Tropical Animal Production 1982 7:14-19

THE EFFECT OF DIETARY PROTEIN LEVEL AND BLOOD MEAL SUPPLEMENTATION ON THE PERFORMANCE OF GROWING LARGE WHITE AND LANDRACE PIGS IN NIGERIA

T F Balogun

Dept. of Animal Science, Ahmadu Bello University, Zaria, Nigeria

Growth and nitrogen balance studies were conducted to determine the effect of dietary crude protein (CP) level and blood meal supplementation on the performance of growing pigs. Large White and Large White x Landrace barrows and gilts averaging 16.8 kg were used in two replicates of a factorial design involving four levels of protein, compounded with or without addition of blood meal. There were forty-eight pigs per replicate. The protein levels used were 18, 20, 22 and 24 per cent. Growth rate and efficiency of feed conversion improved as dietary protein level increased from 18% to 22%. Pigs consuming the blood meal diets were most efficient on the 20 per cent crude protein level. There were no differences in growth rate and feed conversion efficiency between pigs fed diets containing 22% and 24% CP. Apparent percentage nitrogen retention was higher for pigs on the 22% CP diet and the blood meal supplemented diets, although the differences were not significant. At equivalent levels of crude protein, pigs consuming the blood meal supplemented diets performed better than those consuming diets without blood meal.

Key words: Pig growth, nitrogen balance, dietary protein levels, blood meal

Although considerable work has been done in temperate countries to determine the optimum protein requirement for growing pigs (Menge and Probish 1976; Fammatre et al 1977 and Cromwell et al 1978) only very little similar work has been done in Nigeria (Babatunde et al 1972 and Fetuga et al 1975). Apart from the possible effect of the tropical climate on feed intake and utilization, the nature of our protein ingredients could have a major effect on the response of the pig, making the recommendations from the temperate countries inappropriate for the tropical conditions of Nigeria.

A common protein ingredient for pig diets in the temperate countries is soyabean meal, which has been shown to be superior to the readily available groundnut cake in Nigeria (Balogun and Koch 1979). However in Nigeria prohibitive prices of soyabean meal make its use uneconomic as a supplement to grains in pig feeds. Animal blood, which is readily available from the slaughter houses offers a potential replacement. There is therfore a need for more investigation to evaluate the optimum dietary protein levels for our pigs, especially when fed groundnut cake diets supplemented only with blood meal. Babatunde et al (1972) and Fetuga et al (1975) evaluated the inclusion of fish meal and blood meal in pig diets containing groundnut cake. However, the current price of fishmeal in Nigeria has made its continued use in pig diets unattractive. The present study aims at re-examining the optimum crude protein level for growing pigs in a tropical environment when the diets contain groundnut cake and blood meal as protein supplements.

Materials and Methods

Experimental animals: Pigs used in this study were pure bred Large Whites and Large White x Landrace crosses. They were purchased from the Nigerian Livestock Production Company, Kano. Before the start of the experiment, all animals were held in quarantine for one week during which time they were treated for intestinal parasites and the males castrated. They were also sprayed with gammatox to control ectoparasites and were earnotched for identification.

Dietary treatments: The composition of the test diets is shown in Table 1. Diets were compounded to contain protein levels of 18, 20, 22 and 24 per cent on dry matter basis, with and without blood meal supplementation. Maize and groundnut cake were used as the major energy and protein sources respectively.

In the blood meal supplemented diets, the ratio of dietary groundnut cake to blood meal was held constant at approximately 4:1.

The chemical compositions of the groundnut cake and blood meal are shown in Table 2.

Method of processing of blood meal: The blood meal used in this study was processed at the Kano slaughter house. Blood collected from slaughtered animals was heated to boiling in large open drums and then dried in the open air on concrete slabs.

Growth study: Ninety six pigs averaging 16.8 kg were allotted to eight treatment groups (Table 1) in two replicates of a factorial design. Allocation

Table 1:
Composition of experimental diets:

	With Blood Meal				Without Blood Meal			
Protein level, %	18	20	22	24	18	20	22	24
Ingredients, %								
Maize	75.00	70.60	66.10	61.70	72.10	67.10	62.00	57.00
Groundnut cake	15.50	19.10	22.70	26.20	22.40	27.40	32.50	37.50
Blood meal	4.00	4.80	5.67	6.60	-	-	-	-
Bone meal	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Wheat bran	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Oystershell	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Mineral & Vit Mix[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated crude protein, %	18	20	22	24	18	20	22	24
Analysed crude protein,%	18.51	20.17	22.19	24.25	18.09	19.87	21.83	23.84
Calculated lysine, %	0.80	0.90	1.04	1.20	0.77	0.88	0.89	0.89

[1] Minovit Super^{R}: Intervet International B V, Voxmeer, Holland

was based on genotype, sex and initial weight. Pigs were housed in expanded metal pens on concrete floors. Each pen was equipped with a watering trough and a self-feeder. All pigs received meal ad-libitum. The experiment lasted 57 days and the pigs were weighed at the beginning and at the end of the experiment, as well as at weekly intervals. Average daily feed intake, average daily gain, feed conversion efficiency and feed intake/$W^{0.75}$ were also calculated.

