

The effect of dietary protein and palm oil on performance, age, and weight at puberty of indigenous pigs in Nigeria

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Abstract

Forty-eight indigenous pigs averaging 89.6 days in age and 12.9 kg body weight were used in a 4 x 2 factorial experiment. Dietary treatments were 15 and 18% levels of protein and 0, 2, 4 and 8% levels of palm oil, added to each protein level. The diets were fed *ad libitum* and water was available at all times until the onset of puberty (first estrus).

Increasing the protein content of the diet gave significantly higher rates and efficiency of gain in pigs. Increasing the palm oil content of the basal 15 or 18% protein diet improved rate and efficiency of gain up to 4% palm oil level in the 18% protein diet but only up to 2% palm oil level in the 15% protein diet, indicating a need for increased dietary palm oil/energy with increased protein intake to maintain conversion efficiency. Increasing the palm oil content of the basal 15% or 18% protein diet improved feed consumption at all palm oil levels in the 15% protein diets but only up to 4% palm oil level, in the 18% protein diets. Increasing the protein content of the diet resulted in heavier and younger pigs at puberty. Increasing the palm oil content of a basal 15% or 18% protein diet did not appreciably affect big weights at puberty (range 33.3 to 36.1 kg) unlike age of pigs at puberty which was significantly reduced (range 152.3 to 167.5 days) by increasing dietary palm oil levels.

Introduction

Crew (1931) pointed out that puberty and sexual maturity were not the same. Asdell (1946) agreed and defined puberty as the time at which reproduction first becomes possible, and sexual maturity as the time when the animal reaches its full reproductive potential.

Various factors are known to affect puberty in many species of animals. Of these, two in particular have received considerable attention; chronological age and body weight. Puberal age of gilts are known to vary like most other parameters in pigs which are affected by the genotype and environmental factors including its nutrition. Since litters are known to increase with increasing heat period from 1st to 3rd or 4th heat period, gilts must therefore reach puberal age a little earlier

than the 8 months breeding age for more viable and larger litters to be produced at the age of one year. Age as well as weight of pigs at puberty are known to be dependent on the management level (environment) adopted since full expression of genetic potentialities of the gilts is practically impossible without this, e.g. adequate after birth care, clean and healthy housing environment, adequate veterinary attention and feeding to the optimal level. Thus, according to Asdell (1946), attainment of puberty is due not only to one factor but to several which interweave to produce the pattern inherent in the species.

Holness (1972) reported for indigenous South African gilts an earlier puberty (116 days) on a high plane of nutrition compared with pubertal ages of 126 and 127 days respectively for those fed at 75% and 50% of this level. More recently, Friend (1977) investigated the effect of dietary energy and protein levels on age and weight at puberty of Yorkshire gilts. Age at puberty averaged 168 days (range 127 to 212 days) and was affected by neither energy nor crude protein supplementation of the control (0% oil, 0% soybean protein) diet. Body weight at puberty was increased by the addition of soybean oil, but not protein, to the diet.

Most of the studies on the age and weight of pigs at puberty have hitherto been carried out on exotic breeds of pigs. Similar work on the indigenous pig is very scanty. This study was conducted to investigate the effect of dietary protein and palm oil levels on (i) the performance and (ii) age and weight at puberty of indigenous pigs.

Materials and Methods

A total of 48 local gilts was distributed into 8 pens such that no two gilts from the same litter were in the same pen. Each pen measured 7.8 x 1.5 metre, had a concrete floor and was provided with watering and feeding troughs. Each of the experimental pen of 6 gilts was randomly allotted to one of eight treatment combinations (2 protein x 4 palm oil levels), whose composition are shown on table 1. The gilts fed *ad libitum*, with water available at all times.

