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Performance of Weaner Pigs Placed on Composite Cassava Meal Based Diets

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Abstract

A total of twenty four (24) crossbred (Landrace ×Large white) weaned pigs of average weight 12.26 ± 0.54kg were randomly assigned to four (4) treatment diets in a Completely Randomized Design (CRD), with six pigs per treatment and each replicated three times with two animals per replicate. Four diets were formulated with Diet 1 (control) being maize-based, while in diet 2-4 composite cassava meal replaced 50% of maize; diet 2 containing 27% cassava root meal (CRM) and 3% cassava foliage meal (CFM)), diet 3 (24% cassava root meal and 6% cassava foliage meal), and diet 4 (21% cassava root meal and 9% cassava foliage meal). The diets and the cassava products (CRM and CFM) were chemically analyzed. Data were collected on weight gain, feed intake, feed conversion ratio, carcass yield, and cost benefit calculated. Crude fibre and crude protein were higher in diets 3 and 4, and ether extract content higher in CFM than in CRM. Pigs fed the control diets (1) consumed more feed/day (1.3kg) than those on diets 2, 3 and 4 (1.28, 1.28 and 1.23kg), dressing percentage were similar ($p>0.05$) in the pigs fed diets 1 and 4, (59.67 and 59.59%) respectively. Abdominal fat was higher ($p<0.05$) in pigs fed diet 1 and 2 than those on diet 3 and diet4. Back fat was higher ($p<0.05$) in the pigs fed diet 1 than those on diets 2-4. Cost/kg feed and cost/kg weight gain were ($p<0.05$) lower with higher CFM in diets. Diet 4 also recorded higher gross margin. Feeding pigs with cassava products (CRM and CFM) at ratio 2.33 to 1 is therefore recommended as an economical option that can replace 50% maize in weaned pig's diets.

Keywords: weight gain, feed intake, feed conversion ratio, carcass yield, cost benefit

Introduction

With reference to the hike in price of some feed stuffs like cereals in this harsh economic recession, there is need to focus attention on alternative feed stuff which could either directly substitute cereals or could be included at certain levels to attain a comparable production quality with the conventional cereals without deleterious effect on the animal health (Muller *et al*., 1974). Nigeria is the largest producer of cassava in the world. Cassava is produced largely in the tropical region. It seemingly appears to be the very best alternative for conquering these high costs of feed in the livestock industry (Ukachukwu, 2008). Recently, emphasis has been placed on the expanded program of cassava and other tuber crops, and many high yielding varieties of cassava has been developed and released through the collaborative and improvement efforts of National Root Crops Research Institute (NRCRI) Umudike, International Institute of Tropical Agriculture (IITA) Ibadan and other collaborating institutions. This implies that the excess production will be directed to human consumption and enough will be available for feeding livestock in Nigeria.

Tewe and Bokanga (2001), reported that the cost of production of cassava is about 40% lower than maize in Nigeria. However, the use of increasing levels of cassava root meal products for swine creates a problem in diet formulation, since the roots are very poor in nitrogen (Buitrago, 1990; Ly, 1998) and therefore, very little protein can be derived from this feed source. This opens up the possibility of including foliages and tender stems of cassava rich in protein in diets containing increased amount of cassava roots (Garbati *et al*., 2001). These cassava materials have been successfully used in pig feeding (Rajaguru *et al*., 1979; Trompiz *et al*., 2000). Cassava leaf yields as much as 4.60 tones dry matter per hectare and may be produced as a by-product at root harvest (Ravindran and Rajaguru, 1988).

Materials and Methods

Location of experiment

This research was carried out at the piggery unit of the Teaching and Research farm of Michael Okpara University of Agriculture Umudike (MOUAU), Abia State. Umudike is located on latitude 5°27' North and longitude 7°32' East, with an altitude of 123m above sea level, an annual rainfall of 2177 mm and temperature of 22°C-36°C and relative humidity above 50% (NRCRI, 2017).

Source and preparation of test ingredients

Fresh cassava roots from a sweet variety of cassava (TMS-419 variety) were harvested from NRCRI experimental site. The roots were washed to remove soil attached to it. The roots with its peel or back were processed into chips, using a chipping machine. The chips were then pressed using a hydrolic-press (this is done to remove the excess water in the chips to enable it dry quicker). The chips were then spread out on a black polyethylene sheets and sun-dried for 7 days, and it was turned twice daily at a regular interval to prevent fermentation until it was properly dried. Sun drying is carried out as both dehydration method and for removal of the anti-nutritional factors (hydro-cyanide acid) in the cassava. Fresh cassava leaves with the tender stem was collected from freshly harvested sweet variety (TMS-419). The leaves and the tender stem were sun dried for 7 days until properly dried. It was then crushed in a mill to reduce the size for proper mixing.

