THE EFFECT OF FEEDING GRADED LEVELS OF PALM KERNEL MEAL DIETS ON PERFORMANCE, CARCASS QUALITY AND ORGAN CHARACTERISTICS OF PIGS MAINTAINED IN THE HUMID TROPICS.

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ABSTRACT

A total of 24 pigs were used to evaluate the performance, cost benefit, carcass quality and organ characteristics of pigs fed graded levels of palm kernel meal (PKM) diets in the humid tropics. There were 0, 30, 35 and 40% PKM in diets T1, T2, T3 and T4, respectively, replacing part of maize in diets. The experiments were in a completely randomized design (CRD) with each treatment replicated three times. Parameters measured were live weight, weight gain, feed and protein intake, feed conversion ratio (FCR) and protein efficiency ratio (PER). Others were feed cost, feed cost of weight gain, gross margin, warm dressed weight, cut parts and organ weights. Results showed that PKM diets significantly ($P<0.05$) increased FCR (3.52, 3.73 and 3.68 for 30, 35 and 40% PKM diets, respectively), feed and protein intake at the weaner stage and significantly ($P<0.05$) reduced live weight (36.92, 37.67 and 36.08 kg for pigs fed 30, 35 and 40% PKM diets, respectively), total feed cost and affected the back fat thickness (1.67, 1.50, 1.73 and 0.43 cm for pigs fed 0, 30, 35 and 40% PKM diets, respectively), percentage of head (average 19.60%) and kidney (average 0.40%) without regular pattern at the grower stage. It was concluded that diet containing 40% PKM could be fed to weaner pigs to reduce feed cost in comparison to the control, while at the grower stage; PKM should not exceed 35% of the whole diet when total feed cost is of higher interest to the pig farmer. Warm dressed weight and organ characteristics would not be affected by any of the PKM diets.

Keywords: Palm kernel meal, pigs, performance, carcass quality.

INTRODUCTION

Palm kernel meal (PKM) is obtained after oil extraction (either solvent or hydraulic press) from palm kernel seeds. The extraction method used affects the level of residual oil left after extraction, proximate composition and quality of the PKM. It is readily available and cheap, containing 14 – 21% crude protein and 10 – 20% crude fibre (Fetuga et al., 1977; Onwudike, 1986; Olomu, 1995). PKM has been reported to be fibrous, dry and gritty (Olomu, 1995). It is a good source of methionine and cystine but marginal in lysine (Fetuga et al., 1973). Fetuga et al. (1977) reported a moderate level of methionine in PKM while on the contrary, McDonald et al. (1995) pointed out that methionine is the first limiting amino acid in PKM. This is supported by Olomu (1995), who reported that PKM has low content of lysine, methionine, histidine and threonine.

PKM depressed feed intake and live weight gain of finisher pigs when included up to 32% DM of the diet (Babatunde et al., 1975) and similarly at 18.80 – 46.50% of the entire diet (Fetuga et al., 1977). Jegede et al. (1994) reported that final weight of pigs decreased linearly as the level of PKM increased in a diet from 20.55 to 61.65% with no significant effect on dressing percentage and other carcass characteristics. Organ weights were not also affected except the liver, which increased linearly in weight. Olomu (1995) recommended an inclusion level of 10 – 20% PKM in pig diets while Ekenyem (2002) did not observe any significant difference in feed intake, weight gain, feed efficiency and cost benefit among pigs fed 20, 30, 40 and 50% PKM diets.

Considering that PKM may have undergone changes in proximate and nutrient composition with time due to changes in seed variety and methods of processing, the objective of this study was to evaluate the performance, cost benefit, carcass quality and organ characteristics of pigs fed graded levels of palm kernel meal diets.

MATERIALS AND METHODS

This study was conducted at the Teaching and Research Piggery Farm of Michael Okpara University of Agriculture, (05° 29' N, 07° 33' E) Umudike, Abia State, Nigeria. The pigs were purchased from a piggery farm located in Umudike while the feedstuffs were supplied by a local dealer at Umuahia.