The gilts were weighed weekly and weight gains recorded. Feed intake was recorded and efficiency of feed utilisation calculated. From day 28 onwards, the gilts were tested for standing heat by introducing a boar into each pen daily for about forty minutes. Gilts showing standing heat were promptly removed and their ages and weights recorded. All data were subjected to an analysis of variance and different means compared using Duncan's new multiple range test (Steel and Torrie, 1960).

TABLE 1: RATION COMPOSITION

Ingredients	TREATMENTS							
	1	2	3	4	5	6	7	8
Ground maize: (9.0% CP)	76.0	67.0	73.6	70.6	65.6	64.0	61.6	56.6
Groundnut cake; (42.0% CP)	19.6	28.6	20.0	21.0	22.0	29.6	30.0	31.0
Dicalcium phosphate	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Salt (NaCl)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Min-Vitamin Premix ²	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Palm Oil ¹	—	—	2.0	4.0	8.0	2.0	4.0	8.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated Values								
Crude Protein %	15	18	15	15	15	18	18	18
Energy DEKcal/kg	2,395	3,418	3,466	3,539	3,681	3,490	3,561	3,704

1. Energy value for maize is 3,500DEKcal/kg; groundnut cake is 3,750 KEKcal/kg and palm oil is 7,000 DEKcal/kg (from the National Academy of Sciences, Publication 1599 of 1968).
2. The vitamin-mineral premix supplied 440 mg riboflavin, 880 mg calcium panthothenate 2g niacin, 2.2g choline chloride, 15 mg folic acid, 1 mg vit. B₁₂ 5000 I.U. Vit A, 6,600 I.U. Vit D₂ and 1000 I.U. Vit E per 100 kg diet. It also supplied 24 ppm Cu, 2 ppm iodine, 34 ppm Mn, 50 ppm Xn and 100 ppm Iron.

Results
The results of observations made on the growth performance of pigs are summarised in Table 2.

TABLE 2: EFFECT OF LEVEL OF PROTEIN AND ENERGY ON PIG PERFORMANCE

	TREATMENTS								
	11 15	2 18	3 15	4 15	5 15	6 18	6 18	8 18	S. E. of Mean
Palm Oil, %	—	—	2	4	8	2	4	8	—
D.E.Kcal/Kg diet	3,395	3,418	3,466	3,539	3,681	3,490	3,561	3,704	—
Av. Daily Gain, kg.	0.27 ^c	0.32 ^b	0.30 ^{bc}	0.33 ^b	0.31 ^b	0.34 ^{ab}	0.36 ^a	0.35 [±]	.015
Av. Daily Feed intake kg.	1.02 ^c	1.13 ^{abc}	1.09 ^{bc}	1.22 ^{ab}	1.24 ^a	1.18 ^{ab}	1.23 ^a	1.21 ^{ab}	±.04
Feed/Gain Ratio	3.77 ^d	3.53 ^{ab}	3.62 ^{bc}	3.70 ^{cd}	3.75 ^{cd}	3.48 ^{ab}	3.43 ^a	3.47 ^a	±.07

abcd, Means within rows with the same superscript are not significantly different (P 0.05)

Average Daily Feed Intake:

Differences were obtained in daily feed intake due to level of protein in the diet. The 1.02 kg average daily feed intake for pig on the 15% protein diet was 10.8% less ($P < 0.05$) than the 1.13 kg average daily feed intake for pigs on the 18% protein diet.

In isonitrogenous diets, palm oil levels affected daily feed intake of pigs. At the 15% protein level the addition of palm oil at 2.4 and 8% levels increased feed intake by 6.8, 19.6 and 21.6% respectively over those fed the 15% protein diet. Feed intake at the 4 and 8% palm oil levels were significantly ($P < 0.05$) higher than at the 15% protein level. At the 18% protein level feed intake of pigs receiving 2, 4 and 8% palm oil levels were 4.4, 8.4 and 7.08% respectively higher than for pigs receiving the 18% protein diet.