Preparation of experimental diets

Four experimental diets were formulated, with the control (diet 1) containing none of the test ingredients, while groups 2-4 (diets 2-4) had different ratios of cassava root meal to cassava foliage meal replacing 50% of the maize in the control diet. The varying ratios of cassava root meal and cassava foliage meal in the diet 2 to diet 4 were made by combining 90% of cassava root meal with 10% of cassava foliage meal (2), 80% of cassava root meal with 20% of cassava foliage meal (3) and 70% of cassava root meal with 30 % of cassava foliage meal(4), respectively

Experimental animals and management

A total of 24 crossbred weaner pigs bought from Royal Farms in Agbama Olokoro (Umuahia South L.G.A.) and quarantined in the University Teaching and Research Farm for twenty one (21) days were used for the study. The pigs were housed in an open-sided pig house roofed with asbestos roofing sheet. The open sides of the building were covered with expanded metal iron net to prevent flies and other insects from entering. Each pen measured 2m×7m. The pens had a dwarf wall each of 120cm high, separating each other on a concrete floor. Each of the pen had a feeder, watering trough and a wallow, all made of concrete. Two weeks before the commencement of the trial, the pens were washed, disinfected and fumigated with formalin. The pigs were fed with formulated diet while on quarantine to get them acquainted with the diets. Within these period, broad spectrum antibiotics, multivitamins and de-worming drugs were administered to keep the animal fit for the trail. The pigs were divided into 4 groups, with 6 pigs per treatment and three replicates of two weaner pigs per replicate. The treatment groups were assigned to the diets designated 1 (control), 2, 3 and 4, respectively. Feeding was done twice daily at 8.00hrs and 16.00hrs, and pigs fed at 6% of their body weight. Clean water was supplied *ad-libitum* throughout the trail, which lasted for 12 weeks.

Experimental Design and Statistical Analyses

Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) as described by Steel and Torrie (1980), while differences between means were separated using Duncan multiple range test with (SAS, 1999).

Data Collection

Feed intake was taken as the difference between the feed supplied and left over for each animal per day. The pigs were weighed at the beginning of the study and thereafter on a weekly basis and weight gain for each animal per week was calculated as the difference between the initial weight and the final weight. The daily weight gain was obtained by dividing the total weight gain by the number of study days. Feed to gain ratio was calculated as the total feed intake divided by the total weight gain for each animal. Feed cost per kg weight gain was calculated by multiplying cost/kg of feed by the feed to gain ratio. At the end of the experiment, pigs were tagged, starved for 24 hours but were only given drinking water to avoid feed wastage, since the animals were to be slaughtered and to clear their gut content of undigested feed. They were weighed before slaughtering. Subsequent weights were taken after slaughter and dressing. Slaughtering was done by stunning with a stunning stick, severing with sharp knife from the neck and bled completely by hanging from the hind limbs up and held down. The pigs were scalded by pouring hot water (60°C) on the entire skin and hairs easily removed by scratching with knife. The dressed weight which is the weight of pigs after the removal of bristles, head, internal organs, trotters, abdominal fat and gut content were expressed as a percentage of live weight, while weight of different carcass parts were expressed as percentage of dressed carcass weight. The pig carcass was cut according to Serres (1992). Back fat thickness was measured at the 1st and forth ribs with venier calipers. Joint meat cut was also done according to Serres (1992). Each dressed warm carcass was divided along the spinal column by means of a sharp knife. Each half was weighed; the left half was subsequently divided into various cut. Meat cuts were expressed as percentage of the dressed weight.

Analytical Procedure

The proximate composition of the test ingredients and experimental diets were carried out using AOAC (2000) procedure. Dry matter was determined by oven drying at about 80°C to 100°C, till a constant weight was achieved.

Crude protein determination was by micro kjeldahl method and fat by soxhlet fat extraction method.

