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GROWTH AND REPRODUCTIVE PERFORMANCES OF WEANER PIGS FED MAIZE REPLACED CASSAVA DIET

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ABSTRACT

The effect of Cassava replacing maize in the diet of grower pigs was investigated. A total of thirty six 5 week old male weaner large white |landrace cross pigs were used for the study. These were divided into four groups A – D 'S (n = 9)" following two weeks of acclimatization. The basic ingredients in their diets were soybean meal (SBM) palm kennel cake (PKC), maize, cassava flour, vitamin premix and sodium chloride. Four diets A – D were formulated using these ingredients. Diet A had maize only as the source of energy while diets B, C and D had maize replaced with 50, 75 and 100% cassava respectively. Groups a, B, C and D were maintained on diets A, B, C and D respectively from week 7 of age until they attained 5 months of age. Observations for clinical conditions like anorexia, diarrhea, fever and signs of hydrocyanic acid intoxications and sexual behavioral patterns related to puberty were made throughout the course of study. Moreover, weekly determination of live weights and testicular growth were also carried out. There was no overt manifestation of any abnormality by the members of the maize replaced cassava diet. At 15th weeks of age, members of group B and C were showing signs of sexual maturity followed a week later by those of group A and at 19h week by all the groups. Performance of groups C and D members were generally inferior to those of groups A and B. (P < 0.05). However, all the groups had comparable testicular diameter. It was concluded that inclusion of cassava meal in the diet of grower pigs promotes growth and early maturity. To avoid cyanide poisoning the cassava processing should be done properly while protein source should be such as to prevent precipitating its deficiency due to the low protein value of cassava root meal.

Keywords: Pig, Maize replacement, Cassava root meal, Sexual maturity, Weights, Testicular growth

INTRODUCTION

The need to provide adequate animal protein for the growing population of third world countries is of a major concern. It has been recognized over the years that the development of swine, poultry and rabbit sub sector of the animal industry is the fastest means of bridging the protein deficiency gap prevalent in most tropical countries (FAO, 1990). This is due to their short generation interval and high fecundity.

Commercialized production of these animals involves use of ingredients that have prohibitive costs due to their comparative use between man and animals. In Nigeria, the introduction of structural adjustment programme in the late seventies resulted in the devaluation of the local currency and escalation of the prizes of imports, consequently the cost of animal feed ingredients rose significantly (Ikani *et al.,* 2001). Most of these ingredients are energy based. Furthermore, improvement in animal production through the use of non-conventional feed ingredients or energy sources have long been advocated (Nnadi *et al.,* 2007). Effort to reduce the cost of production is being directed towards the use of affordable and available alternative sources of energy in the diets of pig.

Cassava, *Manihot esculenta*, is a major carbohydrate rich staple cultivated in the tropics. Current world production is about 157 million tons per annum with Nigeria, accounting for about 16% of the world total (FAO, 1990). The first attempt at substituting cereals with cassava in commercial pig rations began during the Second World War where its use cushioned the effect of post war shortage of grains in Europe (Muller *et al.,* 1974). Manner and Gomez (1973) and Iyayi and Tewe, (1994) noted conclusively that cassava may replace maize and cereals without any negative effects. In Nigeria, in spite of cassava availability its use as sole or component of energy source in livestock feed has not been given due recognition. However, there are many pioneering studies which highlighted on the suitability of cassava tuberous meal for swine feeding and its potential as a good substitute for maize for all classes of pigs (Job, 1975; Adegbola, 1977; Nghi, 1986; Tewe and Egbunike, 1992). Hahn (1988) had advocated that the future market for increased production of this important crop lies with its use as livestock feed. Jiménez *et al.* (2005) had reported that pigs fed diets formulated to contain 40% of cassava root meal with other ingredients showed similar performance and carcass traits with those fed conventional diet.

Due to intense competition for cereals between man, industry and animals, the last competitors are losing out and that is demonstrated in the cost of animal production where feed is responsible for 80% of the total production cost (Akinfala and Tewe, 2001). Though cassava is produced in abundance in most parts of Nigeria, it enjoys limited use relative to cereals, even when its energy content is higher than that in cereals.