Experimental Pigs

Twenty-four hybrid (Landrace x Large White), mixed sex weaner pigs were used in this experiment. They were 56 days old, with an average initial live weight of 7.50 kg. Each pig had an ear notch for proper identification. There were six weaner pigs per treatment, with each treatment having three replications of two (male and female) pigs per replicate.

Experimental Diets

There were four treatment diets (Table 1) formulated with PKM included at 0, 30, 35 and 40% level in diets T1, T2, T3 and T4, respectively. PKM replaced part of maize in the diets while the main source of plant protein was soybean meal. The PKM used in this study was from a plant that uses hydraulic press method for oil extraction and bought from a local supplier in Umuahia, Abia State, Nigeria.

Housing and Management of the Pigs

The pigs were housed in a tropical-type, open-sided pig house roofed with asbestos roofing sheets. The open sides of the building were covered with expanded metal and iron net to screen out flies and other insects. Each pen, which housed two pigs of a replicate, measured 2 m x 7 m. The pens had a dwarf wall of 120 cm separating one from the other and concrete floors. Each pen had a wallow, feed and water troughs, all made of concrete, and a dunging area. The pigs were fed twice daily, in the morning (8.00 – 8.30 am) and afternoon (2.00 – 2.30 pm). Water was provided both in the wallow and in the water troughs for drinking ad libitum.

Experimental Design and Data Collection Performance

The experimental design was completely randomized design (CRD). The pigs were weighed at the start of the experiment and subsequently on a weekly basis. Growth performance and cost-benefit were evaluated at the weaner and grower stages, while carcass quality and organ characteristics were assessed at the end of the experiment. Weight gain was obtained as final live weight minus initial live weight. Feed conversion ratio (FCR) was calculated as feed intake divided by weight gain. Feed intake was obtained as the difference between the quantity offered and quantity left over (not consumed).

Table 1: Percentage Composition of Diets containing graded levels of PKM fed to pigs.

Feedstuffs	T1 (Control)	T 2	T 3	T4
White maize	35.00	25.00	20.00	15.00
Soybean meal	20.00	10.00	10.00	10.00
Local fish meal	1.00	1.00	1.00	1.00
Palm kernel meal (PKM)	0.00	30.00	35.00	40.00
Maize offal	20.00	20.00	20.00	20.00
Wheat offal	20.00	10.00	10.00	10.00
Bone meal	3.50	3.50	3.50	3.50
Vitamin Premix*	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total (%)	**100**	**100**	**100**	**100**
Calculated:				
CP (%)	19.90	19.70	20.30	20.90
ME (MJ/kg)	11.56	8.86	8.99	9.12
CF (%)	5.88	8.18	8.53	8.88
Lysine (%)	1.15	1.33	1.31	1.28
Methionine (%)	0.33	0.35	0.36	0.37
Ca (%)	1.57	1.61	1.62	1.63
Avail. P (%)	0.87	0.94	0.93	0.91

*Contains per kg: Vit. A, 10000 IU; Vit. B, 2000 IU;Vit. E, 13000 IU; Vit.K, 1500 IU; Vit.B12, 10 mg; Riboflavin, 5000 mg; Pyridoxine, 1300 mg; Panthotheinc acid,8000 mg; Nicotinic acid, 2800 mg; Folic acid,500 mg; Biotin, 40 mg; Copper,7.00 mg Manganese,48000 mg; Iron, 5800 mg; Zinc,58000 mg; Selenium,120 mg; Iodine,60 mg Cobalt,300 mg Choline,275,000 mg.

Cost-Benefit

The cost per kg of the diet was calculated by multiplying the percentage composition of the feedstuffs with the price per kg and summing all. Total feed intake multiplied by cost per kg feed gave total feed cost. Feed cost per kg weight gain was calculated as FCR x cost per kg of diet. Total feed cost was assumed to be 80% of total cost of production (Akinfala and Tewe, 2002). Gross margin was calculated as price per kg pork minus total cost of producing 1 kg of pork.