Results and Discussion

Performance parameters of weaner pigs fed different dietary ratio of cassava composite meal

The growth performance of pigs fed the different dietary ratio of Cassava Composite Meal is shown in Table 3. The result indicated significant ($p<0.05$) difference in the daily feed intake. The daily feed intake shows that the pigs fed the control diet were similar ($P>0.05$) with those fed diets 2 and 3 but significantly ($p<0.05$) higher than those on diet 4. The lower daily feed intake obtained from diet 4 (7:3 ratio of cassava root meal to cassava foliage meal) could be attributed to high hydro-cyanic acid of the diet as well as its less palatability resulting from increase in the quantity of foliage meal (Ly *et al*., 1998). Particles of the CFM were usually left uneaten, and were weighed as left over in the next morning. This is in agreement with Mahendranathan (1971) and Ravindran *et al* (1983). It was also observed that as the ratio of the CFM increased in the diet, the feed intake reduced. Similar observations were also made by Phuc *et al.* (1996). There was no significant ($p>0.05$) difference among treatment means in final weight, weight gain, daily weight gain and feed to gain ratio. Akinfala and Tewe (2001) who fed whole cassava plant obtained a similar result. The similarities observed in these parameters could be attributed to proper utilization of nutrients by pigs on all the diets.

Carcass yield of pigs fed varying dietary ratio of cassava composite meal

Table 4 shows the carcass characteristics of pigs fed varying dietary ratio of Cassava Composite Meal. Most of the carcass parameters considered did not show any significant difference except for dressed weight, abdominal fat and back fat thickness. The highest dressing percentage was observed in diet 1 (59.67%) which was statistically similar to T4 (59.59%), but they are significantly ($p<0.05$) higher than 2 (55.31%) and diet 3 (56.77%). This high dressing percentage in diet 4 may be an indication of optimum utilization of the dietary nutrients in the production of carcass. This shows that the ratio of 70:30 of CRM to CFM (T4). T4 promoted carcass yield in weaner pigs. The low dressing percentage in diets, 2 and 3 might be attributed to the decline in crude protein content of the diets, which increased as the level of CFM was increased in the diet. The abdominal fat values of the pigs show that as the level of CFM increased in the diet of the pigs, the abdominal fat reduced. This might suggest that higher level of CFM led to reduction in energy density of feed, hence reduced fat deposit in the animal. It could also be due to higher crude fiber content of the foliage (10.50), which may have reduced the digestible energy content of the diet (Kennelly and Aherne, 1980). The pigs may therefore have had less energy available for storage when compared with the pigs fed the control diet. The back fat thickness also showed a similar trend as the abdominal fat and this might also be attributed to the fact that as the CFM increased and CRM reduced digestible energy also reduced, and the pigs had less energy available for storage in the form of fat. All the other carcass parameters such as live weight, carcass length, ham weight, shoulder weight, head weight, loin weight and bone-to-lean ratio showed no significant ($p>0.05$) differences. Jimenez *et al*. (2005) who fed cassava root and mixed foliage meal of cassava and *trichantera* leaves did not observe any significant difference in all carcass parameters analyzed. This may be an indication that the pigs in all the treatments optimally utilized the nutrients contained in the diets.

Cost benefits of pigs fed varying dietary ratio of cassava composite meal

Table 5 shows the cost benefit analyses of pigs fed varying dietary ratio of Cassava Composite Meal. It was observed that the cost/kg feed showed reduction as the ratio of CRM to CFM varied. This could be due to the relatively low cost of CRM and CFM. Results obtained in cost/kg weight gain indicated that, diet 1 with 0% CRM to CFM inclusion was higher than diet 2 (9:1), diet 3 (4:1) and diet 4 (2.33:1) respectively. Diet 4 was the cheapest in cost/kg weight gain with #368.28 as opposed to other treatments diet 1 (N461.11), diet 2 (N391.19) and diet 3 (N392.13). There also was an increase in the gross margin (financial benefits) due to the feeding of different ratios of CRM to CFM to pigs, as against the control diet. Diet 4 containing CRM and CFM at the ratio of 2.33:1 had the highest financial benefits. While the feeding of 0% CRM to CFM ratio resulted to lowest financial benefits than the feeding of CRM and CFM diets.

