THE EFFECT OF FEEDING PALM KERNEL MEAL ON PERFORMANCE AND CARCASS CHARACTERISTICS OF PIGS

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ABSTRACT

Thirty two (32) crossbred (Large white Hampshire) boars and gilts of average initial weight of 41.55 kg were fed diets containing graded levels of palm kernel meal (PKM). Pigs were randomly assigned to pens based on initial weight and sex and there were 2 pigs per pen. Palm kernel meal was fed at (a), (b) 20.55 (c) 41.10 and (d) 61.65% of the diet to replace maize offal and full-fat soya-bean in the 16% crude protein diet for treatments 1 to 4. At the end of the 64-day trial, sixteen pigs (8 boars and 8 gilts) were used for carcass evaluation. Final weight of pigs decreased linearly ($P < 0.05$) as the level of PKM increased in the diet. A quadratic response ($P < 0.05$) was obtained for total gain and average daily gain. Average daily feed intake was not significantly affected by level of PKM fed but feed: gain increased linearly ($P < 0.05$) as the level of PKM increased in the diet. Feed cost per kilogramme gain decreased significantly ($P < 0.05$) as level of PKM increased but feed costs for the control and 20.55% PKM diets were similar. The feeding of PKM had no significant effect on dressing %, percentages of ham, shoulder, loin, belly, loin-eye area and backfat thickness. Organ weights (empty stomach, lungs, heart, kidneys and spleen) were not affected by dietary treatment. However, weight of the liver increased linearly ($P < 0.05$) as level of PKM inclusion increased in the diet. Boars had better gain ($P < 0.05$) and better feed: gain ratio ($P < 0.01$) compared to gilts.

Key Words: Palm kernel, pigs, performance, carcass yield

INTRODUCTION

In recent years, the rising prices of livestock feeds and the scarcity of conventional protein concentrates in the animal production industry have forced animal nutritionists to look for alternative, cheaper and readily available protein sources. Palm kernel meal (PKM) is obtained from the palm kernels after the extraction of the oil. In the 1960's, Nigeria was a leading world producer and exporter of palm kernels exporting about 400,000 tonnes per annum (Oyenuga, 1968; FAO, 1975). Presently, there is renewed effort by Government and individuals to reactivate oil palm production in this country and more palm kernels will be available for production of PKM. Most of the PKM produced in the country is exported. However, with increased production of oil palm, more PKM should be available for local use.

Palm kernel meal is a cheap protein concentrate containing 21.30% crude protein and 10.46% crude fibre (Fetuga *et al.*, 1977a; Nwokojo *et al.* 1977). Oyenuga (1968) indicated that pigs do not take readily to PKM-based diets because of the fibrous, dry and gritty nature. Babatunde *et al.* (1975) reported that the feeding of 32% PKM in the diet of finisher pigs depressed feed intake, weight gain and increased feed to gain ratio compared to other conventional protein sources. Similarly, Fetuga *et al.* (1977a) reported that the weight gain and feed intake of finisher pigs fed 18.80 to 46.50% PKM diets were depressed while the feed to gain ratios were increased compared with pigs fed other protein diets.

Although conventionally used as a protein source in swine diets, PKM has a high amount of residual oil depending on the method of

extraction. This tends to increase the energy value of the feedstuff. NRC (1979) and Oyenuga and Fetuga (1975) reported the values of 2.88 and 3.08 Kcal/g respectively as the metabolizable energy value of PKM samples for pigs. PKM has not been used much in diets of finisher pigs and where it has been used the levels appear to be very low. The objective of this study is, therefore, to determine the optimum level of PKM in diets of finisher pigs with a view to formulating cheap practical diets.

MATERIALS AND METHODS

Thirty-two (32) crossbred (Large White x Hampshire) boars and gilts of average initial liveweight of 41.55kg were used in a 64-day trial. Pigs were randomly assigned to pens based on initial weight-group and sex. There were 4 replications of 4 treatments in a randomized block design trial of two pigs per pen.

Cooked full-fat soyabeans were used as the main protein concentrate in this trial. Soyabean seeds were boiled for about 25 to 40 minutes in half-drum container. The soyabeans were removed with a basket; the water was allowed to drain and the soyabeans were sun-dried for about 2 days. Thereafter the soyabeans were ground using a corn mill prior to inclusion in the rations.

