

The influence of type of palm kernel cake on the growth rate and carcass characteristics of pigs

S. W. A. RHULE

Animal Research Institute, CSIR, P. O. Box 20, Achimota, Ghana

SUMMARY

Forty-eight large white pigs at an average initial liveweight of 20 kg were distributed over three treatments made up of a control diet and two diets containing palm kernel cake from two oilmills, incorporated into the diets at 300 g/kg level. The average daily gains of the pigs were 0.57, 0.46, and 0.49 kg/day on control, Oilmill A (PKC A), and Oilmill B (PKC B) diets during the grower period. Corresponding values were 0.60, 0.63, and 0.65 kg/day during the finisher period, and 0.60, 0.54, and 0.55 kg/day during the entire grower-finisher period. Feed conversion efficiency (kg/kg liveweight gain) with the pigs on the diets were 3.44, 3.87, and 3.94 (grower period), 4.53, 5.63, and 4.91 (finisher period), and 4.0, 4.77, and 4.41 (grower-finisher period). There were significant differences ($P < 0.05$) in the carcass length, eye muscle area, and the hand joint of the pigs. Other measures of carcass characteristics were not significantly ($P > 0.05$) different. There was the indication, however, of non-significant differences in the carcass characteristics due to the type of the palm kernel cake. The study has shown that palm kernel cake with high level of residual fat induced higher average daily gain, better feed conversion efficiency, increased carcass fatness with reduced leanness in pigs.

Original scientific paper. Received 27 Aug 96; revised 29 Sep 98.

Introduction

Palm kernel cake (PKC) is a by-product from the extraction of oil from the palm nut which grows abundantly in the tropics. In Ghana, PKC is produced by the extraction method in large

RÉSUMÉ

RHULE, S. W. A.: *L'influence de l'espèce de cake d'amande de palme sur la proportion de croissance et les caractéristiques de carcasse des cochons*. Quarante-huit grands cochons blancs à un poids vif initial moyen de 20 kg étaient distribués sur trois rations y compris un régime de contrôle et deux régimes contenant le cake d'amande de palme de deux tourteaux moulus, incorporés aux régimes à un niveau de 300 g/kg. Les gains quotidiens moyens des cochons étaient 0.57, 0.46, et 0.49 kg/jour sur le contrôle, les régimes de tourteau moulu A (PKC A) et de tourteau moulu B (PKC B) pendant la période croissance. Les valeurs correspondantes étaient 0.60, 0.63, et 0.65 kg/jour pendant la période d'apprêteurs et 0.60, 0.54, et 0.55 kg/jour pendant la période entière de croissance - apprêteur. L'efficacité de conversion de ration (kg/kg gain de poids vif) avec les cochons suivant les régimes étaient 3.44, 3.87, et 3.94 (période de croissance), 4.53, 5.63, et 4.91 (période d'apprêteur), et 4.0, 4.77 et 4.41 (période de croissance apprêteur). Il y avait des différences considérables ($P < 0.05$) dans la longueur de carcasse, la superficie du muscle d'oeil, et l'articulation de la main des cochons. D'autres évaluations des caractéristiques de carcasse n'étaient pas considérablement ($P > 0.05$) différentes. Il y avait d'indication, cependant, des différences non-considérables dans les caractéristiques de carcasse dû à l'espèce de cake d'amande de palme. L'étude a montré que le cake d'amande de palme avec un haut niveau de la graisse résiduaire-provoquait un gain quotidien moyen plus élevé, une efficacité de conversion meilleure de ration, une corpulence de carcasse augmentée avec une maigreur réduite dans les cochons.

commercial oilmills and also on a small scale as cottage industry. The varied methods of extraction would lead to variation in the residual oil in the PKC. Samples of PKC analyzed in the laboratory showed that PKC from an oilmill which uses the

double-extraction method had a composition of 90.3 g/kg moisture, 43.7 g/kg ash, 90.0 g/kg crude fibre, 139.2 g/kg ether extract, and 137.4 g/kg crude protein. Palm kernel cake from another oilmill which uses the single-extraction method had a composition of 84.7 g/kg moisture, 27.2 g/kg ash, 103.5 g/kg crude fibre, 210.5 g/kg ether extract, and 117.3 g/kg crude protein.

