementation. Haemoglobin values ranged between 9.68 and 11.75g/dl while values for the red blood cell ranged from 5.52×10^{12}/L for pigs fed diet containing 50% replacement of maize with CPM to 6.2252×10^{12}/L for pigs fed same diet with SSF supplementation. Values recorded for the platelet count ranged from 155.00 to 210.75×10^3/mm. The white blood cell differentials values were also similar across the treatments. Mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration ranged from 56.0 – 182.0fl, 17.0 – 19.25pg and 29.70 – 30.45g/l, respectively.

Haematological and blood biochemistry are routinely used to evaluate the health status of the animal. The result of the haematological parameters revealed that only white blood cell, of all assayed parameters was significantly affected by the interaction of cassava peel meal inclusion and Allzyme® SSF supplementation. Similarities in the values of packed cell volume were noticed for pigs fed the different diets. The same trend was observed for both haemoglobin and red blood cell counts since they were not significantly different. This result is contrary to the report of Adesehinwa *et al.* (2011) who earlier adjudged that hemoglobin and red blood cells (RBC) of pigs were increased by the inclusion of the enzyme, and that the replacement of the maize content of the basal diet with cassava peel significantly reduced both parameters. White blood cell on the other hand was significantly affected by the interaction of CPM and SSF supplementation as the value was least for pigs fed diet with 50% replacement of maize with CPM while the rest had comparable values across the treatments. Packed cell volume, haemoglobin, red blood cell and white blood cell were normally preponderant for maize-based diets above other diets and obviously implied better nourishment. Albeit, the similar values obtained in this study with pigs placed on the test diets indicates nutritional adequacy. The influence of haematological parameters is very strong (Hackbath *et al.*, 1983), and packed cell volume and haemoglobin have been shown to indicate nutritional status of the subjects.

Reduction in concentrations of erythrocytic parameters (such as packed cell volume, red blood cell counts and haemoglobin concentration) and elevation in mean corpuscular volume (MCV) are indications of macrocytic (regenerative) anemia emanating from increased destruction and subsequently enhanced erythropoiesis at liver, spleen and kidneys (Tripathi *et al.*, 2008). However, this was not the case in this study as almost all haematological parameters assayed were not significantly influenced by the diet and were all in the normal range reported by Merck (1998).

It can therefore be said that the nutrient profiles of the diets were adequate to support the performance of the growing pigs since Babatunde and Pond (1987) adjudged that performance indices and haematological indices are strongly correlated.

Table 6: Effects of Cassava Peel Meal and Allzyme® SSF Supplementation on Haematology of Growing Pigs

Parameters	Cassava peel meal inclusion						
	0%		50%		100%		
Allzyme®SSF	-	+	-	+	-	+	**SEM**
Packed Cell Volume (%)	35.00	34.25	34.25	39.25	33.00	34.25	1.23
Haemoglobin (g/dl)	10.25	11.05	10.10	11.75	9.68	10.47	0.39
Red blood cells ($x10^{12}$/L)	5.90	5.82	5.52	6.22	5.80	5.77	0.13
White blood cells ($x10^{9}$/L)	10.25^{ab}	9.65^{b}	8.92^{c}	10.30^{ab}	10.95^{a}	10.62^{a}	0.16
Platelet count ($x10^{3}/mm^{3}$)	176.25	155.00	197.50	210.75	210.75	209.50	5.94
Neutrophil (%)	36.00	36.50	31.00	38.75	33.25	33.75	1.00
Lymphocyte (%)	64.25	62.25	67.75	60.25	64.75	64.75	0.96
Eosinophil (%)	0.50	0.25	0.50	0.00	0.50	0.50	0.10
Basophil (%)	0.00	0.50	0.50	0.50	0.50	0.00	0.09
Monocyte (%)	0.00	1.25	0.50	0.50	0.00	0.50	0.12
Mean corpuscular volume (fl)	57.75	60.00	62.25	64.00	56.00	182.00	20.80
Mean corpuscular haemoglobin (pg)	17.50	18.00	19.25	18.75	17.00	17.50	0.34
Mean corpuscular haemoglobin concentration (g/l)	30.17	30.00	29.70	30.22	30.45	30.42	0.09

SEM - Standard Error of Mean
+: Allzyme® SSF was included at 20g/100kg of feed.
-: No Allzyme® SSF inclusion (0g/100kg).

Conclusion

Pigs feed intake, body weight gain, feed conversion ratio and feed cost per weight gain were not significantly influenced by dietary replacement of maize with cassava peel meal or enzyme supplementation of the diets. Variations observed in white blood cells could not be traced to the diets and were not detrimental to pigs' health and performance. It is therefore feasible to feed pigs with diets whereby maize content is fully replaced with cassava peel meal with or without enzyme supplementation and still obtain good performance of the animals.

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