PERFORMANCE AND SERUM METABOLITES OF GROWER PIGS FED GROUNDNUT CAKE, EXTRUDED SOYABEAN MEAL AND COTTONSEED CAKE-BASED DIETS

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ABSTRACT

The study assessed the effect on performance and serum metabolites of ninety grower pigs fed extruded full-fat soyabean meal (ESBM) and cottonseed cake (CSC) as partial (-50%) and whole (100%) replacement for groundnut cake (GNC) in practical-type diets over 12 weeks feeding period. Ninety Large White X Landrace pigs with average initial liveweight of 30.50 ± 1.4 kg were randomly assigned to five dietary treatments and each treatment had three replicates. The diets were iso-nitrogenous and iso-caloric. The ESBM in the diets showed an improvement in average daily weight gain and feed conversion. Diet in which there was 50% replacement of GNC with ESBM gave the best result ($P < 0.05$). However, general trend showed a numerical increase with levels of ESBM and CSC in the diets. Serum albumin and cholesterol levels were significantly ($P < 0.05$) reduced by inclusion of extruded full-fat soyabean meal, and CSC while serum creatinine level was increased.

Keywords: Grower pigs, extruded soyabean meal, cottonseed cake, performance, serum metabolites.

INTRODUCTION

The most important commercial sources of plant protein concentrates in livestock industry are groundnut, soya-beans, cottonseed and meals made from the seeds called oilseed meals or cakes, after oil extraction via hydraulic screw expeller or solvent-extraction. The oils have a number of important industrial uses.

Groundnut cake is the most abundant of all the plant protein concentrates (Fetuga, 1972), but, the level of utilization of the cake in monogastric nutrition is low based on the fear of *Aspergillus flavus* infestation resulting in mouldiness (Fetuga 1976; Oyenuga, 1968). The scarcity of GNC in recent times has caused a tremendous increase in its price, coupled with the adulteration of the by-product which results in poor quality finished feeds for the monogastric animals utilizing GNC as the sole plant protein source. It is therefore necessary to explore the possibility of using alternative plant protein concentrates in animal feeds to reduce cost and improve productive performance based on genetic constitution.

One of such concentrates is cottonseed cake, which is locally abundant in the country and is relatively cheaper while the other is extruded full-fat soyabean meal, which is progressively becoming a worldwide potential source of major nutrients required for feeding farm animals. Cottonseed cake has also been reported to give satisfactory results with poultry in Nigeria (NAPRI, 1984, Bamgbose, 1988). The fibre content, which is high, varies in accordance with the amount of lint left on the seed. The composition of the cottonseed cake also varies according to climate, soil and moisture (Oyenuga, 1968). Similarly, CSC utilization in animal feeds is limited by the presence of gossypol, a toxic phenolic compound which has an inhibiting action on the enzymes pepsin and trypsin in the alimentary tract and thus interferes with protein digestion (Tyan *et al.*, 1986).

Soyabean protein is quite rich in its content of lysine and other essential amino acids except methionine (Wiseman, 1986). The oil content (18-22%) of soyabean could also contribute to the energy value of pig feeds.

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TABLE 1: GROSS COMPOSITION OF THE EXPERIMENTAL DIETS (% DM)

Ingredients	1 (%)	2 (50% ESBM)	3 (100% ESBM)	4 (50% CSC)	5 (100% CSC)
Maize	56.25	56.25	55.25	53.25	50.25
Groundnut cake	15.00	7.50	-	9.00	-
Extruded soyabean meal	-	7.50	16.00	-	-
Cottonseed cake	-	-	-	9.00	21.00
Meat meal	5.0	5.00	5.00	5.00	5.00
Corn offal	20.00	20.00	20.00	20.00	20.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00	1.00
Premix	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25
Determined					
(DM basis)					
Crude protein	17.33	16.81	17.01	17.30	17.48
Crude fibre	3.10	3.42	3.51	3.81	4.00
Ether extract	5.00	5.68	6.50	4.51	4.73
Ash	3.01	3.25	3.40	3.58	3.52
Nitrogen free extract	71.63	70.69	69.58	68.32	69.41

Recently extruded full-fat soyabean meal has been successfully used in pig rations (Fasina-Bombata *et al.*, 1994). This study was therefore undertaken to provide insight into the performance and serum metabolites of growing pig fed extruded full-fat soyabean and cottonseed cake as replacement for groundnut cake in balanced practical-type diets.

MATERIALS AND METHODS

Dietary Treatments

The gross composition of the experimental diets is shown in Table 1. The control diet had groundnut cake as the plant protein supplement and this was replaced by hydraulic screw press processed extruded soyabean meal (ESBM) (Bamgbose, 1988) at replacement levels of 50 and 100% to give diets 2 and 3 respectively while CSC was used to replace GNC at 50 and 100% levels to give diet 4 and 5 respectively. The levels of maize were adjusted in an attempt to keep the diets iso-energetic and nitrogenous. Feed and clean water were provided *ad libitum* and routine medication was administered.

Experimental Animals

A total of ninety Large White X Landrace grower pigs were allotted to given experimental treatments on the basis of body weight. There were three replicates per treatment with six pigs per replicate. The average initial liveweight of the grower pigs was 30.50 ± 1.4 kg. Pigs were housed on concrete floored pens equipped with feeding and watering troughs. Weight gain and feed intake measurements were taken weekly. The feeding trial lasted 84 days. Blood samples were collected from three animals per treatment via the jugular vein on the first, 42 and last days of the trial. The samples were immediately centrifuged and the serum fractions separated and stored at -5°C pending analysis. Data were collected on performance of the animals and they included the average daily feed intake (ADFI); average daily gain (ADG); and feed conversion ratio (FCR) Table 2.