The residual oil would influence the energy value of the PKC. Dietary fats affect the average daily gain, feed conversion efficiency, carcass fat, and keeping quality of pork products (Li *et al.*, 1990; Cera, Mahan & Reinhart, 1990; Fischer & Freudenreich, 1990; Myer *et al.*, 1992). Fetuga, Babatunde & Oyenuga (1977) reported that whilst pigs on 188.0 g PKC/kg diet had the best average daily gains and feed conversion efficiency, these were reduced with increasing level of PKC in the diet. Carcass leanness was best with pigs on diets with increasing levels of PKC. Percentage fat cuts were reduced as dietary PKC increased. Jegede *et al.* (1994) observed a decrease in the average daily gain and feed conversion efficiency with pigs as dietary level of PKC increased from 0 to 616.5 g/kg.

The dietary PKC level had no significant effect on the carcass characteristics. Rhule (1996) observed that whilst 200 g PKC/kg diet was best for the grower pig, 300 g PKC/kg diet was best for the finisher pig. Fat thickness increased and leanness was reduced in pigs with increasing level of dietary PKC. Since the pig lays down dietary fat to lay down as body fat, it is possible that the type of PKC could affect production parameters in the pig. For the feed manufacturer, variability within feed ingredients is a major problem. It becomes difficult producing consistent feed which will ensure the steady and profitable level of animal performance producers demand.

The study aimed to determine the effects that the type of palm kernel cake can have on the performance and carcass characteristics of pigs.

Materials and methods

Animals

Forty-eight large white pigs, at an average initial

liveweight of 20 kg, were distributed over three treatments according to a randomized block design with 16 pigs to a treatment. There were equal numbers of females and intact males to a treatment. Pigs on each treatment were grouped by sex. There were eight pigs in a pen and two pens to a treatment.

Treatments

The three dietary treatments were made up of a control diet and two other diets containing palm kernel cake from two oilmills. The palm kernel cake was incorporated at 300 g/kg diets based mainly on maize, wheatbran, and fishmeal. The diets were formulated according to the NRC (1979) nutrient requirements for pigs (Table 1).

Feeding

The pigs on a diet were kept and fed in a group. They were restricted-fed once daily a quantity of feed equipment to 6 per cent of the group liveweight. The diet was fed wet in a feed-to-water ratio of one-to-two. Any feed left-over was carefully removed and weighed. Water for drinking

TABLE I
Composition of Diets Containing Palm Kernel Cake from Two Oilmills (g/kg)

	Diets		
	Control (C)	Oilmill A (PKC A)	Oilmill B (PKC B)
<i>Ingredient composition</i>			
Palm kernel cake	0.0	300.0	300.0
Maize	512.0	396.0	396.0
Wheatbran	401.0	240.0	240.0
Fishmeal	71.0	48.0	48.0
Oyster shell	9.0	9.0	9.0
Salt	5.0	5.0	5.0
Premix	2.0	2.0	2.0
	1000.0	1000.0	1000.0
<i>Determined composition</i>			
Moisture	118.4	100.7	107.2
Ash	124.8	111.6	97.9
Crude fibre	30.5	45.8	49.7
Ether extract	62.0	74.6	104.0
Crude protein	149.4	136.3	134.2

was provided *ad libitum*.

Management

The pigs were weighed individually at the start and thereafter weekly. The feed allowance was adjusted accordingly. The same diets were fed at the grower and finisher periods of growth till slaughter at about 70 kg liveweight.

Carcass measurements

Pigs attaining 70 kg at the weekly weighing were slaughtered the next morning after being weighed again. The weight of the empty carcass with the head intact was recorded. Then the carcass was chilled for 24 h. The head was removed at the base of the skull. The body was split in two by sawing along the vertebral column. The various measurements made according to the procedure of the MLC (1980) were the carcass length; fat depth at the shoulder, loin and P2; width (A), depth (B) used to calculate the eye muscle area; and the weight of the various cuts.

Analyses

The proximate composition of the diets was determined according to the procedures of ADAS (1973). The results were analyzed statistically by ANOVA (Snedecor & Cochran, 1972). Duncan's multiple range test was used to compare significantly different means (Steel & Torrie, 1960).

Results

Palm kernel cake from Oilmill B had a high level of residual oil. This reflected in the diets which contained the palm kernel cakes from the two sources (Table 1).