Carcass Quality Evaluation

One male pig per replicate was selected at the end of the experiment and slaughtered to evaluate the carcass quality. Prior to slaughter, the pigs were fasted for 16 hours but given drinking water. They were stunned and bled completely. Water was poured on the entire skin and the hairs removed with a surgical blade. The head, trotters, tail, intestinal contents and organs were removed. The remaining carcass was weighed to obtain the warm dressed weight and dressing-out percentage, while the ham, shoulder, rib cage region and other cut-up parts were weighed and expressed as a percentage of the dressed weight. The fresh organs were also weighed using a sensitive top-loading balance (Mettler, 0.01) and expressed as a percentage of the carcass weight. Abdominal fat was measured at the abdominal underlay and back fat thickness at the 1st and 4th ribs with Venier calipers. The carcass length was measured from the anterior edge of first rib to anterior edge of aitch bone.

Chemical and Data Analyses

Experimental diets and PKM were analyzed for proximate composition according to methods of A. O. A. C. (1990). Data on growth, live weight, and carcass quality and organ characteristics were subjected to analysis of variance (ANOVA) for completely randomized design. The values in percentages were subjected to Arcsine transformation before ANOVA while differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955). All other statistical procedures were as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Weaner Stage

The performance of weaner pigs fed graded levels of PKM diets is presented in Table 3. There were no significant differences (P>0.05) between the weaner pigs fed 30, 35 and 40% PKM and the control diets in final live weight (at 20th week of age) and daily weight gain. However, PKM inclusion in the diets significantly (P<0.05) increased daily feed intake and feed conversion ratio (FCR) of the weaner pigs over the control diet. This may have been due to the higher crude fibre (Table 2) level of the PKM diets, which Agricultural Research Council (1981) and Low (1985) had reported to cause increase in feed intake. While the diets were adequate in lysine and methionine (National Research Council (NRC), 1998), the energy contents of the PKM diets (Table 1) were lower than the NRC (1998) recommended levels, which may have also contributed to the higher intake of the diets (Agricultural Research Council, 1981; Chiba *et al*., 1991) and general poor performance of the pigs.

Cost Benefit

The feeding of different levels of PKM to weaner pigs did not result in significant differences (P>0.05) in all the cost-benefit parameters measured (Table 4). However, the control diet gave the highest (numerical) cost per kg feed, daily feed cost and cost per kg live weight gain than PKM diets. It was observed that despite the non-significant differences (P>0.05) in cost-benefit as a result of feeding graded levels of PKM to weaner pigs, PKM diets generally reduced the cost of feeding the pigs and consequently increased the gross margin (Tables 4, 6). This could be of much interest to a pig farmer whose aim is to reduce feed cost and increase profit. This could be better achieved with the 30% PKM diet.

At the grower stage, there were steady significant increases (P<0.05) in daily feed costs with increase in the level of PKM in the diets (Table 6). The control diet gave significantly higher (P<0.05) feed cost than the PKM diets.

This may have been due to the differences in the daily feed intake (Table 5) of the pigs. There were no significant differences (P>0.05) between the PKM and control diets in cost per kg feed and cost per kg weight gain.

Table 2: Proximate composition of PKM and diets containing graded levels of PKM (% DM Basis).

	Diets (%)				
Composition	**0**	**30**	**35**	**40**	**PKM**
Dry matter (%)	91.00	90.72	90.88	89.65	89.70
Crude protein (%)	20.10	20.35	20.68	21.30	20.53
Ether extract (%)	4.35	5.87	6.15	6.40	6.15
Crude fibre (%)	6.50	8.46	8.80	9.50	16.25
Crude ash (%)	6.00	8.50	8.70	8.85	4.30
Nitrogen free extract (%)	54.05	47.54	46.55	43.60	42.47

PKM = Palm kernel meal

Table 3: Growth performance of weaner pigs fed graded levels of PKM diets.