The need to use cassava to replace maize is to reduce feed cost as it would constitute about 45 – 60% of energy demand in pig diet. This study was therefore designed to investigate the effect of graded replacement of maize meal with cassava on growth and attainment of puberty in weaner piglets.

MATERIALS AND METHODS

Management of Experimental Animals: Thirty six male weaner large white/landrace cross pigs, 11 – 13kg live weight purchased at 5 weeks of age from the Veterinary Demonstration Farm, University of Nigeria, Nsukka, were used for the study. Following two weeks of adaptation they were randomly divided into four equal groups "n=9". Each group was allocated to a separate concrete floor and cement walls pen. The basic diet of all the groups consisted of soybean meal (SBM) cassava flour (CF), maize, palm kernel cake (PKC) vitamin/mineral premix and sodium chloride. Cassava flour was prepared by first cutting the freshly harvested tubers into small bits, followed by peeling, then fermenting in a big vat for four days. After fermentation, the softened mass was homogenized in a mortar and broken into small masses and then sun dried. It was the sun dried mass that was crushed in a mortar again to make the powdery flour used in the diet formulation. Four diets A – D were formulated using these ingredients. While diet A did not contain cassava, D, also did not contain maize. Diets B and C had maize replaced with 50 and 75% cassava respectively (Table 1). Animal groups A, B, C and D were fed diets A, B, C and D from the onset of observation, until they attained 5 months of age. Each group was fed 2kg of their respective diets daily in two divided rations at 9 am and 2 pm. The ration was progressively increased depending on animal live weight gain till week ten when each group was maintained with 4kg per day. Water was provided *ad libitum*.

Clinical Observation and Sexual Behaviors: All the animas were closely observed for any clinical conditions like anorexia, diarrhea or

Table 1: Percentage of ingredients used in formulating different pig diets and proximate composition on dry matter basis of the four diets (A, B, C and D)

Ingredient	Dietary Types and Percentages of the Ingredients			
	A	B	C	D
Maize	20.58	10.29	5.15	0.00
Cassava	0.00	10.29	15.44	20.58
Soya bean Meal	3.43	3.43	3.43	3.43
Palm Kernel Cake	75.47	75.47	75.47	75.47
Sodium Chloride	0.35	0.35	0.35	0.35
Vitamin Premix	0.17	0.17	0.17	0.17
Proximate composition				
Crude Protein (%)	17.52	16.56	16.52	16.18
Crude fibre (%)	27.00	32.00	38.00	41.00
Ash (%)	4.08	4.25	4.32	4.43
TDN	82.31	80.87	80.01	79.13

fever. They were also observed for behavioral patterns related to sexual maturity and drive.

Determination of Body Weight: Prior to onset of the study, each of the animals was weighed using an Avery Weighing Balance (Avery® England). This was repeated at their 18th and 20th weeks of age respectively. Mean group live weights were calculated on each occasion.

Testicular Measurements and Determination of Puberty: Animals in each group had the scrotal diameter (cm) and length (cm) determined weekly with a Butterfly Flexible Tape (Butterfly® China). The weekly means were used to determine the rates of testicular growth. Beginning from their 16th week of age, 3 animals were randomly selected at 2 weeks interval (weeks 16, 18 and 20) from each group and hemi castrated. Each testis was weighed after which samples were taken and fixed in Bouin's fluid. Within twenty four hours of fixation they were transferred to a solution of 70% alcohol and later subjected to paraffin tissue processing, by dehydrating in increasing percentage of alcohol, clearing with xylene and embedding in paraffin wax. 5 micrometer sections were cut using rotatory microtome and stained using Haematoxylin and Eosin. The seminiferous epithelium was examined to ascertain the spermatozoa maturation stage using an Olympus light microscope.

Statistics: The weekly mean body weights, testicular diameter and lengths were subjected to analysis of variance (ANOVA) using a graph pad Instat package. Multiple comparisons were carried out using the Friedman's test, non parametric ANOVA.

