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# RESPONSE OF GROWING PIGS TO CASSAVA PEEL BASED DIETS SUPPLEMENTED WITH AVIZYME® 1300: GROWTH, SERUM AND HEMATOLOGICAL INDICES

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## Abstract

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Thirty-six growing pigs (Large white x Landrace x Duroc) weighing 27.56±0.51kg were allocated to three groups of Avizyme® 1300 inclusion (100g/100kg diet and 200g/100kg diet) in a 45% Cassava peel meal (CPM) based diet and a control (no enzyme inclusion). The diet with no enzyme inclusion resulted in the least performance, while the pigs on diet supplemented with 100g/100kg diet had the best result in terms of daily weight gains, protein efficiency and feed conversion ratios. The enzyme inclusions had no significant ($P>0.05$) effect on the serum metabolites, hematological parameters and serum electrolytes but for slight variations ($P<0.05$) observed in the values of MCHC and$PO_4^{2-}$. The result suggests 100g Avizyme® 1300 inclusion in 100kg of 45%-CPM based diet as ideal for growing pigs.

*Key words:* growing pigs, cassava peel meal, enzyme, Avizyme, growth performance, blood parameters

## Introduction

Cereals constitute the principal plant harvest of the world (Longe, 1988). The developed countries of the world produce a greater proportion of the grain, while the cereal production in the developing countries cannot keep pace with the demand for human consumption, therefore hardly is any available for livestock feeding (Adesehinwa et al., 1998), hence the 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 prices (Adesehinwa et al., 1998). Cassava peels, leaves and tender stems are under-utilized in Nigeria because they are often left to rot away on farms and homesteads after harvesting the roots (Akinfala and Tewe, 2004). Cassava peel meal has therefore being one feed ingredient which have been consistently incorporated into the diets of pigs as alternative energy source (Iyayi and Tewe, 1988; Tewe and Egbunike, 1988 and Adesehinwa et al., 1998),

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but for its high fibrous content (a feature of most locally available agro-industrial by-products and wastes), which has limited its use and utilization by monogastric animals (Longe and Fagbenro-Byron, 1990). Fibrousness of feedstuffs (mostly of by-product of plant origin) is important in relation to their feeding value to pigs (Adesehinwa et al., 1998). The addition of fibre to swine diets decreases the digestible energy (DE) and metabolizable energy (ME) concentration of the diet (Kennelly et al., 1978 and Kennelly and Aherne, 1980) and often results in bulk feeds. The influence of crude fibre on organic matter digestibility varies from feed to feed, depending on the special characteristics of the crude fibre in individual feeds (Kidder and Manner, 1978). The fibrous portion of feed, being fairly indigestible to pigs, influences the digestibility of the other constituents by exerting a protective action, encasing these constituents in a digestion-proof shield, as it were, thereby obstructing the access of digestive enzymes (Sauer et al., 1991; Mitaru and Blair, 1984). Hence, for efficient use of cassava peel in pig feeding, some form of physical treatment is essential to the breaking down of the fibre encapsulating the more soluble constituents so that digestive secretions can penetrate more completely (Kidder and Manner, 1978).

Many enzymes have been found to be beneficial when added to non-ruminant animal diets containing carbohydrate or protein sources containing high levels of non-starch polysaccharides (Bedford and Morgan, 1996; Chesson, 2001; Acamovic, 2001). Recent studies have suggested that addition of Avizyme, a product containing a mixture of xylanase, protease, and amylase enzymes, may be beneficial in such types of diets (Wyatt et al., 1997, 1999; Zanella et al., 1999; Douglas et al., 2000; Cafй et al., 2002). It was therefore the aim of this study to evaluate the response of growing pigs to cassava peel meal based diet supplemented with Avizyme® 1300.

## Materials and Methods

The experiment was carried out at the Swine Research Unit of the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan. Nigeria.