During the grower period, there were no significant differences in the average daily gains between the two sexes of the pigs on each diet (Table 2). The average daily gain of the pigs on the control diet was significantly different ($P < 0.05$) from those on the PKC diets (Table 2). The average daily gains of the pigs on the PKC diets were similar (Table 2). The average daily gains of the pigs on each diet during the finisher period were

TABLE 2
Average Daily Gains of Pigs Fed Diets Containing Palm Kernel Cake from Two Different Sources (kg/day)

Period	Diets			SEM (\pm)
	Control	Oilmill A	Oilmill B	
<i>Grower</i>				
Males	0.55	0.45	0.49	
Females	0.60	0.47	0.49	
Males + Females	0.57 ^a	0.46 ^b	0.49 ^b	0.01
<i>Finisher</i>				
Males	0.58	0.61	0.67	
Females	0.63	0.64	0.63	
Males + Females	0.60	0.63	0.65	0.02
<i>Grower-Finisher</i>				
Males				
Females				
Males + Females	0.60 ^a	0.54 ^b	0.55 ^{ab}	0.01

Means with different superscripts are significantly ($P < 0.05$) different.

not significantly influenced by sex. No significant differences ($P > 0.05$) were observed on the average daily gains of the pigs on all the diets. Over the grower-finisher period, the average daily gain of the pigs on the control diet was similar to those on the PKC B diet, but significantly higher ($P < 0.05$) than those on PKC A diet. The average daily gain was similar for the pigs on the PKC diets (Table 2).

The feed conversion efficiency by the pigs on diets could not be statistically analyzed as the pigs were group-fed. The pigs showed comparatively no differences due to sex at the grower period. The feed conversion efficiency seemed similar for pigs on the PKC diets, but lower compared to that for pigs on the control diet (Table 3). During the finisher period, the female pigs on the control diet had a comparatively higher feed conversion efficiency than the males. The males on the PKC diets had slightly higher feed conversion efficiency than the females. Feed conversion efficiency was similar for pigs on the control and PKC B diets, and higher than that for pigs on PKC A diet (Table 3). Over the grower-finisher period, feed conversion efficiency was better with the pigs on PKC B diet than for those

TABLE 3

Feed Conversion Efficiency in Pigs on Diets Containing Palm Kernel Cake from Two Different Sources (kg feed/kg liveweight gain)

Period	Diets			SEM (±)
	Control	Oilmill A	Oilmill B	
<i>Grower</i>				
Males	3.36	4.21	3.73	
Females	3.52	3.58	4.21	
Males + Females	3.44	3.87	3.94	
<i>Finisher</i>				
Males	5.66	5.09	4.69	
Females	3.68	6.32	5.13	
Males + Females	4.53	5.63	4.91	
<i>Grower-Finisher</i>				
Males	4.49	4.71	4.17	
Females	3.60	4.84	4.67	
Males + Females	4.00	4.77	4.41	

on PKC A diet.

Table 4 shows the measurement made on the pig carcasses. There were significant ($P < 0.05$) differences in the carcass length of the pigs on the diets. The carcass length was similar for pigs on the PKC diets. The eye muscle area (EMA) of pigs on the control diet was significantly ($P < 0.05$) higher than the EMA of those on the PKC diets. The EMA of pigs on PKC B diet were similar to the EMA of those on the PKC A diet (Table 4).

The hand as a proportion of the carcass weight was significantly ($P < 0.05$) heavier with the pigs on the control diet than those on the PKC diets which were in turn similar (Table 4). No significant differences were found in the other indices of carcass characteristics measured (Table 4).

Discussion

The chemical composition of the PKC from Oilmill A was similar to one reported by Jegede *et al.* (1994). Palm kernel cake from Oilmill B had, comparatively, high ether extract content with low content of crude protein. The ether extract contents of the two palm kernel cakes reflected in the diets which contained them. The PKC B diet had a high fat content. The diets were similar to

TABLE 4

Carcass Characteristics of Pigs Fed Diets Containing Palm Kernel Cake from Two Different Sources

