QUALITY PROTEIN MAIZE AS THE SOLE SOURCE OF AMINO ACIDS IN THE DIETS OF STARTER PIGS: A PRELIMINARY STUDY

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ABSTRACT

A 16-week trial was conducted using 14 Large White starter pigs divided into two equal groups, each containing three females and four males of approximate average weight 8.4 kg. Pigs were individually housed in metal cages measuring 69 x 160 x 110 cm constructed on a concrete floor. Group 1 pigs were fed a diet containing 91% quality protein maize (QPM) while Group 2 pigs received a similar diet but containing 91% normal hybrid maize (NM). The diets were balanced for minerals and vitamins by the addition of a vitamin-mineral premix. Feed and water were supplied ad libitum.

Feed consumption and body weight changes were measured on a weekly basis. Starter pigs fed QPM were significantly heavier ($P < 0.05$) at the end of the trial than their counterparts receiving the normal maize diet (22.3 kg against 14.4 kg per pig respectively). Their corresponding average daily body weight gains were 124.1 g and 52.7 g respectively and the difference was significant at $P < 0.05$. QPM-fed pigs consumed on the average 34.3 per cent more feed than the pigs fed the normal maize diet while the respective feed conversion ratios were significantly different, being 4.12 kg and 7.72 kg feed per kg gain ($P < 0.05$).

Keywords: *Quality protein maize, starter pigs, amino acids, weight gains, feed conversion ratio.*

INTRODUCTION

Maize is an indispensable cereal grain in the diets of monogastric animals in Ghana, constituting up to 60 per cent of the typical pig or chicken diet and is characteristically used as a source of energy. Normal maize (NM), which is traditionally used, has a low protein content and is particularly deficient in essential amino acids like tryptophan and lysine [1,2], making it an inadequate source of protein or amino acids for young pigs. For this reason, maize-based diets for pigs require supplementation with expensive protein sources including fishmeal and soybean meal, both of which may not always be available.

AGRICULTURE

In recent years plant breeders have concentrated their efforts on improving the protein quality of maize so that the use of such improved varieties will reduce the dependence on the expensive protein sources. In Ghana, the Crops Research Institute based in Kumasi released a new variety of maize called quality protein maize (QPM) a few years ago. QPM contains the opaque-2 gene responsible for its better amino acid balance compared with normal maize. QPM cultivars have been tested for their nutritional value for rats, chickens and humans in various countries [3, 4]. Little work on QPM evaluation has been reported in Ghana either for pigs or chickens.

This trial was therefore conducted to investigate the value of QPM as the sole source of protein and amino acids in pig starter diets compared with normal hybrid maize.

MATERIALS AND METHODS

The trial was conducted at the Livestock Section of the Department of Animal Science, University of Science and Technology, Kumasi and lasted for 16 weeks. A total of 14 six-week old Large White starter pigs of the same litter group were divided into two groups, each with three females and four males. Group 1 pigs weighed on the average 8.4 kg while Group 2 pigs weighed 8.5 kg on the average.

The pigs were housed individually in metal enclosures built on a concrete floor and each measuring 69 x 160 x 110 cm. Each pig served as a replicate and the completely randomised design was employed.


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Both groups of experimental pigs received similar diets except that the group 1 diet contained 91 per cent quality protein maize and group 2 diet had 91 per cent normal hybrid maize. The diets were balanced for minerals and vitamins by the addition of a vitamin-mineral premix. Table 1 shows the composition of the diets used. Quality protein maize and normal maize were analysed for their contents of protein and essential amino acids using conventional methods of the Association of Official Analytical Chemists [5].

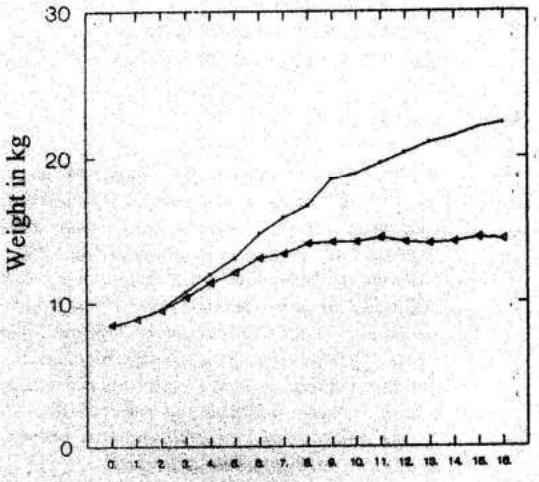
Feed and water were provided *ad libitum*. The feed for each animal was weighed at the beginning of each week and the leftovers weighed at the end of the week to calculate feed intake. Each animal was weighed once a week at the time new feed was supplied.

RESULTS AND DISCUSSION

Table 2 shows the crude protein and essential amino acid compositions of QPM and NM and indicates that of the ten essential amino acids QPM consistently had higher levels than NM except for methionine. Summaries of feed consumption and growth performance data are presented in Table 3 and Figure 1 respectively.