RESULTS

Clinical Observation and Sexual Behaviors: There was no significant clinical manifestation of any abnormality in any of the dietary groups. within the observation period However, starting from week fifteen, animals in groups B and C have started showing sexual maturity as was also later noted among those in group A. Common observations included increased rates of chasing and attempting to mount pen mates. By week nineteen, animals in group D had followed suit but only those in groups A, B and C could ejaculate fluid when they mount.

Body Weight, Testicular Diameter and Length: The body weights and testicular dimensions of experimental animals increased with their age. The rates of increase were more significant among young boars in groups A and B (Table 2).

Table 2: Mean body weight, testicular diameter and length of weaner pigs fed maize replaced with cassava diet

Dietary Groups	Body Weight (kg)			Testicular Diameter (cm)			Testicular Length (cm)		
	7wk	18wk	20wk	7wk	18wk	20wk	7wk	18wk	20wk
A	12.22	40.10	51.20[a]	6.65	7.44	9.80	6.70	12.68	14.15[a]
B	11.00	39.60	50.50[a]	6.55	7.21	9.60	6.60	12.44	14.40[a]
C	11.60	36.60	47.00	6.50	6.85	9.10	6.50	11.16	13.90
D	12.92	35.60	42.20[b]	6.85	6.45	9.20	6.70	10.88	13.15[b]
	ns	ns	ab=$p<0.05$	ns	ns	ns	ns	ns	ab =$p<0.05$

Different superscripts in a row indicate significant difference between the treatment means at the level of probability = $p < 0.05$

The performance of young boars in group D was generally lower to those of control animals. Moreover, the mean body weights of the groups differed significantly especially between groups A and B, and B and D ($p < 0.05$).

In addition, mean testicular lengths of the groups at 20 weeks of age showed that groups A and B had superior growth relative to D ($p< 0.05$). However, the various groups had comparable mean testicular diameter. Similarly only testis from groups A and B showed mature spermatozoa in the lumen of the seminiferous tubules (Figure 1) while testis sections from groups C and D only showed round spermatids as the most advanced cell stage in the spermatogenic series (Figure 2).

DISCUSSION

There was no clinical manifestation of hydrocyanic acid poisoning among pig groups fed maize replaced with cassava diets. This may have been due to the low cyanide content of fermented cassava cultivars from which the cassava flour used in this study was sourced. In the alternative, the processes involved in preparing the cassava flour which involved ensiling the root chips, drying and eventual grinding, may have caused significant reduction in the cyanide contents of the final product to a level below 100 ppm within which intoxication is unlikely (Hahn *et al.*, 1987). The voracious appetite exhibited by all the dietary groups also attests to the low cyanide content of the diets. Iyayi and Oduesu (2003) had demonstrated that in rabbits, the presence of cyanide above the threshold for intoxication caused depressed dry matter and daily water intake. Earlier, Tewe (1982; 1984) had shown that high cyanide levels and microbial contaminations cause reduced performance and changes in the haematology of grower pigs fed on sun dried cassava based rations. Thus, the loss / depressed appetite reported by Maust *et al.* (1969; 1972) for grower pigs fed 36% cassava replaced cereal diet does not support our observation in this study. The differences in results may have been due to the nature of the cassava cultivar that produced the cassava flour used for the diet formulation, the method of processing and level of microbial contamination.

Maust *et al.* (1969; 1972) had further reported that in addition to depressed appetite and reduced rate of weight gain that their animals developed parakeratosis. There was no indication of parakeratosis among studied animals in this investigation. However, field observation in our environment where the use of cassava peel as a major component of weaner pig ration is common, indicated that parakeratosis was a common condition among piglets/grower constantly fed high cassava peel containing diets. As no case of parakeratosis was observed in this study, we postulate that the anti-zinc factors may be contained in the peel and not in the fermented sun dried cassava flour. Moreover, the live-weight benefit of 25% cassava flour inclusion also translated to earlier maturity as demonstrated by the mature sperm cells within the lumen of the seminiferous tubules of B and group A that received maize only as source of energy.