Criteria	Diets			SEM (±)
	Control ¹	Oilmill A	Oilmill B	
Dressing (%)	65.57	64.31	63.76	9.39
Carcass length (cm)	70.69 ^a	69.33 ^{ab}	68.48 ^b	7.21
Shoulder fat (cm)	3.47	3.26	3.51	0.35
Loin fat	1.39	1.39	1.45	0.11
P2 fat	1.23	1.38	1.44	0.09
<i>Exposed surface at last rib (cm)</i>				
A				
B				
<i>Eye muscle area (cm²):</i>				
(A × B)	35.22 ^a	30.31 ^b	28.83 ^b	25.39
<i>Proportions of cuts/joints (g/kg)</i>				
Collar	6.66	6.80	6.90	0.53
Hand	6.92	6.16 ^b	6.21 ^b	0.45
Rib back	6.30	6.71	6.70	0.37
Rib streak	2.74	2.50	2.57	0.31
Rump back	6.63	6.72	6.79	0.36
Rump streak	3.49	3.29	3.52	0.30
Ham	9.52	9.31	9.19	0.35
Head	10.30	10.50	10.76	0.64

Means with different superscripts are significantly ($P < 0.05$) different.

those used in similar studies by Jegede *et al.* (1994) and Rhule (1996). The nutrient composition was similar to that recommended by NRC (1979).

The average daily gain of the grower pigs on the control diet was comparable to rates reported in similar studies (Babatunde, Olomu & Oyenuga, 1972; Rhule, 1995). The higher crude protein and lower crude fibre contents of the control diet could lead to the higher average daily gain of the pigs compared to those on the PKC diets. The higher crude fibre in the PKC diets would comparatively decrease the digestibility of the nutrients in those diets (Baird, McCampbell & Allison, 1970; Lekule, Homb & Katagile, 1986; Ugye, Anugwa & Nwosu, 1988). Of the PKC diets, the PKC B diet had a higher ether extract content than the PKC A diet. The ether extract had a high calorific value. This could have influenced the non-significant difference in the average daily gains of the pigs

on the PKC diets.

During the finisher period, the average daily gain of the pigs on the diets increased with increasing content of ether extract in the diet. The higher fat content of the PKC B diet could have a protein-sparing effect in the pigs, leading to the higher average daily gain (Baird, McCampbell & Allison, 1975; Fuller & Crofts, 1977). The higher crude fibre content of the PKC B diet was considered low for finisher pigs. The average daily gains of the pigs on the diets were comparable to those reported on similar studies (Lekule, Homb & Katagile, 1986; Jegede *et al.*, 1994; Rhule, 1995). Over the grower-finisher period, the average daily gains of the pigs indicated that the control diet (149.4 g CP/kg and 62.0 g EE/kg) was similar to PKC B diet (134.9 g CP/kg and 104.0 g EE/kg). This again suggested a protein-sparing effect of fat in the pigs. With the relatively high crude fibre and low crude protein contents, the PKC diets could be considered low density, despite the possibility of high calorific value due to the higher fat level.

The possible reduction in the digestibility of the palm kernel cake diets with the attendant reduced availability of nutrients would result in reduced feed conversion efficiency as observed. This was also observed by Babatunde *et al.* (1975), Lekule, Homb & Katagile (1986), Jegede *et al.* (1994), and Rhule (1995, 1996). Feed conversion efficiency was influenced by the type of the PKC at the finisher and grower-finisher periods, being better with the PKC B diet. This could be attributed to the higher calorific value.

The reduction in the carcass length, eye muscle area and the collar with the palm kernel cake diets could be ascribed to reduction in digestibility of the nutrients. The carcass characteristics observed in the pigs in this study were similar to those recorded by Jegede *et al.* (1994) and Rhule (1995, 1996).

Conclusion

The study has indicated that there could be differences in animal performance between types

of palm kernel cake. It has shown that the palm kernel cake with high content of residual fat induced higher average daily gain at both the grower and finisher periods of growth in the pig. Feed conversion efficiency was better in pigs on the palm kernel cake with the high fat content. Carcass fatness was increased and leanness reduced in the pigs on the high-fat palm kernel cake diet. Although not statistically significantly different, it could be important economically, especially where carcasses are graded.

