Preliminary studies on the complete replacement of fishmeal by house-fly-larvae-meal in weaner pig diets: Effects on growth rate, carcass characteristics, and some blood constituents

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ABSTRACT

Ten Large White weaners with an average liveweight of 10.6 kg were assigned to two diets containing either fishmeal or house-fly-larvae-meal as the main protein source. The average daily gains of the pigs were 0.25 and 0.29 kg for the fishmeal and house-fly-larvae-meal diets, respectively. Feed conversion ratios were 3.64 and 3.29, and feed cost per kg gain were ¢2735.18 and ¢2470.89 for the fishmeal and house-fly-larvae-meal diets, respectively. Dressing percentage, fat measurements, and eye muscle area were not significantly affected (P>0.05) by the dietary treatments. The carcass fat contents were, however, higher in the house-fly-larvae-meal-fed pigs. The weights of joints and cuts expressed as proportions of carcass weight were not significantly affected (P>0.05) by diet. The blood parameters studied, i.e., packed cell volume (PCV) and haemoglobin, were not significantly affected (P>0.05) by diet. House-fly-larvae-meal could, therefore, be used to replace dietary fishmeal completely without compromising growth performance and the economics of pig rearing.

RÉSUMÉ

DANKWA, D., ODDOYE, E. O. K. & MZAMO, K. B. : *Etudes préliminaires sur le remplacement complet de guano de poisson avec le guano d'asticot de la mouche domestique dans les régimes de jeune cochon sevré : Les effets sur la proportion de croissance, les caractéristiques de carcasse et quelques constitutifs sanguins.* Dix jeunes cochons gros blancs sevrés avec un poids vif moyen de 10.6 kg étaient donnés deux régimes contenant soit le guano de poisson soit le guano d' asticot de mouche domestique comme la source principale de protéine. Les gains quotidiens moyens des cochons étaient 0.25 et 0.29 kg respectivement pour les régimes de guano de poisson et guano d' asticot. Les proportions de conversion de ration étaient 3.64 et 3.29 et le coût de ration par kg de gain étaient ¢2735.18 et ¢2470.89 respectivement pour les régimes de guano de poisson et guano d'asticot de mouche. Le pourcentage de préparation, le mesure de la graisse et la superficie de muscle du filet n'étaient pas considérablement affectés (P > 0.05) par les traitements de régime. Les niveaux de graisse de carcasse étaient, cependant, plus élevés dans les cochons nourris avec le guano d' asticot de mouche domestique. Les poids des jointures et des morceaux exprimés comme des proportions de poids de carcasse n'étaient pas considérablement affectés (P > 0.05) par le régime. Les paramètres du sang étudiés c.-à-d., le volume de cellule serrée (VCS) et l' hémoglobine n' étaient pas considérablement affectés (P > 0.05) par le régime. Le guano d' asticot pourrait donc être utilisér pour remplacer le guano de poisson complètement sans compromettre le rendement de croissance et le côté économique de l'élevage du cochon.

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Introduction

The profitability of the swine enterprise in Ghana is highly dependent on the provision of adequate but inexpensive feed. The traditional protein

sources, such as fishmeal and soyabean-meal, are expensive and their prices continue to escalate. Several attempts (Abu, Okai & Tuah, 1984; Okai & Bonsi, 1989; Rhule, 1995, 1996, 1999) have been made to reduce the cost of pig feeds mainly through the use of non-conventional feed ingredients. Fly-larvae-meal is one such non-conventional feed ingredient which could be used as a protein source.

Fly-larvae-meal is a good source of protein (Gawaad & Brune, 1979; Ocio-Trueba, Vinaras-Garcia & Rey-Arnaiz, 1978), providing adequate supplies of some limiting amino acids, particularly arginine (3.7 %), lysine (6.0 %), and methionine (1.6 %) (Teotia & Miller, 1973; Rey, Vinaras & Ocio, 1979). Fly-larvae-meal is an inexpensive source of protein (Bayandina, 1979; Atteh & Ologbenla, 1993; Dankwa & Nelson, 1995; Dankwa, Nelson & Wallace, 1998).

Studies on larvae-meal with pigs indicated no adverse effect on rate of gain and development of pigs, neither was there any ill effect on the physiological function and breeding performance of pigs fed larvae-meal diets (Bayandina, 1979; Bayandina & Inkina, 1980; Poluektova *et al.*, 1980). Bayandina & Inkina (1980) found that pigs on larvae-meal diets produced more meat with good organoleptic properties than those fed fishmeal or meat and bone meal diets. No pathological changes were observed during the experiment.

This study was designed to determine the effects of the complete replacement of fishmeal with larvae-meal on the growth performance, carcass characteristics, and some blood constituents of weaner pigs.

