PROTEIN AND ENERGY UTILIZATION BY WEANER PIGS FED CHICKEN OFFAL MEAL OR BLOOD MEAL WITH GRADED LEVELS OF MAIZE OFFAL

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ABSTRACT

Thirty six weaner pigs (Large White x Landrace) averaging 8.86 ± 0.22kg body weight were randomly assigned to six isonitrogenous (20% crude protein) dietary treatment groups in a 2x3 factorial design of two protein sources (Blood Meal (BM) and Chicken Offal Meal (COM) and three replacement levels of maize offal (MO) for maize (0,25 and 50%) in a fifty six (56) day feeding trial after an adjustment period of seven days. Dry matter intake was not significantly (P>0.05) affected by feeding COM or BM at the three levels of MO. The pigs fed the 0 and 25% levels of MO for both protein sources had comparable (P>0.05) growth performance. They performed significantly (P<0.01) better than for those fed BM. The metabolisable energy intake per day was not significantly (P>0.05) affected by varying MO levels and the protein sources. Conversely, the metabolisable energy intake per kilogramme gain was significantly (P<0.05) influenced by both treatments.

The cost of feed per kg live weight gain followed the same pattern as the performance parameters. The 0 and 25% MO diets with comparable costs were more cost effective (P<0.05) than the 50% MO diets while COM supported cheaper cost of feed per gain. The serum metabolites were not significantly (P>0.05) influenced by the varying MO levels and the protein sources except for the urea and globulin contents. The results establish the fact that weaner pigs can tolerate maize offal inclusion in feed up to 25% but not up to 50% (P<0.01) and that COM enhanced performance than does BM as an unconventional protein supplement in the diet for weaner pigs.

Key Words: Protein, Energy, Weaner pigs, Chicken Offal Meal, Bloodmeal, Maize Offal.

INTRODUCTION

Maize has been the conventional energy source for pig production. Problems of cost and availability of maize induced researchers to study the use of maize offals in place of maize for feeding pigs (Longe and Fagbenro-Byron, 1990 and Ande, 1992).

Traditionally, swine diets are formulated on the basis of crude protein. Protein levels have been established for various classes of pigs so that the most limiting amino acid (lysine) will be present in adequate amounts (NRC, 1988; Adesehinwa and Ogunmodede, 1995). Optimal use of protein is therefore essential in any practical feeding system, especially for those animals that are kept intensively.

Some of the animal protein sources available to the livestock industry in Nigeria are imported, particularly fish meal (Bello, 1988). The other protein sources are predominantly of plant origin. Their use calls for the addition of protein sources of animal origin because of the imbalanced nature of the amino acid profile of plant protein. Soybean protein has proved to be such a valuable alternative to the other protein sources, such as groundnut, because

TABLE 1: GROSS COMPOSITION (%) OF WEANER DIETS CONTAINING BM OR COM WITH GRADED LEVELS OF MO.

	Replacement levels of maize with MO(%)					
	with BM			with COM		
INGREDIENTS	0	25	50	0	25	50
Maize	54.62	40.88	27.20	53.34	39.94	26.62
Maize offal	0.00	13.72	27.60	0.00	13.66	27.26
Fullfat Soybean(Ext)	23.20	23.20	23.20	23.20	23.20	23.20
Blood Meal	2.65	2.45	2.25	0.00	0.00	0.00
Chicken Offal Meal	0.00	0.00	0.00	3.71	3.45	3.17
Palm Kernel Cake	10.00	10.00	10.00	10.00	10.00	10.00
Brewers Dried Grain	5.00	5.00	5.00	5.00	5.00	5.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster Shell	1.00	1.00	1.00	1.00	1.00	1.00
Premix (Vit-Min)*	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Vit A 10,000 IU; Vit. D3 2,000 IU; Vit. E 8,000 IU; Vit. K 2,000mg; Vit B1 2,000mg; Vit. B2 5,500mg; Vit. B6 1,200mg. Vit. B12 12mg; Biotin 30mg; Folic Acid 600mg; Niacin 10,00mg; Panthothenic Acid 7,00mg; Choline Chloride 500,000mg; Vit. C 10,000mg; Iron 60,000mg; Mn 80,00mg; Cu 8,000mg; Zn 50,000mg; Cobalt 45mg; Selenium 100mg; Mg 100,000mg; Anti Oxidant 6,000mg.

of its favourable amino acid profile (Weingartner, 1988), which makes it comparable to those of animal proteins. However, for pig starter diets, the addition of proteins of animal origin is needed (Kansas Swine Nutrition Guide (KSING), 1991).