Table 2:

Proximate analysis and essential amino acid composition of groundnut cake and blood meal (% air dry basis)[1]

Constituent	Groundnut cake	Bloodmeal
Dry matter	91.96	89.52
Crude protein	44.91	77.35
Ether extract	9.16	0.53
Crude fibre	3.81	1.46
Ash	5.51	2.08
Arginine	5.37	2.97
Cystine + methionine	1.09	2.10
Histidine	1.77	5.45
Isoleucine	1.56	1.01
Leucine	3.27	10.05
Lysine	2.07	8.13
Phenylalanine	2.35	5.83
Threonine	1.67	3.86
Valine	2.12	6.31

[1] Analyses at NAPRI, Shika

Nitrogen balance studies: Sixteen Large White litter-mate barrows weighing approximately 13.5 kg were used in a completely randomized block design with period as the blocking factor. The experiment had two periods. Pigs were housed individually in locally constructed metal metabolism crates allowing for separate collection of faeces and urine. Each pig was fed 0.8 kg per day at approximately 08.00 hours. A five-day faecal and urinary collection period followed a five-day pre-test period. Urine was collected daily in plastic buckets to which 15 ml of concentrated HCl was previously added. Each daily urine collection was diluted to 4,000 ml. A 100 ml aliquot was taken from each day's collection and the 5-day composite used for chemical analysis. Faeces were collected daily for each period in plastic bags and stored in a deep freezer. Total collection for a period was dried in an oven, cooled and then weighed. It was then ground , mixed and samples taken for analysis. At the end of the first collection period, the procedure was repeated for a second period, with the pigs reallotted to the dietary treatments on a random basis. Chromic oxide powder was used as a marker to identify the beginning and end of each faecal collection period. Water was supplied to the pigs each day as required.

All feeds not consumed were collected daily and stored. The total for a particular period was weighed. Representative feed, faecal and urine samples were analysed in duplicate for nitrogen by AOAC procedures (AOAC 1970).

Statistical analysis: Treatment effects were examined using an analysis of variance and the significance of differences between means by the method of Least Significant Difference (Snedecor and Cochran 1967).

Results and Discussion

Results are presented in Table 3 for daily gain, food consumption and feed efficiency. There were no significant ($P < .05$) interactions between dietary protein level and blood meal inclusion in the diet for these characters.

Pigs on the blood meal diets tended to gain faster, consume more feed and to be slightly more efficient than those whose diets contained no blood meal. Voluntary feed intake per metabolic size (LWG $kg^{0.75}$) was also higher on the blood meal diet. The means for the protein levels showed a general trend towards improved liveweight gain as the dietary protein level increased from 18 to 22%. Average daily feed intakes calculated on a liveweight basis were not significantly different but there was an indication of higher intakes with the higher protein levels. This effect was statistically significant when the results were calculated on a metabolic weight basis. The extreme protein levels gave significantly different efficiencies of conversion with the higher protein level the more efficient.

Table 3:

Effect of blood meal inclusion and dietary protein level on pig performance

Factor	Main effect means							
	Protein source			Protein levels, %				
	With blood meal	Without blood meal	SE of means	18	20	22	24	SE of means
Initial weight, kg	16.88	16.66	-	16.96	16.57	16.82	16.72	-
Final weight, kg	39.34	35.64	-	32.59	36.44	41.19	39.74	-
Average daily gain, kg/d	0.40	0.34	0.03	0.28^{a}	0.35^{a}	0.43^{b}	0.41^{b}	0.06
Average daily feed intake, kg/d	1.32	1.15	0.09	1.15^{a}	1.19^{a}	1.31^{a}	1.31^{a}	0.07
Average feed intake/$W^{0.75}$ g/$kgW^{0.75}$	108.0	99.0	6.36	103.0^{a}	101.8^{a}	104.8^{ab}	106.9^{b}	2.22
Feed/gain ration	3.30	3.38	0.04	4.10^{a}	3.40^{ab}	3.05^{b}	3.20^{b}	0.40

W = Average weight

^{a,b} Means in the same row followed by different letters differ significantly ($P < .05$)

These results are in agreement with those of Babatunde et al (1972) who showed that the crude protein requirement for pigs of the weight used in this study is between 22 and 24 per cent. Fetuga et al (1975) reported 20 per cent crude protein as the optimum level.