Average Daily Gains (ADG);

Observations on body weight changes showed an increase in average daily gains as the dietary protein level was increased. Gilts receiving the 18% protein diet grew 18.5% faster ($P < 0.05$) than the pigs fed the 15% protein diet.

In isonitrogenous diets the level of palm oil fed influenced ADG in pigs. At the 15% protein level ADG in pigs receiving 2.4 and 8% palm oil was 11.1, 22.2 and 14.8% respectively higher than for pigs fed no oil supplement. The ADG of pigs receiving the 4 and 8% palm oil in the 15% protein was significantly ($P < 0.05$) higher than those of pigs given no oil supplement. At the 18% protein level, ADG in pigs receiving 2.4 and 8% palm oil was 6.25, 12.0 and 9.4% respectively, higher than those of pigs on the 18% protein diet. The ADG of pigs receiving palm oil at 4 and 8% in the 18% protein diet was significantly ($P < 0.05$) higher than those obtained for pigs at the 18% protein level. At the two protein levels the highest response to additional palm oil was at the 4% level with regards to rate of gain in pigs. Rate of gain at the different palm oil levels was in general greater in pigs receiving the basal 18% than the 15% protein diet.

Feed consumed per kilogram liveweight gained (F/G ratio):

The dietary protein level affected F/G ratio. Pigs receiving the 15% protein diet had a (F/G) ratio 6.8% less efficient ($P < 0.05$) than the F/G ratio for pigs receiving the 18% protein diet. At the 15% protein level, addition of palm oil at 2.4 and 8% levels improved feed efficiency ($P < 0.05$) by 4.14, 1.9 and 0.6% respectively while at the 18% protein level addition of palm oil at 2, and 8% improved feed effi-

ciency ($P < 0.05$) by 1.4, 2.9 and 1.7 respectively. The improvement in feed efficiency of pigs on experimental diets decreased as the palm oil levels in diet was increased; in the 15% protein diet, it improved from 2 to 4% level after which at the 8% level, feed efficiency was only slightly higher than at the 2% level. Except for the 2% palm oil supplement 15% protein diet, all the 18% protein diet containing dietary palm-oil were significantly better utilized than the 15% protein diets. Pigs on the 18% protein diets and the three levels of palm oil utilised their feeds more effectively than pigs receiving the corresponding 15% protein and palm oil diets.

Weight of Pigs at Puberty:

Mean values for the effects of the different protein and energy levels on weight and age of pigs at puberty are shown in Table 3.

TABLE 3: EFFECT OF LEVEL OF PROTEIN AND ENERGY ON AGE WEIGHT OF PIGS AT PUBERTY

	TREATMENTS								S. E. of Mean
	11	2	3	4	5	6	7	8	
Protein, %	11	2	3	4	5	6	7	8	
Protein, %	15	18	15	15	18	18	18	18	
Palm Oil, %	—	—	2	4	8	2	4	8	
D.E. Kcal/kg diet	3,395	3,412	3,466	3,539	3,681	3,490	3,561	3,704	
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Weight of Pigs									
Av. initial weight, kg	13.17	12.83	12.50	12.50	13.83	13.67	12.67	12.33	0.65
Av. final weight, kg.	33.73 ^{bc}	36.08 ^a	35.15 ^{ab}	36.10 ^a	33.32 ^c	35.25 ^a	35.87 ^a	35.82 ^a	0.78
Av. Daily rate of weight gain, kg.	0.27 ^c	0.32 ^b	0.30 ^{bc}	0.33 ^{ab}	0.31 ^b	0.34 ^{ab}	0.36 ^a	0.35 ^a	0.015
Ages of Pigs									
Av. initial age days	91.33	87.50	84.67	86.17	95.50	93.33	90.50	88.17	2.88
Av. final age days	167.50 ^c	160.17 ^{ab}	160.20	157.70 ^{ab}	158.33 ^{ab}	156.83 ^{ab}	152.30 ^a	155.37 ^{ab}	2.4
No of days on experiment	76.15	72.66	75.50	71.52	62.87	63.47	64.44	67.11	—

abc. Means within rows with the same superscript are not significantly different. ($P .05$)

Increasing protein levels from 15 to 18% produced pigs that were 33.73 and 36.08 kg. respectively in weight at puberty and those weights were significantly ($P < 0.05$) different.