The experimental diets and their proximate contents are shown on Table 1.

All animals were dewormed with Banminth prior to the start of the experiment and at monthly intervals. The dosage was 25mg per kilogramme body weight. Pigs were fed at 5% of body weight daily throughout the trial period. All the diets were offered to the animals in weighed quantities twice daily at 0800 and 1600 hours throughout the trial period. Animals had free access to water. Left-over feed was collected and the weight recorded. Pigs were weighed every week and the level of feeding was adjusted to 5% of body weight daily. The performance of the animals was monitored in terms of feed consumption, weight gain and feed to gain ration throughout the 64-day trial period.

The feed cost per kilogramme gain was also computed.

Sixteen (16) animals (8 boars and 8 gilts) were selected based on final weight across the replications, that is, one pig from each pen. These were slaughtered to evaluate the carcass quality. Prior to slaughtering, pigs were fasted overnight but had access to water. The carcasses were processed for data collection according to the procedure of Eusebio (1980). Proximate analysis of test diets and major feed ingredients was carried out according to the methods of A.O.A.C. (1980) and gross energy was determined using Gallenkamp automatic bomb calorimeter (Table 2). Data collected were statistically analysed according to the method of Cochran and Cox (1975) and treatment means compared using Duncan's Multiple Range Test (Steel and Torrie, 1960). The trend of the performances of treatments was also investigated using the linear and quadratic models and the effects of sex was tested.

RESULTS AND DISCUSSION

Performance Characteristics:

Final weight of finisher pigs decreased linearly ($P < 0.05$) as PKM increased in the diets (Table 3). However, weights of pigs fed the control and 20.55% PKM diets were not significantly different. Daily gain of pigs fed the control diet was similar to those of pigs on the 20.55% PKM diet. The gain on the 20.55% PKM diet was superior to gain on the 41.1% and 61.65% PKM diets. Weight gain of pigs fed the control diet was similar to gain of pigs on 41.1% diet. A quadratic response ($P < 0.05$) was observed for total gain and average daily gain of pigs. It increased up to the point where 20.55% PKM was fed and decreased thereafter. This reduced gain at the higher levels of PKM inclusion in the diet could probably be attributed to the reduced feed intake on the high PKM diets, with consequent reduction in quantity of available nutrients of the tissue level. Babatunde *et al.* (1975) investigated the inclusion of PKM at 33 and 49% levels in

finisher diets and observed that the pigs fed PKM diets gained at a significantly lower rate compared to those on diets containing groundnut cake, milk powder, blood meal and fish meal.

Feed intake (2.57 ± 0.13 kg) of pigs was not significantly ($P > 0.05$) different across treatments. This could be attributed to the method of feeding. Pigs were fed at 5% body weight daily and left-over feed was collected and weighed. This system of feeding did not allow the animals to over-feed as obtained on ad-libitum or voluntary feeding. Fetuga *et al.* (1977a) observed non-significant difference in feed intake of pigs fed diets containing 18.8 and 46.5% PKM. This, they attributed to incorporation of 2.5% cane molasses which improved the palatability of the diets. This is in agreement with the present trial in which 5% cane molasses was incorporated in the diets.

Feed to gain ratio increased linearly ($P < 0.05$) as the levels of PKM fed to the finisher pigs increased. The feed to gain ratios for treatments 1 to 3 were similar but significantly different ($P < 0.05$) from treatment 4. The reduced efficiency of feed conversion may be due to reduced digestibility of the PKM diets especially at the highest inclusion level. Babatunde *et al.* (1975) fed 33 or 49% PKM and observed significant decline in the growth rate and feed conversion. This, they attributed to the dry, gritty and fibrous nature of high PKM diets which reduced their digestibility. This is in agreement with the result obtained in the present trial. However, Fetuga *et al.* (1977b) observed improved weight gain and feed efficiency with the addition of 10.0 - 30.0% cane molasses to diets containing 33.0% or 38.0% PKM.

