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The Use of Different Sources of Protein on the Growth and Reproduction of Pigs

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Abstract: Eighteen clinically sound and parous sows and 6 boars of Large White x Landrace crosses were used to study the effects of different sources of protein on the growth and reproduction. The treatments T_1, T_2 and T_3 which contained T_1 Fish meal (FM) control, T_2 Chicken offal meal (COM) and T_3 Full-fat soybean (FFSB) and fed to the pigs in a completely randomized block design (CRD). The mean body weight gain, feed intake and feed conversion ratio did not differ significantly ($P > 0.05$) between treatment groups. However, higher numerical values were obtained for COM and FFSB treatment diets. The gestation length ranged from 114 – 116 days. The number of piglets born were similar ($P > 0.05$) between the treatment groups, but COM and FFSB treatment groups showed higher values. The piglet birth weight gain were similar ($P > 0.05$) between COM and FFSB treatment groups, however, they differed significantly ($P < 0.05$) from T_1 FM control. The piglets weight gain at 0- 2, 0 – 4 weeks of age were similar ($P > 0.05$) between treatment groups. However, piglets weight gain at 4 – 8 weeks of age were similar between COM and FFSB treatment groups but differed significantly ($P < 0.05$) from T_1 FM group. The number of piglets weaned and weaning weights were similar ($P > 0.05$) between treatment groups, however, higher values were observed in COM and FFSB treatment groups. It is concluded that COM and FFSB can completely replace fish meal in the rations of pregnant pigs without any deleterious effects on growth and reproduction.

Key words: Protein sources, growth, reproduction, pigs

Introduction

The high cost and adulteration of fish meal is becoming increasingly important to explore other alternative sources for providing dietary protein in monogastric animal feeding (Esonu *et al.,* 2001; Madubuike, 1992). Chicken offal meal (COM) is an abattoir waste whose potential as feed ingredient in monogastric rations is presently being investigated. Chicken offal meal is a product resulting from rendering of some poultry eviscerating parts mainly the gut contents. It is rich in protein, fat and minerals. Chicken offal meal has been established as a valuable ingredient in broiler diets, with growth promoting properties similar to those of fish meal. It has been used as a protein source in the diets of chickens (Salami and Oyewole, 1997) and pigs (Akpodiete *et al.,* 2001).

Full-fat soybean (FFSB) has proved to be a valuable alternative of plant protein source that can be used to replace groundnut cake, as well as reduce the conventional requirement of fish meal in monogastric animal feeds (Madubuike, 1992). If properly processed, full-fat soybean can make a particularly useful contribution to the diets of pigs by virtue of a high protein content with good acid balance, a large proportion of oil, which over half is the poly-unsaturated essential fatty acid, linoleic acid and an ability to mix rapidly and uniformly with other dietary ingredients (Aburto *et al.,* 1998). According to Bowers *et al.* (2000), it was possible to achieve levels of performance in pigs which were higher with the use of FFSB than those with more traditional diet based on skimmed milk and fish meal. This study was designed to evaluate the effect of different protein sources on the growth and reproduction of sows.

Materials and Methods

Management of experimental animals: Eighteen clinically sound and parous sows and 6 boars, large White x Landrace were used for this study. The pigs were housed in concrete floored pens equipped with feeding and watering troughs. Feed and water were provided *ad libitum*. The experiment lasted for 36 weeks. Pigs weight and feed consumption were recorded weekly throughout the 12-week feeding trial.

Preparation of the protein meal: The full-fat soybean was processed by lowering a raw soybean packed in jute bags in a half-drum of boiling water and allowed to boil for 60 minutes. Timing of the boiling commenced when the water reached 100°C after introducing the bags. The boiled seeds were drained of water and sundried to less than 10% moisture level before being ground for use.

The chicken offal meal was got from the broiler chicken intestines (gut content inclusive). They were cleaned of residues and washed with water to remove dirt. These

Table 1: Proximate chemical composite of the protein sources (g/kg)

Nutrients	FM	COM	FFSH
Moisture	80.00	118.00	82.10
Crude protein	656.00	600.00	430.00
Crude fibre	10.00	61.10	64.80
Ether extract	77.00	84.60	185.00
Nitrogen free extract	161.00	110.30	274.80
Ash	96.00	144.00	45.40
Minerals			
Calcium	51.00	8.10	5.91
Magnesium	3.40	2.30	0.61
Sodium	1.80	20.06	26.67
Potassium	3.50	12.02	10.48
Phosphorus	30.00	5.10	0.86
Iron	0.30	0.08	0.33