Pigs receiving the NM diet consumed non-significantly more feed in the first two weeks of the trial than their QPM counterparts, but were overtaken in the third week. The differences persisted throughout the duration of the trial and became significant as early as the 8th week. At the end of the 16 weeks, QPM pigs were consuming 83 percent more feed than the NM-fed pigs, while the overall feed intake of the QPM pigs was 1.34 times that of NM pigs. These observations are in agreement with data earlier reported by various workers elsewhere [1, 4, 6].

Pigs on the QPM diet grew faster throughout the 16-week trial period and gained overall an average 13.9 kg compared with 5.9 kg by the pigs on normal maize. The corresponding average daily gains were respectively 124.1 g and 52.7 g for QPM and NM showing that the QPM pigs grew at a rate 2.36 times that of NM pigs. Previous work in the USA showed that growing pigs gained weight 3.6 times faster on improved maize than on normal maize [1, 7]. Normal maize-fed pigs reached a weight plateau around 14.1 kg after the 8th week on the diet (Figure 1) while QPM pigs continued to gain weight throughout.



Week of Experiment
Δ NM □QPM
Figure 1: Growth of pigs fed QPM or NM

The superior growth rate and weight gain of QPM pigs were not due solely to the increased feed intake, but also to their far superior feed conversion efficiency (4.42 g feed per g gain as against 7.76 for the NM-fed pigs). Similar observations have been made by other researchers [1, 2, 8]. QPM has a better essential amino acid balance than normal maize; in addition, the higher levels of lysine and tryptophan, normally limiting in normal maize, are responsible for the better nutritional value of quality protein maize according to Sullivan et al [9].

Data presented in this report indicate that QPM is superior to normal maize as a source of essential amino acids in promoting the growth of starter pigs. However, the improved growth on QPM is still below that of Large White pigs on a properly balanced diet which attain live weights of between 60 and 70 kg at 22 wk of age at the livestock farm where the trial was

Table 1: Composition of experimental diets

Ingredients (kg per 100kg diet)	Group 1 (QPM)	Group 2 (NM)
Quality protein maize	91.0	-
Normal maize	-	91.0
Sucrose	5.3	5.3
Dicalcium phosphate	3.3	3.3
Vitamin premix[1]	0.1	0.1
Trace mineral premix	0.1	0.1
Common salt[2]	0.2	0.2
Furasol[3]	0.2	0.2

[1]*Vitamin premix containing per kg: Vitamin A, 12.5 million IU; D, 2.5 million IU; E, 25,000 IU; K, 2,500 IU;Bl, 1000 mg; B2, 5,000 mg; B6, 1,000 mg; B12, 20 mg; pantothenic acid, 13,750 mg; niacin, 40,000 mg; folic acid, 500 mg; biotin, 50 mg.*

[2]*Mineral premix contained per kg: Fe, 44,000 mg; Cu, 5,000 mg; Zn, 56,000 mg; I, 300 mg; Mn, 62,000 mg; Co, 200 mg; Se, 200 mg.*

[3]*Furasol is an antibiotic (Radar N.V., Dorpestraat, Belgium).*

Table 2: Essential amino acid contents of QPM and normal maize (per cent dry matter basis)

Amino acid[1]	QPM	NM	QPM/NM
Threonine	0.34	0.24	1.42
Alanine	0.57	0.48	1.17
Cystine	0.26	0.19	1.37
Valine	0.48	0.33	1.45
Methionine	0.15	0.17	0.88
Isoleucine	0.30	0.23	1.30
Leucine	0.88	0.77	1.14
Phenylalanine	0.39	0.31	1.25
Histidine	0.35	0.22	1.59
Lysine	0.36	0.23	1.56
Arginine	0.56	0.35	1.60
Tryptophan	0.10	0.06	1.67

[1]*Each value is the mean of duplicate determinations.*

Table 3: Summary of feed consumption (kg feed per pig per week)b

Week	QPM	NM	QPM/NM
1	2.17	2.32	0.93
2	2.72	2.95	0.92
3	3.66	3.45	1.06
4	3.74	3.65	1.02
5	4.37	3.70	1.18
6	5.10	3.80	1.34
7	3.97	3.70	1.07
8	3.79	3.15	1.52**
9	4.61	3.61	1.73**
10	4.69	3.44	1.36**
11	4.02	2.32	1.73**
12	2.71	2.04	1.81**
13	3.64	1.96	1.85**
14	3.29	1.79	1.84**
15	3.44	1.87	1.84**
16	3.59	1.96	1.83**
Mean	3.84	2.86	1.34**

***Differences between QPM and NM significant at P = 0.05*

conducted. It is clear therefore that QPM by itself is not an adequate source of amino acids for growing pigs. On the other hand, the improved contents of essential amino acids suggests that the use of QPM can reduce the need for fishmeal (and soybean meal) in pig diets and thereby cut feed and production costs. Further work is required to ascertain this.

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