Materials and methods

Animals

Ten Large White weaners with an average liveweight of 10.6 kg were assigned to two dietary treatments according to a completely randomized design with five pigs to a treatment. There were two females and three males on each treatment.

Treatments

The main difference between the two diets was that one had fishmeal as the main protein source while the other had larvae-meal as the main protein source. The fishmeal-based diet was the standard one in use and the larvae-meal replaced all the fishmeal in the larvae-meal-based diet. Tables 1 and 2 show the ingredient composition of the two diets and their chemical analysis as well as that of the larvae-meal, respectively.

Preparation of larvae meal

A mixture of blood and gut contents of cattle, with a little dry poultry manure added to bring moisture content of the mixture to about 70 per cent, serves as the growing medium. This medium was put in plastic bowls which were then placed on shelves in a cement tank, and in a shady place. House flies (*Musca domestica*) laid their eggs in this medium. After 3 days, when eggs had hatched into larvae, the bowls were covered with black polyethylene sheets. The gases and heat

TABLE 1

Ingredient Composition (%) of the Two Diets

Ingredients	*Fishmeal diet*	*Fly-larvae-meal diet*
Maize	50.1	50.1
Ricebran	17.5	17.5
Palm kernel cake	20.6	20.6
Fly-larvae-meal	-	10.8
Fish meal	10.8	-
Shell grit	0.3	0.3
Common salt	0.5	0.5
Vitamin/mineral premix	0.2	0.2

TABLE 2

Proximate Analysis of Diets (g kg^{-1} DM)

Determined analysis	*Fishmeal diet*	*Fly-larvae-meal diet*	*Fly-larvae-meal*
Moisture	106.8	111.7	129
Ash	84.9	52.1	93
Crude protein	133.8	136.6	604
Ether extract	45.4	57.2	94
Crude fibre	99.7	108.8	77

generated within the medium made the larvae uncomfortable. The larvae crawled out of the medium, falling into the bottom of the tank to be collected. After collection, the larvae were placed in a big sieve and washed continuously in a stream of running water. The larvae were kept in a freezer overnight to kill them, and they were then sun-dried. The sun-dried material was milled and used in feed preparation.

Feeding

Pigs on a particular treatment were kept and fed in a group. They were fed once daily but water was provided *ad libitum*.

Management

The pigs were weighed individually at the start of the experiment and thereafter weekly. Feed allowance was 6 per cent of body weight and was adjusted at the weekly weighing. The pigs were fed for 10 weeks after which four pigs from each treatment were slaughtered for carcass measurements.

Carcass measurements

After slaughtering, the weight of the empty carcass was recorded. The carcasses were then chilled (0 °C) for 24 h. The head was removed and the body split into halves by sawing along the vertebral column. The left side of the carcass was used for the various measurements according to the procedures of the Meat and Livestock Commission (1980). Measurements taken were carcass length, fat depth at the shoulder, loin and P_2, width of carcass (A), depth of carcass (B), and the weight of the various cuts. The measurements A and B were used to calculate the eye muscle area.

Blood parameters

The pigs were bled through the capillary vein. The cyanmethhaemoglobin method was used to determine the haemoglobin content (Baker, Silverton & Luckcock, 1966). Samples of blood were put in microcapillary tubes and centrifuged (2500 rpm) for 5 min. The Hawksley microheaematocrit reader was then used to read the packed cell volume (PCV).

Analyses

The chemical analysis of the diets followed the procedures of AOAC (1984). Treatment means were compared by t-test (Cochran & Cox, 1957). *A priori,* it was decided to use a one-tailed test in this study, as larvae-meal had been shown to be a good substitute for fishmeal in experiments with poultry (Dankwa & Nelson, 1995; Dankwa *et al.*, 1998).

Results and discussion

The crude protein content of the two diets were fairly similar. The larvae-meal diet had higher crude fibre and ether extract contents (Table 2). This may reflect the high crude fibre content of larvae-meal (77 g kg^{-1} DM). The crude fibre content was high probably because some of the larvae might have started to pupate before collection, and as a result the larvae-meal contained some of the more fibrous puparium. The high ether extract content might correct for the high fibre content of the maggot-meal diet. Fats contain 2.25 times the amount of energy as carbohydrates, and the high ether extract content will, therefore, improve the digestible energy content of the larvae-meal diet.

The growth rates of pigs on the two diets (Table 3) were not significantly different ($P>0.05$). The feed conversion ratio could not be analyzed statistically as the pigs were fed in groups. The pigs on the larvae-meal diet, however, had a better feed conversion ratio than those on the fishmeal diet (Table 3). This difference, together with the fact that larvae-meal is cheaper than fishmeal, resulted in the larvae-meal diet being ¢264.29 cheaper in feed cost per kg of gain.