FM = Fish meal, COM = Chicken offal meal, FFSB = Full-fat soybean

Table 2: Composition of experimental diets (g/kg)

	FM	COM	FFSH
Maize	450.0	445.4	425.0
Maize offal	250.0	250.0	250.0
Fish offal	25.0	-	-
Chicken offal meal	-	27.1	-
Full-fat soybean	250.0	250.0	300.0
Bone meal	12.5	12.5	12.5
Oyster shell	7.5	7.5	7.5
Premix*	2.5	2.5	2.5
Salt	2.5	2.5	2.5
Determined (DM basis)			
Crude protein	171.0	177.0	180.0
Crude fibre	46.0	53.0	40.0
Ether extract	40.0	51.0	40.0

*Supplied the following per kg of ration: Vit A, 11,785 IU; Vit. D, 1944.3 IU; Riboflavin, 5.4 mg; Panthotenic acid, 9.82 mg; Nicotinic acid, 24.55 mg; Choline chloride, 4.0 x 10^5 mg; Vit E, 4.91 IU; Vit. B_{12} 0.01 mg; Methionine, 245.53 mg; Cobalt, 1.23 mg; Iodine 0.98 mg; Cu, 9.82 mg; Mn., 55.0 mg; Zn, 49.11 mg and Fe, 19.64 mg.

were then transferred into a half-drum, where the "wet rendering" method of processing was applied by cooking the intestines at a temperature of about 150°C for 2 hours. The broth was allowed to cool, partially defatted by decanting the oil at the top layer and further pressed gently to expel oil and water. The sample was sun-dried to less than 10% moisture level and ground for use. The chemical composition of the protein sources were determined by the methods of AOAC (1995).

Experimental design and procedure: The eighteen sows were divided into 3 treatment groups identified as T_1, T_2 and T_3. Each treatment group consisted of 6 sows and was further replicated 3 times with two sows per replicate. Three diets were formulated, the control T_1 contained fish meal, T_2 contained COM and T_3 FFSB with total replacement of the fish meal with COM and FFSB respectively on protein basis. The diets were isonitrogenous and caloric with 18% CP and 2900 kcal ME/kg and randomly allotted to the treatment groups. All the sows were served by the respective boars attached to the treatment group. The dates of mating and farrowing of the pregnant pigs were recorded. The following parameters were evaluated. 1. Gestation length. 2. Number of piglets born. 3. Number of piglets born alive 4. Weight of piglets. 5. Number of piglets weaned. 6. Piglets weaning weights.

Data analysis: All the data collected from this study were subjected to analysis of variance Steel and Torrie (1980) and treatment means where significant were separated using Duncan's New Multiple Range Test as described by Obi (1990).

Results and Discussion

The results of the Chemical Composition of the protein sources are shown in Table 1, the proximate composition of the experimental diets are shown in Table 2, growth performance is shown in Table 3 while the reproductive performance of the sows are shown in Table 4. The growth performance of pigs fed on the different sources of protein did not show any significant differences ($P > 0.05$) between the treatment groups. The weight gain FM 0.51 (kg/day); Com 0.58 (kg/day) and FFSB 0.59 (kg/day) were not significantly different ($P > 0.05$) between the treatment groups. Feed intake, FM 1.62 (kg/day) COMM 1.55 (kg/day) and FFSB 1.56 (kg/day) were not significantly different ($P > 0.05$) between treatment groups. The feed conversion ratio (feed/gain) showed that pigs fed on FM diets had 2.75; COM 2.63 and FFSB 2.85. However, COM showed a better feed conversion ratio. Protein sources had no significant effect ($P > 0.05$) on the growth performance of pigs, although FM slightly improved the performance. These observed results are consistent with the findings of Bamgbose and Kudi (1996), Salami and Oyewole (1997) who reported that chicks fed COM had comparable performance to those fed the animal protein-free control diet. Also Akpodiete and Ologhobo (2000) found COM to be effective as FM when used to supplement a simplified corn-soya ration. The results confirmed the possibility of replacing fish meal with FFSB in pig diets Udedibie *et al.* (1987).

The results of the effect of different sources of protein on the reproductive performance of pigs are shown in Table 4.