REFERENCES

- ADAS (1973) *The analysis of agricultural materials*. London, Ministry of Agriculture, Fisheries and Food, Her Majesty's Stationery Office. London.
- Babatunde, G. M., Olomu, M. J. & Oyenuga, V. A. (1972) Determination of the optimum crude protein requirement of pigs in a tropical environment. *Anim. Prod.* **14**, 57-67.
- Babatunde, G. M., Fetuga, B. L., Oyenuga, V. A. & Akpapwunam, O. (1975) The effects of feeding graded levels of wheat offals and groundnut shells to pigs on their performance and carcass characteristics and nutrient utilization. *Nig. J. Anim. Prod.* **2** (2), 135 - 148.
- Baird, D. M., McCampbell, H. C. & Allison, J. R. (1970) Levels of crude fibre with constant energy levels for growing-finishing swine using computerised rations. *J. Anim. Sci.* **31**, 518-525.
- Baird, D. M., McCampbell, H. C. & Allison, J. R. (1975) Effects of levels of crude fibre, protein and bulk in diets for finishing hogs. *J. Anim. Sci.* **41** (4), 1039-1047.
- Cera, K. R., Mahan, D. C. & Reinhart, G. A. (1990) Evaluation of various extracted vegetable oils, roasted soybeans, medium-chain triglyceride and an animal vegetable fat blend for postweaning swine. *J. Anim. Sci.* **68**, 2756-2765.
- Fetuga, B. L., Babatunde, G. M. & Oyenuga, V. A. (1977) The value of palm kernel meal in diets for finishing pigs. 1. The effect of varying the proportion of protein contribution from blood meal and palm kernel meal on performance and carcass quality of finishing pigs. *J. agric. Sci. (Camb)* **88**, 655-661.
- Fischer, K. & Freudenreich, P. (1990) Meat and fat quality of pigs after fattening with specific feed fat components. *Nut. Abstr. Rev.* (B) **61**, 123.

- Fuller, M. F. & Crofts, R. M. J.** (1977) The protein-sparing effects of carbohydrate. 1. Nitrogen retention of growing pigs in relation to diet. *Br. J. Nutr.* **38**, 479.
- Jegade, J.O., Tegbe, T. S. B., Aduku, A. O. & Olorunju, S. A. S.** (1994) The effect of feeding palm kernel meal on performance and carcass characteristics of pigs. *Nig. J. Anim. Prod.* **21**, 88-94.
- Lekule, F. P., Homb, T. & Katagile, J. A.** (1986) Digestibility and effect of copra cake on rate of gain, feed efficiency and protein retention of fattening pigs. *Trop. Anim. Hlth Prod.* **18**, 243-247.
- Li, D. F., Thaler, R. C., Nelssen, J. L., Harmon, D. L., Allee, G. L. & Weeden, T. L.** (1990) Effect of fat sources and combinations on starter pig performance, nutrient digestibility and intestinal morphology. *J. Anim. Sci.* **68** (11), 3694-3704.
- Meat and Livestock Commission (MLC)** (1980) *Commercial pig evaluation management and procedures*, p. 3. Milton Keynes, UK, Meat and Livestock Commission.
- Myer, R. O., Johnson, D. D., Knauff, D. A., Gorbet, D. W., Brendemuhl, J. H. & Walker, W. R.** (1992) Effect of feeding high-oleic peanuts to growing-finishing swine on resulting carcass fatty acid profile and on carcass and meat quality characteristics. *J. Anim. Sci.* **70**, 3734 - 3741.
- National Research Council (NRC)** (1979) *Nutrient requirement of swine*. Washington, DC, National Academy Press.
- Rhule, S. W. A.** (1995) Evaluation of sheanut cake as feedstuff for pigs in Ghana. 1. Growth rate and carcass characteristics of pigs fed diets containing varying levels of sheanut cake. *Legon agric. Res. Ext. J.* **4**, 41-47.
- Rhule, S.W. A.** (1996) Growth rate and carcass characteristics of pigs fed diets containing palm kernel cake. *Anim. Fd Sci. Tech.*, **61**, 167-172.
- Snedecor, G. W. & Cochran, W. G.** (1972) *Statistical methods*, pp. 258-296. Ames, Iowa, State University Press.
- Steel, R. G. D. & Torrie, J. H.** (1960) *Principles and procedures of statistics*, pp. 107-109. New York, McGraw-Hill Book Co., Inc.
- Ugye, B. H., Anugwa, F. O. I. & Nwosu, C. C.** (1988) Effects of varying levels of dietary-dried brewer grains on performance and carcass characteristics of growing pigs. *Bull. Anim. Hlth Prod. Afr.* **36**, 31-37.