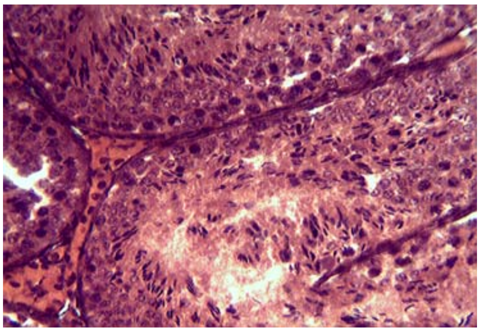

Figure 1: Testicular histology of groups A and B pigs with fully mature spermatozoa within the lumen of the seminiferous tubules

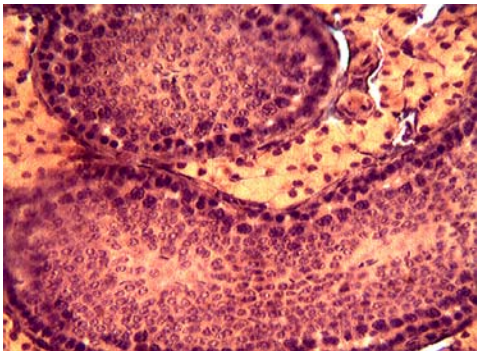

Figure 2: Testicular histology of groups C and D pigs with immature sperm cells within the lumen of the seminiferous tubules

This study also showed that despite the variations in the cassava content of the various diets, there was a relative adequacy of protein in all the diets. This is not withstanding the very poor protein content of cassava meal which is 2 – 4% (Gomez, 1977). As the source and quality of dietary protein was common among the various dietary groups, maintenance of adequate dietary protein levels among the experimental diets as the proportion of cassava increased may have utilized the relatively medium protein content of the PKC (Imasuen *et al.,* 2003). Thus, we postulate that the source and nature of other ingredients used in formulating swine diets especially where cassava is replacing cereal as source of energy is important in balancing the dietary protein levels.

The superior effect of carbohydrate source diversification over cereal as a sole source of energy was demonstrated by members of group B. This was manifested in higher live weight gain, testicular developments and onset of pubertal manifestation relative to groups with maize or cassava alone as source of carbohydrate. Testicular growth was apparently greater among members of group B, and they also first showed signs of attainment of puberty. This agreed with the observation of Hurtgen (1980) that in swine, the attainment of puberty is related to the level of energy intake in both sexes. Thus, the superior energy contents of the cassava\maize mixture in groups B enabled a better performance than members of group A.

At this level of cassava inclusion, there appears to be minimal interference by anti-nutritional factors as high fibre content in the utilization of the dietary ingredients. Furthermore, the superior performance due to cassava inclusion has started to wane at 75% level of replacement. Thus, with increasing level of cassava especially in group D with cassava completely replacing cereal, the earlier superior performance due to cassava inclusions did not only disappear but significant poor performance was observed among the members of the group. This poor performance may be due to the higher fibre content of this diet relative to the other groups, due to the increasing proportion of cassava in the diet. As reported by Muller *et al.* (1974), cassava root meal has high fibre content and its use in livestock feed generally decreases the digestibility of the feed ingredients. They demonstrated that cassava root meal with more than 4% fibre is not suitable as a total substitute for cereals in high energy diets. Thus, the relative low performance of the members of group C (poor live weight gain, diminished testicular development to late attainment of puberty) may have been due to the high dietary fibre content of the diet. However, our findings disagreed with their report on the level of replacement that could cause either toxicity or depressed performance.

In conclusion, this study has demonstrated again the obvious advantages in replacing maize with cassava root meal at 25% level in the diet of grower pigs. Moreover, the use of PKC (CP 18) as part of the ingredient may have helped in maintaining an acceptable protein economy which the increasing level of cassava may have depressed. Furthermore, the study also lends credence to our local method of cassava processing which reduces the cyanide level as well as anti zinc factor in the final product. Finally, toxicity or growth suppression as earlier ascribed to cassava meal as a whole diet or component of livestock diet may not be exactly as earlier believed.

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