The litter size of the pigs fed on diet containing FFSB was 12.00, COM 10.00 and FM 8.00. These values were similar ($P > 0.01$) between the treatment groups. The highest litter size of 12.00 observed in this study was higher than the range 7.11 ± 0.78 – 7.46 ± 0.45 reported by Orheurata (2000) in pigs. The piglets birth weight were significantly different ($P < 0.05$) between treatment groups. Pigs fed on FFSB diet 1.43 kg, COM 1.40 were similar ($P > 0.05$) but they differed significantly ($P < 0.05$)

Table 3: Effect of different protein sources on the growth performance of pigs

Parameters	Treatment (Protein sources)			
	T_1 FM	T_2 COM	T_3 FFSB	SEM
Initial live weight (kg/pig)	24.30	24.20	24.10	0.26
Final live weight (kg/pig)	61.40	58.20	59.00	0.30
Weight gain (kg/day)	0.51	0.58	0.54	0.05
Feed intake (kg/day)	1.62	1.55	1.56	0.16
Feed/gain	2.75	2.63	2.85	0.18

Means on the same row followed by the same superscripts are not significantly different (P > 0.05). FM = Fish meal, COM = Chicken offal meal, FFSB = Full-fat soybean

Table 4: Effect of different protein sources on the reproductive performance of pigs

Parameters	Treatment (Protein sources)			
	T_1 FM	T_2 COM	T_3 FFSB	SEM
Gestation length (days)	114.0	116.0	116.0	0.99
Litter size	8.00	10.00	12.00	2.46
Liter birth weight (kg)	1.32^b	1.40^a	1.43^a	0.02
Piglet with gain (kg)				
0 – 2 weeks	2.66	2.70	2.73	0.08
2 – 4 weeks	2.74	3.15	3.05	0.47
4 – 8 weeks	5.20^b	5.79^a	5.78^a	0.13
No. of piglets weaned	7	9	11	3.47
Weaning weight of pig (kg)	5.80	6.98	6.59	0.34
Mortality	1	1	1	

from pigs fed on FM diet 1.32 kg. These values in litter weight were comparably lower than 5.60 ± 0.17 reported by Orheurata (2000) in pigs. The differences in litter weight observed in their study many be due to breed differences (Belstra *et al*., 1997).

It is observed that with increase in litter size, birth weight, decreased (Orheurata, 2000). An interesting observation that can be made from this study was that there was an inverse relationship between litter size and litter weight. This observation is in agreement with the findings of Barker and Chung (1992), Mahan and Grifo (1995).

The piglets weight gain at 0 – 2 weeks of age were for FM diet 2.66 kg, COM diet 2.70 kg while FFSB diet was 2.73 kg. Higher numerical values were obtained in pigs fed COM and FFSB diets, however, they were not significantly different (P > 0.05) from FM treatment diets. Piglets' weight gain at 2 – 4 weeks of age followed the same pattern as in the 0 – 2 weeks of age. However, at 4 – 8 weeks of age, the piglets' weight gain for FM diets was 5.20 kg, COM diets 5.79 kg and FFSB diets 5.78 kg; these values for COM and FFSB diets differed significantly (P < 0.05) from FM diet. The observations in piglets weight as affected by age is in agreement with the reports of Belstra *et al*. (1997) who indicated that piglets weight gain increased with the age of the piglets.

The number of piglets weaned from FM diet 7.0, COM diets 9.0 and FFSB diet 11.0. These values were similar (P > 0.05) between the treatment groups. The weaning weight followed the same trend as in the number of piglets weaned. The higher weaning weight observed in COM treatment diet in this study was comparably higher than 4.87 – 5.58 range reported by Orheurata (2000) in pigs. The observed differences in this study may be attributed to breed differences Speer (1990), nutrition and physiological status of the animal. Esonu *et al*. (2001).

The results show higher gestation length for COM and FFSB diets of 116 days for each group of pigs. A lower gestation length of 114 days was observed in pigs fed the FM diet. The observed gestation lengths in this study ranged from 114 – 116 days. This value falls within the range 113 – 118 reported by Orheurata (2000) n pigs. Susan Higginson (1998) indicated that pigs with higher gestation length manifested improved reproductive performance. This observation is in agreement with the results obtained in this study.

The mortality of the piglets showed no significant differences (P > 0.05) between the treatment groups. The similarity in piglet mortality observed in this study may be attributed to fewer deaths from crushing and that the piglets were better at escaping from under the sow. This finding is in agreement with the reports of Susan Higginson (1998).

Conclusion: The results from this study suggest that fish meal can be completely replaced by chicken offal meal or full-fat soybean in the rations of pregnant pigs for improved growth and reproductive performance.

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