### *Experimental Diets and Animal*

The utilization of cassava peel meal supplemented with two levels of Avizyme® 1300 in the diets of growing pigs was investigated using thirty six growing cross bred (Large White x Landrace x Duroc) pigs with average initial live weight of 27.56±0.51kg. They were injected with Ivomec® (Ivermectin) subcutaneously against endo-and ecto-parasites (1ml/50kg live weight) and were randomly allotted to three dietary treatment groups of Avizyme® 1300 supplementation (100g/100kg diet and 200g/100kg diet) in a 45% Cassava peel meal (CPM) based diet and a control (no enzyme inclusion) in a completely randomized design.

The basal diet was formulated to contain approximately 18% crude protein (NRC, 1998). There were six replicates of two animals per treatment group. They were allowed *ad libitum* access to feed and water in the concrete floored pens where they were kept throughout the 42-day duration of the trial and the performance were monitored.

### *Chemical Analysis*

The test ingredient (cassava peel meal) and feed samples were analyzed for the proximate chemical composition using the recommended procedures of Association of Official Analytical Chemist (A. O. A. C., 1990). The metabolisable energy content of the diets was determined with the prediction equation reported by Morgan et al. (1975) based on proximate composition. The proximate chemical components and metabolisable energies of the diets on dry matter basis are shown on Table 2.

### *Blood Collection and Analyses*

Six of the twelve experimental pigs in each of the three dietary treatment groups were randomly selected for blood collection at the end of the feeding trial. The bleeding was done in the morning before feeding and 10 ml of blood was collected in serum tube through the jugular vain puncture method into two sample

bottles using a sterilized needle and syringe (Adesehinwa, 2007). The blood samples for serum analysis were allowed to clot before centrifuging to obtain the serum. The separated sera were decanted into bijoh bottles and stored at – $20^0$C until analyzed. The serum metabolites (total protein, albumin, globulin, creatinine, cholesterol, glucose, urea nitrogen (serum urea-N) and hepatic serum enzyme activities of Serum Glutamate Pyruvate Transaminase (SGPT), Serum Glutamate Oxalo-Transaminase (SGOT) and alkaline phosphatase) were estimated using commercial kits of Span Diagnostics, Surat, India. The blood samples for the hematological studies were collected in sample bottles with EDTA before being analyzed. Hematological attributes were estimated in whole blood just after bleeding, using standard procedures (Jain, 1986) for its hemoglobin, red blood cells (RBC), packed cell volume (PCV) and white blood cells (WBC) contents as described by Makinde et al. (1991), Mafuvadze and Erlwanger (2007) and Tripathi et al. (2008).

***Statistical Analyses***

All the data obtained were subjected to analysis of variance and where statistical significance were observed, the means were compared using the Duncan's Multiple Range (DMR) test (Steel and Torrie, 1980). The SAS Computer software package (1991) was used for all statistical analyses.

## Results and Discussion

***Chemical composition of the Experimental diets***

The gross and proximate compositions of the basal diet and dried cassava peel meal used are as shown in Tables 1 and 2. The crude protein levels of the diets were quite higher than the level recommended by NRC (1998) and Fetuga (1990) but the energy values were within the recommended range. This may be responsible for the satisfactory performance of the animals despite the highly fibrous nature of the diets. The hydrocyanic acid (HCN) level of the cassava peel meal used for this study was low. This may be attributed to the processing method adopted, strain and variety of cassava used (Hahn et al., 1987).

**Table 1**
**Gross composition of basal diet**

| Feed Ingredients | % Composition |
|---|---|
| Cassava peel meal | 45 |
| Palm kernel cake | 23 |
| Groundnut cake | 25 |
| Blood meal | 3 |
| Bone meal | 2.25 |
| Oyster shell | 1 |
| Salt | 0.5 |
| Vitamin-Mineral Premix* | 0.25 |
| Calculated Analysis | |
| Crude protein | 18.9 |
| Crude fibre | 12.43 |
| Metabolizable Energy, kcal ME/kg | 2700 |