The feed cost per kilogramme gain of pigs fed the Control and 20.55% PKM diets were not significantly different (Table 3). However, these were significantly higher ($P < 0.01$) compared to those of pigs fed 41.10 and 61.65% PKM diets. The feed cost was reduced as the level of PKM in the diets increased. The least expensive diet was at the highest level of PKM inclusion in the

diet. With the inflationary trend and with the prices of conventional feed ingredients always on the increase, the feeding of 61.65% PKM diet to fattening pigs is thus highly beneficial and cost saving. In a fattening scheme designed to attain 45% liveweight gain, the waiting period between using the control and the 61.65% PKM diet is only about 12 days. The saving during this period is equivalent to ₦56.70k on each pig fattened. These findings are in line with those of Babatunde *et al.* (1975) who fed diets containing 33.0 to 46.5% PKM and observed that it was more economical to use the higher level of PKM in finisher diets.

Carcass Characteristics:

All the carcass measurements taken (dressing%, percentages of ham, shoulder, loin and belly, loin-eye area and back fat thickness) were not significantly different across treatments (Table 4). This might be due to the adequacy of the amino acid profile and the metabolizable energy levels of the control and the PKM diets. In the present trial, the limiting amino acids lysine and methionine, in PKM and control diets appeared to meet the minimum requirement of this class of pigs (NRC, 1979). Thus the amino acids must have produced similar muscle growth and development of these pigs and hence the non significant differences in the carcass traits measured. The results of this trial are in line with the findings of Babatunde *et al.* (1975) and Fetuga *et al.* (1977) who fed diets containing 18.8 to 56.5% PKM to finisher pigs and observed no significant differences in the above carcass traits compared to conventional protein sources.

Organ Weights:

Weight of the organs (empty stomach, lungs, heart, kidneys and spleen) were not statistically significant ($P > 0.05$) across treatments (Table 5). However, the weight of the liver increased linearly ($P < 0.05$) with increased level of PKM fed. The feeding of high levels of PKM in the present trial resulted in increased liver weight which may not be unconnected with the role of the liver in nutrient metabolism with more nutrients being available on PKM diets.

Effect of Sex:

The finishing weight of boars was more ($P < 0.05$) compared to gilts (Table 6). Boars significantly ($P < 0.05$) gained faster considering the total gain and the average daily gain. The boars were also more efficient ($P < 0.05$) in converting feed to gain compared to the gilts. Since the animals are at the growing stage the boars must have laid down more muscle as component of their gain compared to slow growing gilts. Newell and Bowland (1972) earlier observed insignificant differences in feed intake of male and female pigs but they observed that boars gained significantly more weight than gilts. Hale *et al* (1968), on the other hand observed no sex difference in body weight gain of individually fed pigs.

The dressing % of boars was lower ($P < 0.01$) than for the gilts but the boars had higher ($P < 0.01$) percentage shoulder than the gilts (Table 7). Sex did not influence percentages of ham and Loin and Loin-eye area. However, gilts had significantly higher ($P < 0.05$) % belly and backfat thickness (cm) than boars. Perhaps this might be due to the fact that some of the gains put on by the gilts is composed of intracellular fat which is more expensive in terms of energy compared to protein. The female hormones, estrogens are reported to cause deposition of increased quantities of fat in the subcutaneous tissues (Guyton, 1971). The laying down of fat in the subcutaneous tissues as well as initiation of growth of teats and the milk producing apparatus in young gilts may be responsible for these differences in the fat content of the gilts and boars. This is evidenced by the significant differences ($P < 0.01$) observed for the back fat thickness and the % belly between the gilts and boars. On the contrary, Ellis *et al* (1983) observed that gilts' carcasses had less backfat thickness than boar carcasses.

The weights of stomach, lungs, heart and spleen (Table 8) were not significantly influenced by sex. However, boars had significantly higher ($P < 0.01$) liver and ($P < 0.05$) kidneys than the gilts. Cunha (1977) observed

that the fat depots of the pig body are located in and around the abdomen, heart, kidneys and liver. In the present trial, the boars might have higher fat depots around the liver and the kidneys compared to the gilts.

It can be concluded from the results of this trial that the 20.55% PKM level was the best among the levels of PKM used in the present experiment. However, considering the economics of production and performance, higher levels of PKM could be fed. The feeding of as much as 61.65% PKM in the diets of finisher pigs had no adverse effect on the carcass characteristics of the pigs and it also resulted in savings in feed cost.

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Table 1 COMPOSITION AND PROXIMATE ANALYSIS OF DIETS IN WHICH PALM KERNEL MEAL REPLACED MAJOR ENERGY AND PROTEIN SOURCES.