The conventional animal protein source, fishmeal, is expensive and it is not readily available. Fanimo (1991) found that fishmeal can be totally replaced with chicken offal meal at the starter and grower phases of pigs. Fetuga *et al.* (1974) also noted blood meal protein was better than plant protein.

The objective of this study was to compare the response of weaner pigs to chicken offal meal or blood meal as animal protein supplements in diets when maize offal replaced maize.

MATERIALS AND METHODS

Diet

The test ingredients were maize offal, blood meal and chicken offal meal. The maize offal (MO), purchased from the local grain millers in Bodija market, Ibadan, was sundried before being incorporated into the diets as shown on Table 1 to constitute 25 and 50% of the metabolisable energy (ME) supplied by maize in the control diet.

Fresh blood samples collected from Bodija and Moniya abattoirs, were allowed to clot and it was sundried as described by Fanimo (1991). The chicken offals were obtained from the Continental Feeders, Old Ife Road and the University of Ibadan Slaughter House, Ibadan. They were processed as described by Fanimo (1991). The blood meal (BM) or chicken offal meal (COM) replaced 20% of the crude protein contributed by the soybean cake in the basal diets (Table 1).

Animals

Thirty six Large White x Landrace weaner pigs with average body weight of 8.86 + 0.22kg were randomly assigned to the six isonitrogenous (20% crude protein) dietary treatment groups in a 2x3 factorial design of the two slaughter house by-products (COM and BM) and the three replacement levels of MO (0,25 and 50%). Each group of six weaner pigs comprised of three males and three females, with each constituting a replicate.

Feed and water were provided to the animals *ad libitum* in the 56-day feeding trial. The pigs were individually penned in concrete floored pens. Pigs and consumption were weighed weekly to determine the average daily weight gain, Daily Dry Matter Intake, Feed Efficiency (Feed: Gain), Protein Efficiency Ratio (PER), Metabolisable energy (ME) intake per day ME intake per kg gain. The costs of Feed/kg diet, Feed consumed/day and Feed/Liveweight gained were also calculated and recorded.

Chemical Analysis:

Feeds and test ingredients samples were assayed for proximate composition (A.O.A.C., 1990). The metabolisable energies were also determined with the prediction equation reported by Morgan *et al.* (1975) based on the proximate composition:

ME = 0.416CP+0.605EE+0.367NFE-20.06

where ME = Crude Protein

CP = Crude Protein

NFE = Nitrogen Free Extract

EE = Ether Extract

Blood Analysis:

Four (two males and two females) of the six experimental pigs in each of the six dietary treatment groups were randomly selected and bled at the first and last weeks of the feeding trial. The animals were given only water on the evening preceeding the bleeding. The bleeding was done in the morning before feeding and 10ml of blood was obtained from the jugular vein, using a sterilized needle and syringe into a sample bottle. The samples were allowed to clot before centrifuging to obtain the serum used in the determination of some serum metabolites as described by Toro and Ackermann (1975) and Kaneko (1989).

Statistical Analysis: The data obtained were subjected to analysis of variance (ANOVA) and the treatment means were separated by Duncan's Multiple Range Test (Little and Hills, 1978). The regression analysis of the performance parameters (X) as dependent on the daily weight gain (Y) by treatment were also carried out. The SAS Computer software package (1988) was used for all statistical analysis.

RESULTS AND DISCUSSION

The chemical compositions of the test ingredients (MO,COM and BM) used in the study are shown in Table 2. The blood meal used in this study had similar proximate composition with those reported by Pond and Maner (1974), Sonaiya (1988) and Fanimo (1991).

The crude protein content of the COM employed in this study agreed with the values reported by Lima (1988), Udedibie *et al.* (1988) and Fanimo (1991). The crude fibre content also agreed with the reported values of Bhargava *et al.* (1975) and Udebibie *et al.* (1988). The ash content observed in this study agreed with those reported by Bhargava *et al.* (1975) and Udedibie et al. (1988), though Fanimo (1991) reported a relatively higher value.