* Pfizer Agricare Grower Premix supplied the following per kg diet:
Vit A 10,000,000 IU; Vit $D_3$ 2,000,000 IU; Vit E 8,000 IU; Vit
K 2,000mg;Vit $B_1$ 2,000 mg; Vit $B_2$ 5,500mg; Vit $B_6$ 1,200 mg;
Vit $B_{12}$ 12 mg; Biotin 30 mg;Folic Acid 600 mg; Niacin 10,000 mg;
Pantothenic Acid 7,000mg;Choline chloride 500,000 mg; Vit C 10,000mg;
Iron 60,000 mg; Mn 80,000 mg;Cu 8,00mg; Zn 50,000 mg; Iodine 2,000 mg;
cobalt 450 mg; Selenium 100 mg; Mg 100,000 mg; Anti Oxidant 6,000 mg.

***Performance of growing pigs***

The summary of the performance characteristics of the growing pigs fed cassava peel meal based diet supplemented with two levels of Avizyme® 1300 is shown in Table 3. There were no significant differences in the dry matter intakes of the pigs but the daily weight gain differ significantly ($P<0.05$) across the treatment groups. The diet supplemented with 100g

**Table 2**
**Proximate composition of experimental diets and cassava peels used**

| Parameters | No Avizyme | 0.1% Avizyme | 0.2% Avizyme | Cassava peel |
|---|---|---|---|---|
| Dry matter | 89 | 91.89 | 91.58 | 80.75 |
| Crude Protein | 19.02 | 20.53 | 19.61 | 5.69 |
| Crude Fibre | 12.53 | 12.92 | 12.95 | 20.49 |
| Ether Extract | 3.62 | 4.96 | 3.91 | 0.75 |
| Ash | 7.41 | 9.28 | 9.08 | 5.04 |
| N.F.E. | 47.89 | 46.39 | 48.5 | 68.08 |
| HCN, mg/kg | - | - | - | 27 |

**Table 3**
**Performance characteristics of growing pigs fed cassava based diet supplemented with Avizyme®**

| Parameters | No Enzyme | 0.1% Avizyme | 0.2% Avizyme | SEM (±) |
|---|---|---|---|---|
| Daily weight gain, kg | $0.30^{c}$ | $0.57^{a}$ | $0.41^{b}$ | 0.04 |
| Daily dry matter intake, kg | 1.78 | 1.84 | 1.84 | 0.01 |
| Feed conversion ratio | $5.97^{a}$ | $3.23^{c}$ | $4.65^{b}$ | 0.17 |
| Protein Efficiency ratio | $0.88^{c}$ | $1.50^{a}$ | $1.14^{b}$ | 0.03 |

a,b: Means along the same row having different superscript differ significantly ($P<0.05$)

Avizyme® 1300 in 100kg of 45%-CPM based diet had the highest weight gain followed by diet supplemented with 200g Avizyme® 1300/100kg diet, while the least was the diet with no enzyme supplementation. This could be attributed to enhanced utilization of the fibrous diets, as a result of the Avizyme® 1300 supplementation (Chesson, 2001). Abubakar (1997) reported enzyme as a rich source of high quality protein, amino acid (lysine) and vitamins, hence its growth promoting properties. However, the result was not in agreement with the findings of Douglas et al. (2000) who reported that addition of 0.1% of Avizyme® to broiler diet had no significant effect on weight gain or gain: feed ratios.

The rate of feed conversion to gain and the protein efficiency ratio obtained in this trial were significantly ($P<0.05$) different across the groups. Pigs on the 100g/100kg diet had the best result. Wyatt et al. (1997) reported addition of Avizyme® to Sorghum-soybean meal based diets to improve feed conversion ratio and reduction in diet without adversely affecting broiler performance. Addition of 0.1% Avizyme® to corn-based diets utilizing soybean meal, extruded soybean or roasted soybean was reported (Zanella et al., 1999) to result in significant improvements in digestibility of crude protein (+2.9%), starch (+1.8%) and fat ((1.6%). The metabolizable energy of the test diet was also significantly ($P<0.05$) improved (+2.5%) by enzyme addition.