Increasing the energy level of the basal 15% protein diet by the addition of 2, 4 and 8% palm oil resulted in 11%, 22% and 15% pig weight increases respectively, at puberty. The weight at puberty of pigs receiving the 4% palm oil in a 15% protein diet was significantly ($P < 0.05$) higher than those of pigs receiving the 15% protein diet or the 15% protein diet and 8% palm oil. At the 18% protein level the weights at puberty of pigs receiving palm oil at 2, 4 and 8% levels were all slightly lower but not significantly ($P > 0.05$) different from those of pigs receiving the basal 18% protein diet. In general there was a greater uniformity in the weights at puberty of pigs fed the 18% protein diet and the different palm oil levels than pigs receiving the corresponding 15% protein based diets. Except for the weight of pigs receiving the 15% protein and 8% palm oil that was significantly ($P > 0.05$) low, weights of pigs at puberty in all the palm oil based 15 or 18% protein diets were not significantly different.

Age of Pigs at Puberty:

Age of pigs at puberty varied significantly depending on dietary protein and energy levels. Pigs receiving 15 and 18% protein diets were 167.5 and 160.2 days respectively in age at first estrus. The ages were not significantly ($P > 0.05$) different.

Addition of palm oil at 2, 4 and 8% levels to a basal 15% protein diet showed a tendency towards a decrease in age of pigs at puberty with additional dietary energy. Pigs receiving the 4 and 8% oil in basal 15% protein diet were significantly ($P > 0.05$) younger than those receiving the basal 15% protein diet, but not significantly ($P > 0.05$) younger than those on the 18% protein diet, at puberty. The ages of pigs on the 18% protein diet and those on the basal 15% protein diet and 2% palm oil were the same at puberty.

Addition of palm oil at 2, 4 and 8% to a basal 18% protein diet produced pigs that were 156.6, 152.3 and 153.4 days old respectively at puberty. Again all the pigs on the 18% protein and palm oil added diets were younger at puberty than those receiving the basal 18% protein diet, however it was only the pigs receiving the basal 18% diet and 4% palm oil that were significantly ($P > 0.05$) younger at puberty in comparison to those receiving the 18% at protein diet. In general, pigs on the 18% protein diet and the added different palm oil levels were younger at puberty than pigs receiving the corresponding 15%

protein and same levels of dietary palm oil. However, only pigs receiving the 18% protein diet and 4% palm oil were significantly ($P < 0.05$) younger at puberty than those receiving a basal 15% protein diet and 2% palm oil. Pigs on all the other protein and palm oil added diets were not significantly different in age at puberty.

Discussion

Growth Performance.

The most commonly scrutinized parameters from the standpoint of performance characteristics in nongestating pigs are average daily gains and feed/gain ratio, which are of paramount economic importance. The results of the present study have shown both parameters to be significantly influenced by protein and energy levels.

Observed rates and efficiency of gain in the local pigs used improved with increase in dietary protein levels. Ilori (1974) and Bressani (1974) reported that optimum growth rate of local pigs were achieved at a lower than a higher protein level. The fact that local pigs now show a tendency to respond to increasing dietary protein levels could be due to the fact that a more rigorous selection for fast and efficient gaining local pigs has continued to be made. The results obtained in this study are in general agreement with the work of Catron *et al* (1952) and Kuryvial *et al* (1962) who found more rapid and efficient gains from the use of greater amounts of protein in rations of growing pigs. Observed rates of gain for the local pigs at the protein levels used were comparable to those reported by other workers. Cameroon and Ashton (1969) reported an average daily gain of 0.25 kg for local black pigs reared in Ghana. Fetuga *et al* (1976) obtained an average daily gain of 0.29 kg for pigs of about the same weight at the University of Ibadan Station.