	0	Levels of PKM in diets (%)		
		20.55	41.10	61.65
Maize offal	56.06	42.75	29.75	16.09
Boiled full-fat Soya-bean	26.09	18.85	11.63	4.41
Palm Kernel Meal	0.00	20.55	41.10	61.65
Rice Offal	10.00	10.00	10.00	10.00
Molasses	5.00	5.00	5.00	5.00
Bone Meal	2.00	2.00	2.00	2.00
Common Salt	0.50	0.50	0.50	0.50
Vit. Premix ^a	0.20	0.20	0.20	0.20
Methionine	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00
Feed cost per ton (N) ^b	1174	1023	869	714
Calculated Analysis				
Crude Protein, %	16.00	16.00	16.00	16.00
M.E. Kcal/g	3.25	3.29	3.45	3.62
Crude Fibre, %	11.37	11.84	12.31	12.77
Ether Extract, %	5.75	6.32	6.90	7.46
Calcium, %	0.67	0.72	0.75	0.78
Phosphorus, %	0.61	0.67	0.74	0.80
Lysine, %	0.67	0.62	0.56	0.51
Methionine, %	0.52	0.54	0.56	0.67

^a Roche Vit-Mineral Premix (VM 501) contributed the following per kg of diet: Vit. A, 9,600 I.U., Vit. D³ 1,600 I.U., Vit. E. 12. I.U., Vit. K, 1.6 mg.; Vit. B¹ 0.9., Vit. B²

3.2 mg, Nicotinic Acid, 12.0mg., Calcium D-Panthenate, 6.4mg; Vit. B⁶ 1.6mg., Vit. B¹² 8.0mg., Folic Acid, 0.4mg; Biotin, 0.6mg, Choline Chloride, 16.0mg. Manganese, 8.0mg., Iron, 4.0mg, Zinc, 46. 8mg.; Copper 8.0mg, Iodine, 0.48 mg; Cobalt, 0.28mg and Selenium, 0.01mg.

^b - Prices of Feedstuffs as at December, 1988

^c - M.E. Values Calculated using the relationship ME = GE x 0.78 (Ewan, 1976)

Table 2 CHEMICAL COMPOSITION OF DIETS AND MAJOR FEED INGREDIENTS IN THE FINISHER DIETS (% DM BASIS).

	Levels of PKM in Diets(%)				Maize	Full fat	Palm	Rice
	0	20.55	41.10	61.65	Offal.	Soyabean	Kernel Meal	Offal
Gross energy, kcal/g.	4.17	4.22	4.43	4.65	4.09	5.12	4.69	3.76
Dry Matter, %	80.40	91.04	89.35	90.71	89.11	92.50	88.10	91.30
Crude Protein, %	15.83	16.61	16.50	16.85	7.25	42.75	21.38	6.19
Crude Fibre, %	11.61	12.30	12.88	14.34	10.66	5.64	11.62	38.62
Ether Extract, %	4.94	5.84	7.38	8.38	1.26	10.48	10.33	1.79
Ash, %	4.9	5.98	6.51	6.55	6.08	6.06	4.20	1.22

Table 3 THE EFFECT OF FEEDING PALM KERNEL MEAL DIETS ON PERFORMANCE CHARACTERISTICS OF FINISHING PIGS.

	Levels of PKM in Diets							Response
	0	20.55	41.10	61.65	Mean	S.E.		
Avg. Initial Weight, Kg.	41.59	41.19	41.85	41.55	41.55	0.92	NS	
Avg. Final Weight, Kg.	85.39 ^{ab}	89.35 ^a	83.08 ^c	80.14 ^c	84.49	2.78	TL*	
Avg. Daily feed, kg.	2.59	2.75	2.49	2.44	2.57	0.13	NS	
Avg. Daily Gain, kg.	0.68 ^{ab}	0.74 ^a	0.64 ^c	0.58 ^c	0.66	0.03	TQ*	
Feed: Gain	3.82 ^a	3.72 ^a	3.89 ^a	4.20 ^b	3.91	0.16	TL*	
Feed Cost/kg Gain (N)	4.26 ^a	3.81 ^a	3.21 ^b	3.00 ^b	3.57	0.11	**	

a,b,c, = Row means with different superscripts are significantly different ($P < 0.05$),** ($P < 0.01$).

N.S. = Non-Significant difference among treatment means.