Pigs on the larvae-meal diet had a higher slaughter weight than those on the fishmeal diet, although this difference was not significant ($P>0.05$). Dressing percentages, eye muscle area and fat measurements were not significantly ($P>0.05$) affected by diet. All the fat measure-

ments were, however, higher in the pigs fed the larvae-meal diet (Table 3). This could indicate excess energy in the diet as shown by the high ether extract value in Table 2.

The weights of the various cuts and joints were expressed as percentages of carcass weight (Table 3). There were no significant differences ($P>0.05$) between any of the various cuts or joints. The PCV and haemoglobin measurements were not significantly affected by diet ($P>0.05$).

Since the use of non-conventional protein sources such as house-fly-larvae-meal is still relatively new, there is a paucity of information on work done in this area. The results of this study, however, agree with other work that has been done in this area. Bayandina (1979) concluded that pigs fed on house-fly-larvae, as the main protein source, had better digestibility of dietary nutrients and at reduced cost as compared to other diets. Poluektova *et al.* (1980) fed pigs on a diet containing house-fly-larvae-meal and observed no adverse effects on erythrocyte and leucocyte counts, Hb, and the activity of catalase and peroxidase in the blood. They also concluded that the inclusion of larvae-meal improved metabolism and development of muscular and connective tissues, gastric glands, and mucous membranes of the small intestines.

Demeutèva & Pishchenko (1985) also reported that when house-fly-larvae-meal was used as the main protein source in a diet for weaner pigs, there were no adverse effects on the activity of catalase and peroxidase in blood at 3, 6 and 9 months of age. Bayandina & Inkina (1980) also reported an experiment in which sows and their offspring were fed for a prolonged period on a diet containing house-fly-larvae-meal. There were no adverse effects on rate of gain and development of weaner pigs compared to the control diet. The reproductive perfor-mance of sows was also not adversely affected. The larvae-meal diet gave more meat with good organoleptic properties. Gudilin & Bayandina (1985) fed pigs with a diet containing meat-and-bone-meal or one

TABLE 3

Growth Rates, Carcass Characteristics and Some Blood Constituents of Pigs Fed Diets Containing Either Fishmeal or Fly-Larvae-Meal (Mean ± SE)

Criteria	*Fishmeal diet*	*Fly-larvae-meal diet*
Performance		
Daily gain (kg/day)	0.25 ± 0.007	0.29 ± 0.021
Feed conversion	3.64 ± 0.098	3.29 ± 0.258
Cost/kg gain (¢)	2735.18 ± 73.92	2470.89 ± 194.23
Carcass traits		
Slaughter weight (kg)	25.87 ± 0.473	29.00 ± 1.814
Dressing (%)	63.45 ± 1.660	63.95 ± 0.617
Carcass length (cm)	51.05 ± 0.889	50.67 ± 1.599
Exposed muscle surface of last rib (cm)		
A	6.05 ± 0.323	6.32 ± 0.214
B	2.77 ± 0.250	2.62 ± 0.063
Eye muscle area (cm^2) (A×B)	16.97 ± 2.200	16.60 ± 0.662
Shoulder fat (cm)	2.65 ± 0.275	3.02 ± 0.309
Loin fat (cm)	0.42 ± 0.048	0.45 ± 0.096
P_2 (cm)	0.37 ± 0.085	0.50 ± 0.091
*Collar	8.28 ± 0.877	6.72 ± 0.501
*Hand	7.87 ± 0.355	7.05 ± 0.702
*Rib back	4.56 ± 0.325	4.06 ± 0.457
*Rump back	4.12 ± 0.170	4.35 ± 0.487
*Streak	5.24 ± 0.387	5.73 ± 0.179
*Ham	11.53 ± 0.848	11.48 ± 0.676
*Head	12.25 ± 0.758	10.69 ± 0.253
Blood parameters		
PCV	0.47 ± 0.026	0.42 ± 0.018
Hb	119.40 ± 2.482	112.60 ± 3.341

* Expressed as a percentage of carcass weight.

** Fat thickness measured 65 mm from the dorsal mid-line.

in which 20 per cent of the digestible protein was provided as house-fly-larvae-meal. Average daily body weight gain was 560 and 630 g, respectively. For carcass quality, the two diets were comparable.

Conclusion

This study indicated that larvae-meal is a potential protein source in pig feeds. It can be used as an economical protein source for weaner pigs without any detrimental effect on their growth performance. In this study, all the fishmeal in the standard diet was replaced by larvae-meal. There may be the need to find out how weaner pigs will perform if higher levels are fed.

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