The energy and protein values of the diets were within the range recommended for weaner pigs in the tropical environment by

TABLE 2: PROXIMATE COMPOSITION (DM BASIS) OF TEST WEANER DIETS AND INGREDIENTS (%)

	With BM			With COM					
	0	25	50	0	25	50	MO	BM	COM
Dry Matter	92.05	92.95	93.13	92.92	93.02	92.94	89.70	92.00	90.64
Crude Protein	20.19	20.13	20.88	20.63	20.69	20.38	10.15	79.56	59.09
Crude Fibre	4.47	5.03	5.31	5.04	5.28	5.56	9.20	1.10	4.64
Ether Extract	5.82	5.66	5.89	6.84	6.62	6.73	2.60	1.40	14.36
Ash	7.05	7.06	6.91	7.01	6.97	6.83	1.50	6.50	7.50
Nitrogen Free Extract	62.47	62.12	61.01	60.48	60.44	60.50	76.55	11.44	14.41
Metab. Energy (KCal ME/kg)	3520.71	3460.71	3471.43	3537.14	3508.10	3498.39	3292.68	4305.34	4404.22

Fetuga (1984). Based on the results of the proximate analysis, the diets were relatively isonitrogenous (20% crude protein) while the diets containing the COM had slightly higher numerical energy values than their corresponding MO levels in the diets containing BM. This could be attributed to the higher caloric content of the COM, probably resulting from the high fat content (Table 1) of the protein concentrate. Udedibie *et al.* (1988) reported high caloric density for COM.

The crude fibre content of COM was higher than for BM probably due to the undigested feed present in the gut.

Performance Characteristics

The summaries of the performance characteristics are reported in Table 3. Although isonitrogenous diets were offered, the avarage daily gains varied considerably. The better gains achieved with the diets containing COM agreed with the report of Bhargava and O'Neil (1975), who observed good effects on body weight gain, feed efficiencey and performance index as a result of the addition of COM as a protein supplement to the diet of broiler chicks. The gains, feed efficiency and protein efficency and the ME intake per gain for pigs on the maize-based control and the 25% MO diets containing either BM or COM were superior to those on the respective 50% MO diets. This could be attributed to the increased fibre contents in the diets resulting from increased MO inclusion.

The diets varied in their ME contents, with those containing COM having higher values which could be attributed to the higher fat content of the COM over BM. This however, had no effect on the average daily DM intake per day as shown in Table 3. It could therefore be inferred that the variations in the energy contents were not sufficient to vary feed intakes. The ARC (1981) and Low (1985) reported that increased feed resulted from the attempt by pigs to maintain the digestible energy intake. It could be inferred that the digestible energy intake did not vary with the diets. The similarity in DM intake also resulted in similar protein intakes because the diets were isonitrogenous. The comparable feed intakes across the groups disagree with the findings of Fanimo(1991) who reported lower feed intake for pigs on BM diets (with the same CP content, 20%) which he attributed to the amino acid imbalance obtained with BM compared with COM.

The efficiencies of feed and protein and energy utilization observed in this study decreased with the increased fibre in the diets as the MO level increased. This was similar to the report by Stanogias and

Pearce (1985). The COM diets were more efficiently utilized than the BM diets at all levels of MO inclusions. This agreed with the findings of Becker *et al.* (1963); Fetuga *et al.* (1974a, b); Njoku (1985) and Fanimo (1991) wwho reported a lesser efficiency of utilization for BM diets and poor performance for animals fed BM compared to other animal protein sources. The addition of COM to the diets improved the daily weight gains. Such effects have been reported (Babatunde *et al.*, 1971).

Serum Metabolites

The levels of serum metabolites of the pigs as affected by the treatment diets are shown in Table 4. The serum total proteins and albumin of the weaner pigs employed in this study were neither affected by the varying MO inclusions nor the test protein concentrates contained in the diets. This indicated that the isonitrogenous protein level contained in the diets was able to support normal protein reserves across the group as reflected in the observed total protein and albumin values. The absence of variation in the albumin content could be attributed to the comparable protein intake across the groups. Gouache *et al.* (1991) reported albumin content to be specifically influenced by protein shortage. The total proteins and albumin contents observed in this study were within the normal ranges reported by Mitruka and Rawnsley (1977).