	Diets (%)				
Parameters	**0**	**30**	**35**	**40**	**SEM**
Initial live weight (kg/pig)	8.13	7.50	8.30	7.53	0.24
Final live weight (kg/pig)	22.67	20.00	20.25	19.50	1.45
Daily weight gain (g)	173.02	148.81	142.26	142.46	17.60
Daily feed intake (g)	400.67^{b}	521.82^{a}	526.11^{a}	524.17^{a}	11.81
FCR	2.48^{b}	3.52^{a}	3.73^{a}	3.68^{a}	0.28
Daily Protein intake (g)	79.74^{b}	102.80^{a}	106.80^{a}	109.55^{a}	2.35
PER	2.16	1.45	1.33	1.30	0.19

a, b Means in a row with different superscripts are significantly different ($P<0.05$).
SEM = Standard Error of Mean.

Table 4: The cost-benefit of feeding graded levels of PKM diets to weaner pigs.

	Diets (%)				
Cost	**0**	**30**	**35**	**40**	**SEM**
Cost per kg feed (₦)	33.27	22.57	24.17	25.77	-
Total feed cost (₦)	1119.76	989.32	1068.15	1134.65	32.85
Daily feed cost (₦)	13.33	11.78	12.72	13.51	0.39
Cost per kg weight gain (₦)	82.56	79.39	90.16	94.86	8.64
Total cost of Production (₦)	103.20	99.23	112.70	118.57	10.79
Price per kg Pork (₦)	250 250	250	250	-	
Gross margin (₦)	146.80	150.77	137.30	131.43	10.79

SEM = Standard Error of Mean. ₦130.00 = $1.00

Grower Stage

The continued feeding of the PKM diets to the pigs at the grower stage up to 9th month of age resulted in significant differences (P<0.05) only in daily feed intake of the pigs. There was significantly higher (P<0.05) intake of the PKM diets by the grower pigs than the control diet.

Table 5: Growth performance of grower pigs fed graded levels of PKM diets.

	Diets (%)				
Parameters	**0**	**30**	**35**	**40**	**SEM**
Initial live weight (kg/pig)	22.67	20.00	20.08	19.50	1.44
Final live weight (kg/pig)	41.58^{a}	36.92^{b}	37.67^{b}	36.08^{b}	1.19
Daily weight gain (g)	168.90	151.04	155.51	148.07	17.10
Daily feed intake (g)	548.75^{b}	596.43^{a}	599.11^{a}	599.11^{a}	5.05
FCR	3.60	3.95	3.89 4.0	6 0.48	-
Daily Protein intake (g)	109.20^{d}	117.49^{c}	121.62^{b}	125.21^{a}	1.00
PER	1.56	1.29	1.28	1.18	0.16

a, b, c, d = Means in a row with different superscripts are significantly different (P<0.05).
SEM = Standard Error of Mean.

This had earlier been attributed to the increased crude fibre content of the diets and lower energy density compared to the control diet, which did not meet recommended levels (NRC, 1998). At the same time, there were no significant differences (P>0.05) among pigs fed 30, 35 and 40% PKM diets in feed intake and other growth parameters measured (Table 5).