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Table 1: Composition of Concentrate diet containing different ratio of cassava composite meal fed to weaner pigs

Ingredients	Diet 1 (0)	Diet 2 (90:10)	Diet 3 (80:20)	Diet 4 (70:30)
Maize	60	30	30	30
CRM	-	27	24	21
CFM	-	3	6	9
Blood meal	7.0	7.0	70	7.0
Soya bean cake	13	13	13	13
PKC	17.1	17.1	17.1	171
Bone meal	2.1	2.1	2.1	2.1
Salt	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30
	100	100	100	100
Calculated composition				
Crude protein	17.83	17.05	17.63	18.21
ME(Kcal/kg)	3056.05	2925.85	2865.85	2805.85
Crude fibre (%)	5.28	7.01	7.38	7.75
Energy protein ratio	116.270	165.209	157.291	149.805

Premix supplied per kg diet 4,000,000 I.U Vit.A, 800,000 I.U Vit. D3, 12,000 I.U Vit E, 0.80g Vit K, 0.60g Vit B1, 2.0g Vit B2, 1.40g pantothenic acid, 20.00mg biotin, 0.40g folic acid, 120.0g cholinechloride, 8.0g zinc bacitracin, 40.0g manganese, 20.0g iron, 18.0g zinc, 0.80g copper, 0.60g iodine, 0.09g cobalt, 0.04g selenium, 36.0g lasalocid (Avate c). CRM= cassava root meal. CFM= cassava foliage meal

Table 2: Proximate composition of the experimental diet, cassava root and foliage meals

	Diet 1 (0:0)	Diet 2 (90:10)	Diet 3 (80:20)	Diet 4 (70:30)	CRM (root meal)	CFM (foliage meal)
Dry matter (%)	87.30	89.84	91.27	90.92	89.16	92.30
Crude fibre (%)	7.60	7.40	8.80	9.00	8.90	10.50
Crude protein (%)	18.38	17.71	18.22	18.73	3.06	20.13
Ether extract (%)	3.27	8.29	7.81	8.10	3.00	5.68
Ash (%)	9.28	10.00	10.21	10.00	6.30	8.00
NFE (%)	48.77	46.44	46.23	45.09	67.90	47.99

CRM – Cassava Root Meal. CFM – Cassava Foliage Meal

Table 3: Growth parameters of pigs fed different Dietary Ratio of Cassava Composite Meal

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Initial weight(kg)	12.43	12.63	12.26	12.80	1.76
Final weight(kg)	45.68	45.30	44.18	45.43	7.26
Daily weight gain(kg)	0.40	0.38	0.38	0.38	0.07
Daily feed intake(kg)	1.31[a]	1.28[ab]	1.28[ab]	1.23[b]	0.02
Feed to gain ratio	3.28	3.37	3.37	3.24	0.66

[a,b] ***Means along the same row with different superscripts are significantly (p<0.05) different. SEM= standard error of mean***

Table 4: Effects Varying Dietary Ratio of Cassava Composite Meal on the carcass yield of pigs

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Slaughter Weight (kg)	19.71	18.01	19.61	18.13	1.53
Dressed weight (%)	59.67[a]	55.31[b]	56.77[b]	59.59[a]	1.06
Carcass length (cm)	60.76	60.00	64.33	63.30	2.06
Abdominal fat (%)	1.80[a]	1.76[a]	1.50[ab]	1.04[b]	0.25
Ham weight (%)	14.61	14.60	14.07	12.95	1.40
Shoulder weight (%)	19.68	18.03	20.25	17.64	1.83
Head weight (%)	9.67	10.02	9.04	10.92	0.85
Back fat thickness (mm)	15.20[a]	12.23[b]	9.56[c]	1.86[d]	0.83
Loin weight (%)	8.36	9.28	8.24	10.04	1.54
Bone to lean ratio	0.17	0.22	0.26	0.26	0.39

[a,b,c,d] ***Means within the same row with different superscripts are significantly (p<0.05) different. SEM= standard error of mean***

Table 5: Cost-benefits of pigs fed different Dietary Ratio Of Cassava Composite Meal

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Cost/kg feed (₦)	138.25[a]	116.54[b]	115.73[c]	114.92[d]	0.17
Total feed consumed (kg)	110.40[a]	108.33[ab]	107.13[ab]	103.60[b]	1.97
Cost/kgweight gain (₦)	461.11[a]	391.19[ab]	392.13[ab]	368.28[b]	36.15
Cost of production (₦)	15314.98	12836.60	12382.45	11810	2162.99
Revenue (₦)	36626.66	36120.00	35346.66	3634.66	5762.86
Gross margin (₦)	21311.68	23283.39	22964.21	24535.97	4366.21

[a,b] ***Means along the same row with different superscripts are significantly (p<0.05) different. SEM= standard error of mean***