Chemical and Statistical analysis

The methods of the A.O.A.C. (1990) were used to determine proximate composition

GROUNDNUT CAKE, EXTRUDED SOYABEAN AND COTTON SEEDCAKE IN GROWER PIG DIETS
TABLE 2: PERFORMANCE OF GROWER PIGS FED GNC, ESBM AND CSC DIETS

Parameters	1 (%)	2 (50% ESBM)	3 (100% ESBM)	4 (50% CSC)	5 (100% CSC)	SEM
Average initial body wt (kg)	33.5	28.5	29.5	31.0	29.9	1.41
Average final body wt (kg)	65.4	64.5	61.4	62.0	54.2	2.10
Average daily feed intake (g)	1490	1570	1580	1590	1620	11.91
Average daily gain (g)	380 ^a	430 ^a	380 ^a	370 ^a	290 ^b	3.25
Feed/gain	3.92 ^b	3.65 ^b	4.16 ^{ab}	4.31 ^a	5.60 ^a	0.14
Protein efficiency ratio (PER)	1.46	1.43	1.41	1.35	1.03	0.20

a,b. Means without common superscripts in horizontal rows are significantly different ($P < 0.05$)

TABLE 3: SERUM METABOLITES OF GROWER PIGS FED GNC, ESBM AND CSC DIETS

Parameters	1 (%)	2 (50% ESBM)	3 (100% ESBM)	4 (50% CSC)	5 (100% CSC)	SEM
Total protein (g/dl)	5.61	5.54	5.34	5.30	5.19	0.130
Albumin (g/dl)	3.61 ^a	3.25 ^{ab}	3.10 ^{ab}	2.80 ^{bc}	2.52 ^c	0.153
Globulin (g/dl)	2.0	2.29	2.25	2.39	2.78	0.164
Creatinine (mg/dl)	2.39	2.45	2.46	2.58	2.72	0.053
Serum urea (mg/dl)	1.43	1.51	1.56	1.67	1.72	0.066
Glucose (mg/dl)	90.07	96.84	102.10	92.36	91.3	3.230
Cholesterol (mg/dl)	88.28 ^a	44.08 ^b	49.60 ^b	54.48 ^b	51.70 ^b	5.115

a,b,c. Means without common superscripts in horizontal row are significantly different ($P < 0.05$)

while energy was determined using a ballistic bomb calorimeter. Serum analysis was as described by Lynch *et al.*, (1969). The parameters evaluated were subjected to analysis of variance (ANOVA) by the methods described by Steel and Torrie (1980). Duncan's multiple-range test (Duncan, 1955) was used to estimate differences between treatment means.

RESULTS

Data on average daily feed intake (ADFI), average daily gain (ADG) and feed conversion ratio (FCR) are shown in Table 2. The treatments had no significant effect on ADFI. However the general trend was an increase in

ADFI as the levels of ESBM and CSC increased in the diets. The results of the ADG show an inverse trend to the data on ADFI. The effect was pronounced with total replacement of GNC with CSC which led to significant ($P < 0.05$) depression in ADG. Diet in which 50% of the GNC was replaced by ESBM gave the best ADG. ESBM diets tended to be more efficiently utilized by the pigs while CSC diets were the least ($P < 0.05$) utilized.

The results of serum metabolites are present in Table 3. Serum albumin, creatinine and cholesterol levels showed positive response to dietary treatment. Serum albumin was significantly ($P < 0.05$) lowered while

creatinine level increased ($P < 0.05$) when GNC was replaced by CSC. Inclusion of ESBM and CSC in the diets lowered ($P < 0.05$) the cholesterol level of the pigs. During the experiment no mortality was recorded.

DISCUSSION

The result showed that the total replacement of GNC with CSC reduced the ADG while CSC was replaced by ESBM gave the best overall result. Similar results were obtained for poultry (Bamgbose, 1985) and for pigs (Fashina-Bombata *et al.*, 1994). The poor performance of pigs on the CSC diets could be due to the gossypol content, high dietary fibre, amino acid imbalance or lysine deficiency associated with CSC.

Generally, pig performance is closely related to the intake level of nutrients, especially protein and energy (Babatunde *et al.*, 1972; Fetuga *et al.*, 1975 a,b). The improvement in growth performance of pigs that resulted from ESBM supplementation was probably as a result of a more correctly balanced protein and caloric density of the diets. Lin and Jensen (1985) have shown that pigs respond positively in growth and in carcass characteristics when fed diets high in protein.

Serum albumin level was significantly lowered ($P < 0.05$) by the inclusion of CSC in the diets, especially in 100% CSC diet. This might suggest an amino acid imbalance. Serum cholesterol levels were lowered by inclusion of both ESBM and CSC in the diets. It is also worth noting that the cholesterol level decreased with increasing levels of ESBM and CSC in poultry diets (Bamgbose, 1988). This was due, in part, to the presence of unsaturated fatty acid in the extruded full-fat soyabean and the high fibre content of the CSC diets which resulted in lower serum cholesterol. Serum creatinine and urea were highest for CSC diets compared to ESBM and GNC diets, indicating trace of muscular wastage with CSC - diets (Okosun, 1987) as a result of poor utilization of CSC - based diets. In conclusion, extruded full-fat soyabean meal is more efficient in replacing groundnut cake

than cotton seed cake in diets for grower pigs.

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