Table 6: The cost-benefit of feeding graded levels of PKM diets to grower pigs

	Diets (%)				
Cost	**0**	**30**	**35**	**40**	**SEM**
Cost per kg feed (₦)	33.27	22.57	24.17	25.77	-
Total feed intake (kg)	61.46^{b}	66.80^{a}	67.10^{a}	67.10^{a}	0.56
Total weight gain (kg)	18.92	16.92	17.42	16.58	1.90
Total feed cost (₦)	2044.77^{a}	1507.68^{d}	1621.81^{c}	1729.17^{b}	18.45
Daily feed cost (₦)	18.25^{a}	13.46^{d}	14.48^{c}	15.44^{b}	0.17
Cost per kg weight gain (₦)	119.60	89.15	93.93	104.52	15.56
Total cost of Production (₦)	149.50	111.45	117.41	130.65	19.46
Price per kg Pork (₦)	250.00	250.00	250.00	250.00	-
Gross margin (₦)	100.50	138.55	132.91	119.35	19.46

a, b, c, d = Means in a row with different superscripts are significantly different (P<0.05).
SEM = Standard Error of Mean. ₦130.00 = $1.00

These results are contrary to earlier reports that PKM diets depress feed intake, weight gain and final live weight of pigs (Babatunde et al., 1975; Fetuga et al., 1977; Jegede et al., 1994). Ekenyem (2002) had also stated that there was no effect in feed intake and weight gain when pigs were fed up to 50% PKM diet. Our results could be attributed to differences in the variety of palm kernels, which may have changed over time, and processing method of the palm kernels to obtain the PKM. The general poor growth performance of pigs used in this study compared those in the temperate and other environments could, apart from diet, be attributed to poor genetic potentials for growth and loss of hybrid vigor.

Carcass Quality and Organ Characteristics

Pigs fed PKM and control diets did not significantly (P>0.05) differ in percent dressed weight, ham and trotters (Table 7) despite the significant differences observed in the final live weight of the pigs. This suggests that the meat yield as a result of feeding mainly PKM diets to grower pigs could not affect entire carcass composition. However, the significant increase in the proportion of the head (% head) to the dressed carcass weight could be due to individual differences among the pigs. The significant decrease (P<0.05) in the back fat thickness of pigs fed 40% PKM diet could be attributed to the higher crude fibre content (Table 1), which may have reduced the DE content of the diet (Kennelly and Aherne, 1980). The pigs may have therefore had less energy available for storage compared to the pigs fed other diets. It implies more lean meat production and less fat production from feeding of PKM to pigs. Generally, the results obtained in this study are in line with those of Obioha and Anikwe (1982) who fed ensiled and sun dried cassava peels.

Table 7: Carcass quality and organ characteristics of pigs fed graded levels of PKM diets.

	Diets				
Parameters	**0**	**30**	**35**	**40**	**SEM**
Dressed Weight (%)	56.62	60.74	61.59	62.16	1.32
Ham (%)	41.29	37.13	39.47	36.38	0.97
Shoulder (%)	41.86	37.56	39.54	37.56	0.33
Loin (%)	7.53	7.44	7.26	7.69	0.57
Rib cage region (%)	20.64	20.47	20.02	20.51	0.88
Head (%)	22.01[a]	18.73[b]	20.20[ab]	19.86[ab]	0.62
Tail (%)	0.40	0.51	0.56	0.59	0.39
Trotters (%)	6.04	5.70	5.13	5.61	0.37
Back fat thickness (cm)	1.67[a]	1.50[a]	1.73[a]	0.43[b]	0.23
Abdominal fat thickness (cm)	0.27	0.41	0.40	0.07	0.11
Liver (%)	4.76	4.21	3.57	3.59	0.55
Spleen (%)	0.24	0.29	0.22	0.29	0.20
Lungs (%)	1.13	1.33	1.08	1.29	0.51
Heart (%)	0.55	0.75	0.95	0.77	0.41
Kidney (%)	0.24[b]	0.39[ab]	0.43[a]	0.39[ab]	0.22

a, b Means in a row with different superscripts are significantly different (P<0.05).
SEM = Standard Error of Mean.

CONCLUSION

It was concluded from this study that diet containing 40% PKM could be fed to weaner pigs to reduce feed cost in comparison to the control, while at the grower stage; PKM should not exceed 35% of the whole diet when total feed cost is of higher interest to the pig farmer. Warm dressed weight and organ characteristics would not also be affected by any of the PKM diets.

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