The least feed conversion ratio was recorded with the 0.1% Avizyme®, implying that the least amount of feed required to gain one kg of weight was obtained with this inclusion. This shows that a higher inclusion of the enzyme (i.e. 0.2% or above) was an economic waste, as it did not result in an improvement in gains and the efficiency at which the protein and the entire feed was utilized.

***Serum Metabolites of the growing pigs***

The serum total protein and albumin of the growing pigs used in this study were not affected by the two levels of Avizyme® 1300 inclusion. This indicated

that the protein level of the basal diet, with or without the two levels Avizyme® 1300 supplementation was able to support the protein reserves of the pigs across the groups. The absence of variations in the serum metabolites could also be attributed to the comparable protein and feed intakes across the groups. Gouache et al. (1991) reported albumin content to be specifically influenced by protein shortage. The levels observed in this study were with the normal range reported by Adesehinwa (2004 and 2007) (Table 4).

The serum urea, which is an indicator of muscular wastage in animals (Mitruka and Rawnsley, 1977), 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-products (Longe and Fagbenro-Byron, 1990), which may affect its utilization. The physical bulk may affect the overall retention time of digesta in the gastro-intestinal tract and consequently its utilization Stanogias and Pearce, 1985a and b). High fibre diets were reported to be associated with some cardiovascular risks such as low density lipoprotein and total cholesterol (Ande, 1992) and reduction in blood glucose and serum insulin concentration (Dodson et al., 1981) contrary to the results obtained in this study.

**Table 4**
**Serum metabolites of growing pigs fed cassava peel meal based diet supplemented Avizyme® 1300**

| Metabolites | No Enzyme | 0.1% Avizyme | 0.2% Avizyme | SEM (±) |
|---|---|---|---|---|
| Total protein, g/dl | 7.2 | 7.27 | 6.9 | 0.16 |
| Albumin, g/dl | 2.97 | 2.73 | 2.7 | 0.12 |
| Globulin, g/dl | 4.23 | 4.53 | 4.2 | 0.19 |
| Alb: Glob ratio | 0.69 | 0.62 | 0.67 | 0.05 |
| Creatinine, mg/dl | 0.93 | 0.67 | 0.57 | 0.11 |
| Urea, mg/dl | 21.33 | 18.67 | 17.33 | 0.96 |
| Cholesterol, mg/dl | 114 | 115 | 105.33 | 6.35 |
| Glucose, mg/dl | 88 | 87 | 89 | 7.62 |
| Alkaline phosphatase | 0.93 | 0.66 | 0.57 | 4.77 |
| SGOT | 9.67 | 12.67 | 8.33 | 0.91 |
| SGPT | 13 | 9.33 | 11.67 | 0.67 |

### *Serum Electrolytes*

The summary of the effect of the dietary treatment on the serum electrolyte is as shown in Table 5. This revealed that the two levels of Avizyme® supplementation of CPM-based diet did not significantly ($P>0.05$) influence all the measured serum electrolyte parameters of the growing pigs but for the $PO_4^{2-}$. The value obtained for the pigs fed diets supplemented with 0.1% was the highest ($P<0.05$) across the group. It could be inferred that the 0.1% Avizyme® supplementation enhanced better utilization of the dietary $PO_4^{2-}$, thereby increasing the serum $PO_4^{2-}$ value, which was superior to the values obtained with the control and 0.2% Avizyme® supplemented diets.

Phosphorus from plants is of low bioavailability to swine and poultry as a result of phytate (the principal form of P storage in plants) being relatively indigestible by non-ruminants (NRC, 1998). Phytate consists of an inositol ring binding up to six phosphate groups that, unless cleaved from the inositol ring, are unavailable for absorption (Maga, 1982). Exogenous supplementation of feeds with some enzyme has demonstrated the ability to increase P bioavailability and thus