However, the similarity in albumin contents could have given rise to the comparable total protein values obtained across the group, even when variations were observed in the globulin contents. This was in agreement with the findings of Allison (1955), who reported changes in total protein content to result from alterations in the albumin fraction. The variations in the globulin content was observed not to be influenced by the protein sources but could be by the MO inclusion, resulting in increased serum globulin content with the inclusion of MO. The slightly increased values observed at the 50% over the 25% MO levels with both protein concentrates were not significantly (P>0.05) affected by the MO inclusion.

There were no observable muscular wastage resulting from either the Mo inclusions or the inclusion of the protein sources, thereby indicating the adequacy of the proteins in the diets as shown by the comparable (P>0.05) creatinine values across the groups. The values were within the range reported by Kaneko (1989). The observed variations in the blood urea contents was significantly influenced by the protein types and not by the varying MO inclusions in the diets of the pigs. The higher values obtained with the COM diet could be as a result of increased catabolism of the amino acid constituent of the protein. This was reported by Wilson *et al.* (1972) to be obtained when proteins of lower biological values are fed.

The observed serum cholesterol levels, which were within the range reported by Mitruka and Rawnsley (1977), were not significantly (P>0.05) influenced by either the MO inclusion or the incorporated protein sources. The glucose content of the serum was equally unaffected by the dietary treatment of varying MO levels and the two protein sources.

Economy of Production

The cost of feed per kg diet is shown in Table 5. The comparable (P>0.05) feed cost per day for both protein sources could be attributed to the similar DM intake and cheapness of both animal protein sources. They have both been reported as agro-industrial by-products of slaughter house origin (Tegbe *et al.*, 1995).

TABLE 3: PERFORMANCE OF WEANER PIGS FED GRADED LEVELS OF MAIZE OFFAL IN DIETS CONTAINING BLOOD MEAL (BM) OR CHICKEN OFFAL MEAL (COM)

	Replacement Levels of Maize with MO (%)					
		With BM			With COM	
PARAMETERS	0	25	50	0	25	50
Daily Weight Gain (DWG) kg	0.37±0.017^{b}	0.37±0.022^{b}	0.32±0.025^{c}	0.49±0.011^{a}	0.47±0.012^{a}	0.38±0.009^{a}
Daily DM Intake (DDMI) kg	0.82±0.048	0.85±0.053	0.87±0.052	0.87±0.052	0.85±0.047	0.86±0.051
Daily Protein Intake (DPI)	0.16±0.010	0.17±0.011	0.17±0.010	0.17±0.010	0.17±0.010	0.17±0.010
Feed: Gain Ratio (FGR)	2.25±0.141^{b}	2.33±0.128	2.90±0.220^{a}	1.75±0.86^{c}	1.82±0.083^{c}	2.22±0.012^{b}
Protein Efficiency Ratio (PER)	2.36±0.151^{b}	2.23±0.098	1.85v0.122^{c}	2.97±0.164^{a}	2.86±0.160^{a}	2.35±0.125^{b}
Metabolisable Energy Intake per Day (MEID)	2890.5±168.574^{a}	2927.75±184.336	3023.62±178.882	3016.96±165.057	3023.98±179.009	2974.72±169.268
Metabolisable Energy Intake per Gain (MEIG)	7926.8±498.012^{b}	8046.00±441.506^{b}	10065.81±763.389^{a}	6205.18±303.525^{c}	6365.92±291.112^{c}	7778.96±403.124^{b}

a,b,c: Means along the same row having different superscripts differ significantly at P<0.05.

* as at 1994

TABLE 4: EFFECTS OF TEST WEANER DIETS CONTAINING OFFAL MEAL OR BLOOD MEAL ON SOME SERUM METABOLITES.

	Replacement levels of Maize with MO (%)					
	With Blood Meal (BM)			With Chicken Offal Meal (COM)		
	0	25	50	0	25	50
Total Protein	6.83±0.31	6.53±0.27	6.65±027	6.70±021	7.00±0.38	6.98±0.31
Albumin (g/d)	3.95±0.17	3.38±0.14	3.38±0.24	3.83±0.12	3.58±0.28	3.45±0.12
Globulin (g/dl)	2.88 ± 0.37^{b}	3.15 ± 0.17^{ab}	3.28 ± 0.15^{a}	2.88 ± 0.23^{b}	3.43 ± 0.21^{a}	3.53 ± 0.13^{a}
Creatinine (mg/dl)	1.25±0.16	1.10±0.15	1.38±0.26	1.28±0.21	1.18±0.18	1.18±0.17
Urea (mg/dl)	$24.00+2.16^{cd}$	22.75 ± 1.32^{d}	26.50 ± 1.85^{bcd}	$33.25+3.99^{a}$	30.50 ± 3.80^{ab}	29.50 ± 3.52^{abc}

a,b,c,d: Means along the same row having different superscripts differ significantly at P<0.05.