The effect of adding three levels of palm oil to the basal 15 or 18% protein diet was to increase rate and efficiency of gain in pigs. At both protein levels rate of gain was improved up to 4% palm oil level after which it dropped at the 8% level. Efficiency of gain on the other hand was improved only at the 2% palm oil level in the 15% protein diet, after which it was progressively poorer in the 4 and 8% palm oil diets. In contrast, in the 18% protein diets, efficiency of gain was improved up to 4% palm oil level after which it dropped slightly at the 8% palm oil level. This would seem to indicate that the indigenous pigs used were able to utilise a high energy diet more at a higher protein level. This is in agreement with the work of Friend (1977) who observed

that efficiency of feed utilization improved at the higher level of energy intake, pointing to the need for increased energy intake at higher levels of protein intake to maintain the efficiency of protein utilisation. Clawson *et al* (1962) reported a slight but significant increase in daily gains of pigs during the period from 38 to 200 lb due to inclusion of 5 or 10% fat in the ration. Kuryvial *et al* (1962) on the other hand found the use of 15 or 30% supplemental fat in the ration of pigs to decrease feed consumption and increase daily gains. The levels of fat used in the present study were not as high, hence there was no comparable depression in feed consumption. Improved efficiency of feed utilisation due to added fat as obtained in the present study has also been reported by Clawson *et al* (1962) and Kuryvial *et al* (1962).

Feed intake of pigs in all the palm oil added diets was higher than in the basal protein rations. Feed intake was progressively higher from 2 to 4 or 8% palm oil levels in the 15% protein diets while in the 18% protein diets it increased only to the 4% palm oil level. Feed intake at the 4 or 8% palm oil level was about the same in the 15 or 18% protein diets. However, the higher or similar feed intake at the 4 or 8% palm oil level in the 15% protein rations in comparison to the 18% protein rations could have been a compensation for lower dietary protein intake.

Age and Weight of Pigs at Puberty:

Holnes (1972) considered the effect of three levels of energy and two levels of protein on age of pigs at puberty. No significant effect of level of energy on age was evident whereas a significant reduction in age occurred as a result of increasing content of dietary protein. Similarly, Gunningham *et al* (1974) reported that gilts fed a 14% protein diet reached puberty 18.9 days earlier than those fed the 10% protein diet. Friend (1977) reported that the general effect of increasing the energy and protein content of the diet was to increase the rates of body weight gain thus resulting in gilts which were heavier but not younger at puberty. In the present study, increasing protein intake resulted in pigs heavier at puberty which is in agreement with Holness (1972), Gunningham (1974) and Friend (1977) reports. However, in contrast to Holness (1972), significant effect of energy on age at puberty was evident in the present study. Except for pigs receiving the 15% protein diet and 8% palm oil, the general effect of additional energy to the diet was to increase weight of pigs at puberty. The results of the present study therefore showed increasing energy and protein contents of the

diet to increase rates of body weight gains and production of gilts that were heavier and younger at puberty in contrast to Friend's (1977) which were not younger. This study, suggests that attainment of puberty in indigenous pigs is growth-rate and body weight dependent since puberal weight range was 33.32 to 36.10, kg in contrast to puberal age that range between 152.3 to 167.5 days. It is age dependent only indirectly in that the slow growing pigs attained puberal age much later than the faster pigs. This was evident from the observations within 63 days, while the slower growing ones attained the same at about 76 days. Kennedy and Mitra (1963) found puberty in the rat to be more closely related to body weight than age as reported in our present study. However, this observation is in conflict with the findings of Lodge and McPherson (1961) who reported the attainment of puberty in pigs not to be growth rate or body weight dependent but age dependent.

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