**Table 5**
**Serum electrolytes of growing pigs fed cassava peel meal based diet supplemented Avizyme® 1300**

| Electrolytes | No Enzyme | 0.1% Avizyme | 0.2% Avizyme | SEM (±) |
|---|---|---|---|---|
| $Na^+$, $Mmol^{-1}$ | 128.33 | 127.67 | 127.67 | 1.7 |
| $K^+$, $Mmol^{-1}$ | 3.5 | 3.53 | 3.4 | 0.09 |
| $Cl^-$, $Mmol^{-1}$ | 100 | 100.67 | 99 | 0.79 |
| $HCO_3^-$, $Mmol^{-1}$ | 21 | 21.67 | 21.67 | 0.48 |
| $Ca^{2+}$, mg/100ml | 10.27 | 10.1 | 10.07 | 0.36 |
| $PO_4^{2-}$, mg/100ml | 5.70$^{ab}$ | 6.87$^{a}$ | 5.60$^{b}$ | 0.27 |

a,b: Means along the same row having different superscript differ significantly (P<0.05)

growth rates in pigs (Young et al., 1993; Adeola and Sands, 2003) by the cleavage of P molecules from the phytate (Maga, 1982). The poor digestive utilization of phytic acid P by monogastric animals and its consequences on diet cost, environment and digestibility of minerals and proteins have led to extensive research efforts directed toward improving phytate digestion. Research has demonstrated definitively that some enzymes have merit as a tool for minimizing P excretion by increasing P availability and subsequent utilization (Ravindran et al., 1995).

***Hematology***

The hematological parameters of the growing pigs used in this study are shown in Table 6. Hematology and blood biochemistry are routinely used in veterinary medicine to evaluate the health status of animals and poultry (Mafuvadze and Erlwanger, 2007). Nutrition, especially, dietary protein intake is known to affect the live weight and hematological parameters of animals (Makinde, 1991). The influence of diets on hematological variables was also established by Ologhobo et al., 1993 and Otesile et al., 1991). However, results obtained in this study shows that the dietary treatment had no significant (P>0.05) effect on all the observed hematological parameters but for the MCHC values of the growing pigs. Its highest value was recorded for the pigs fed the diet without Avizyme supplementation.

Reduction in concentrations of erythrocytic parameters (such as PCV, RBC counts and Hb concentration) and elevation in MCV are indications of macrocytic (regenerative) anaemia emanating from increased destruction and subsequent enhanced erythropoiesis

**Table 6**
**Hematological parameters of growing pigs fed cassava peel meal based diet supplemented Avizyme® 1300**

| Parameters | No Enzyme | 0.1% Avizyme | 0.2% Avizyme | SEM (±) |
|---|---|---|---|---|
| PCV, % | 38.33 | 37.67 | 35.33 | 1.66 |
| Hb, g/dl | 12.77 | 12.53 | 11.73 | 0.56 |
| RBC, $x10^6/\mu l$ | 5.77 | 5.77 | 5.3 | 0.2 |
| MCV (Fl) $\mu^3$ | 66.35 | 65.24 | 66.48 | 1.1 |
| MCHC %, g/100ml | 33.30$^{a}$ | 33.27$^{ab}$ | 33.21$^{b}$ | 0.02 |
| MCH (Pg) | 22.1 | 21.71 | 22.08 | 0.37 |
| WBC, $x10^3/\mu l$ | 18267 | 19867 | 23867 | 1503.7 |

a,b: Means along the same row having different superscript differ significantly (P<0.05)

in the liver, spleen and kidneys (Jain, 1986). 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 defense against infectious agents (Kaneko, 1989). Protein deficiency has been reported to reduce most haematological and serum parameters (Jain, 1986) through reduced or impaired synthesis of blood cells which are largely proteinaceous. It suffices to say that the nutrient profile of the diets was adequate to support the performance of the pigs based on the comparable results obtained across the groups.

## Conclusion

The result of this study indicates that inclusion of 0.1% of Avizyme® 1300 (100g/100kg diet) in 45%-cassava peel based diet for growing pigs may result in enhanced growth as a result of improved protein efficiency and feed conversion. This may probably due to the efficient utilization of the diets as shown by the serum and hematological parameters.

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