Improved performances of the blood meal diets could result from the supplementary effect of lysine from blood meal (Table 1). Lysine has been shown to be the first limiting amino acid in groundnut cake diets for growing pigs (Brooks and Thomas 1959). This is evidenced from the slightly better FCE on a lower crude protein level of 20 per cent when blood meal was included in the diet than the 22 per cent crude protein level without blood meal. The FCE results also suggest a lower optimum crude protein requirement for pigs when lysine is adequate. The isoleucine deficient blood meal was conveniently balanced by the isoleucine rich groundnut cake in the diets. Lack of statistical significance of some parameters measured could be due to the small size of experimental units. Another reason could be the effect of processing method

on the nutrient availability of the blood meal used. Previous workers (Wahlstrom et al 1977) have shown that the value of blood meal in soybean meal-based diets for pigs was affected by processing method.

The results of this study suggest that locally processed blood meal could be used to advantage in groundnut cake-based rations for growing pigs especially where the high costs of other protein supplements make them uneconomic. The results also suggest that the optimum protein level for growing pigs under the conditions of the experiment is between 20 and 22 per cent.

Results of the percentage apparent nitrogen digestibility and retention are presented in Table 4. Addition of blood meal to the diet resulted in higher percentage apparent nitrogen retention, although the difference was not significant. The value for the apparent digestible nitrogen was slightly lower for the blood meal diets than for those without blood meal. Although these differences were not significant, lack of significance could be due to the small size of experimental units and a larger experiment is required to verify the influence of blood meal inclusion on nitrogen retention and digestion.

Table 4:

Apparent nitrogen digestibility and retention by pigs

Factor	Main effect means					
	Protein source		Protein level, %			
	With blood meal	Without blood meal	18	20	22	24
Nitrogen intake, g	26.23	23.85	21.80	23.85	27.45	27.05
Urinary nitrogen, g	8.12	8.38	7.72	7.75	8.41	9.13
Faecal nitrogen, g	4.15	3.67	3.38	3.95	4.10	4.21
Apparent nitrogen digeated, %	84.19	84.53	84.46	83.46	85.12	84.40
Apparent nitrogen retained, %	53.12	49.26	48.95	50.73	54.50	50.57

Differences between treatments are not statistically significant ($P > .05$)

The presence of blood meal increased lysine level (Table 1) which could result in improved nutrient balance and hence higher percentage nitrogen retention. Groundnut cake also supplemented blood meal in isoleucine. The slightly lower apparent digestible nitrogen of the blood meal diets suggests low digestibility of blood meal by pigs.

The highest values for both the percentage apparent nitrogen digestibility and retention for the combined protein effects were obtained at the 22% CP level. This suggests that optimum utilization of the nutrient occurred when the pigs were fed 22% CP diet.

Acknowledgements

The author appreciates technical assistance by Messrs S Isiaka, S Itodo and A Oparaeke. The study was supported by funds from the Ahmadu Bello University Board of Research.

References

AOAC Association of Official Agricultural Chemists 1970 Official Methods of Analysis 11th Edition

Babatunde G M, Olomu M J & Oyenuga V A 1972 Determination of the optimum crude protein requirement of pigs in a tropical environment Animal Production 14:57-67

Balogun T F & Koch B A 1979 Influence of trypsin inhibitor level and processing on the nutritional value of groundnuts for finishing pigs Tropical Agriculture 56:245-251

Brooks C C & Thomas H R 1959 Supplements to peanut oil meal protein for growing fattening swine Journal of Animal Science 18:1119-1127

Cromwell G L, Hays V W, Trujillo-Figueroa V and Kemp J D 1978 Effects of dietary protein and energy levels for growing finishing swine on performance, muscle composition and eating quality of pork Journal of Animal Science 47:505-513

Fammatre C A, Mahan D C, Fetter A W, Grifo A P and Judy J K 1977 Effects of dietary protein, calcium and phosphorus levels for growing and finishing swine Journal of Animal Science 44:65-71

Fetuga B L, Babatunde G M and Oyenuga V A 1975 Protein levels in diets for european pigs in the tropics Animal Production 20:133-146

Menge H and Frobish L T 1976 Protein and energy in the diet of the weaning pig Journal of Animal Science 43:1019-1023

Snedecor G W and Cochran W G 1967 Statistical Methods Iowa State University Press 6th Edition

Wahlstrom R C and Libal G W 1977 Dried blood meal as a protein source in diets for growing -finishing swine Journal of Animal Science 44:778-783

Received 16 August 1981