TL* = Significant linear effect of feeding level ($P < 0.05$).TQ* = Significant quadratic effect of feeding level ($P < 0.05$).

Table 4 THE EFFECT OF FEEDING PALM KERNEL MEAL DIETS ON CARCASS QUALITY OF FINISHER PIGS:

Parameters	0	20.55	41.10	61.65	Mean	S.E.
Slaughter weight kg. *	85.39 ^a	89.35 ^a	83.08 ^b	84.46	84.49	2.70
Carcass weight, kg. *	64.04 ^a	65.03 ^a	62.00 ^b	62.36 ^b	63.37	1.10
Dressing, %	77.12	76.35	76.38	76.43	76.58	0.83
Ham, %	22.05	22.19	22.02	22.64	22.64	0.60
Shoulder, %	25.02	25.49	25.64	25.11	25.82	0.70
Loin, %	18.05	18.25	17.27	17.49	17.76	1.04
Loin-eye area cm ²	23.38	23.39	23.30	23.30	23.57	0.52
Back-fat thickness, cm	2.55	2.68	2.61	2.60	2.61	0.22
/ Belly, %	15.31	16.31	16.39	16.23	16.22	0.74

a, b. = Row means with different superscripts differ significantly* ($P < 0.05$).

Table 5 THE EFFECT OF FEEDING PALM KERNEL MEAL DIETS ON ORGAN WEIGHTS OF FINISHER PIGS.

Parameters	Levels of PKM in Diets %				Mean	S.E.
	0	20.55	41.10	61.65		
Empty Stomach, g	608	638	641	669	649	44.70
Liver, g*	1408.75 ^b	1475.00 ^b	1480.00 ^b	1571.25 ^a	1483.75	70.30
Lungs, g	658.50	630.00	647.50	675.00	658.13	58.10
Heart, g.	290.50	307.25	281.25	300.00	293.38	18.69
Kidneys, g	241.75	255.00	253.00	270.00	246.38	16.81
Spleen, g	145.50	160.50	145.50	150.00	152.00	17.87

a, b. = Row with different superscripts differ significantly ($P < 0.05$)

* = Significant linear effect of level of feeding ($P < 0.05$).

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Table 6 THE EFFECT OF FEEDING PALM KERNEL MEAL DIETS ON PERFORMANCE CHARACTERISTICS OF BOARS AND GILTS.

Parameters	Boars	Gilts	SEX	S.E.
			Mean	
Initial weight kg.	41.96	41.13	41.55	0.62
Final weight, kg.*	86.86	82.12	84.49	1.97
Avg. Daily feed, kg	2.59	2.55	2.57	0.09
Avg. Daily Gain, kg*	0.69	0.63	0.66	0.23
Feed: Gain**	3.71	4.11	3.91	0.11
Feed cost per kg gain, N	3.47	3.38	3.57	0.11

* = Significant effect ($P < 0.05$)

** = Significant effect ($P < 0.01$)

Table 7 THE EFFECT OF FEEDING PALM KERNEL MEAL DIETS ON CARCASS CHARACTERISTICS OF BOARS AND GILTS.

Parameters		SEX		Mean	S.E.
		BOARS	GILTS	MEAN	S.E.
Dressing, %	**	74.40	78.75	76.58	0.59
Ham, %		22.58	22.36	22.47	0.422
Shoulder, %	**	26.37	24.30	25.33	0.49
Loin, %		17.65	17.86	17.76	0.74
Backfat thickness, c**		2.63	3.18	2.91	0.16
Loin-eye area		36.59	38.98	37.78	1.99
Belly, %	**	17.03	19.36	18.19	0.63

** = Significant effect ($P < 0.01$)

Table 8 THE EFFECT OF FEEDING PALM KERNEL MEAL DIETS ON ORGAN WEIGHTS OF BOARS AND GILTS.

Parameters	Boars	SEX		Mean	S.E.
		Gilts			
Stomach weight, g	649	650		649.5	31.60
Liver weight, g**	1588	1379		1484	49.70
Lung weight, g	673	644		658	41.10
Heart weight, g	297.5	287.3		293.4	13.21
Spleen weight, g	152.5	151.5		152.0	12.63
Kidney weight, g*	260.3	232.5		246.4	11.89

* = Significant effect ($P < 0.05$)

** = Significant effect ($P < 0.01$).