The average cost of feed consumed per day varied considerably with MO inclusions (P<0.05), decreasing as the MO level increased despite the comparable dry matter intake. This was due to the lower cost of MO compared to maize. However, the comparable costs per kg diet and the dry matter intakes for all MO levels for both proteins were enough reasons for the comparable costs (P>0.05) of feed consumed per day. Both proteins were comparably cost effective at the 0 and 25% MO levels than at the 50% MO inclusions, though the results with the COM protein for the three MO levels were better than those of BM. A relatively lowered cost was required for a kilogramme body weight gain with the 0,25 and 50% MO levels in diets containing COM was better utilized and more efficient than BM protein in the real production value. This was noted in pigs by Ikurior (1993). This also agreed with the findings of Fanimo (1991) who reported better nutritive and production value for COM over BM. United Kingdom Ministry of Agriculture, Fisheries and Food (1986) has also reported COM to be one agro-industrial by-product that could be employed for a more cost effective as feeding maize and the COM.

Regression Analysis

The regression equations for the two MO levels (25 and 50%) containing BM proteins indicated the significant (P<0.05) dependence of the weight gains of the pigs on these diets on the efficient utilization of the ingested proteins. Whereas, none of the other considered performance variables significantly (P>0.05) influenced the body weight gains of the pigs on the BM-control diet. O'Grady and Bowland (1971), Cooke *et al.* (1972a and b) and Fetuga et al. (1975) had reported the rate and efficiencey of gains to be closely related to the nutrient intake and utilization. This was only true for the pigs on the 25% MO-BM diet whose growth rate were comparable to those on the control diet containing the BM protein but better than those of the 50% MO-BM diet. However, the weight gains of pigs on the diets containing COM proteins were not significantly (P>0.05) affected by the considered variables at the 0 and 50% MO levels. This showed that these parameters were signly not significant explanatory variables for weight gains at these MO levels with COM inclusions as shown by their coefficient for prediction functions. But, the daily dry matter and ME intakes significantly influenced (P<0.05) the daily weight gains at the 25% MO inclusion. This agreed with the findings of O'Grady

TABLE 5: ECONOMY OF PRODUCTION OF WEANER PIGS FED DIETS CONTAINING BM OR COM.

	Replacement levels of Maize with MO (%)					
	With Blood Meal (BM)			With Chicken Offal Meal		
	0	25	50	0	25	50
FeedCost/kg Diet(N)	7.61	7.21	6.79	7.60	7.17	6.77
Cost of Feed Consume /day (FCD)(N/Day)	6.27± 0.37[cd]	6.10±0.38[bc]	5.95±0.21[ab]	6.48±0.36[d]	6.18±0.37[bc]	5.76±0.33[a]
Cost of Feed/kg Liveweight Gain (FCLWG) (N/kg)	17.20±1.80[c]	16.76±0.92[b]	19.69±1.49[d]	13.33±0.65[d]	13.01±0.65[a]	15.06±0.78[b]

a,b,c: Means along the same row having different superscript differ significantly at P<0.05
* as at 1994

TABLE 6: LINEAR REGRESSION EQUATIONS OF SOME PERFORMANCE PARAMETERS AS DEPENDENT ON DAILY WEIGHT GAIN (Y) OF THE WEANER PIGS AT EACH LEVEL OF MO INCLUSION WITH BM OR COM.

level of M.O. Inclusion(%)	Regression Equations	R^2
O with BM	Y=0341 - 3.561DDMI-21.174DPI+1.605FGR+0.008PER+2.352MEID-0.502MEIG	0.986
	(0.150) (3.248) (13.898) (1.391) (0.029) (1.1334) (0.405)	
25 with BM	Y=-0.495 + 1.354DDMI + 16.187DPI - 1.977FGR + 0.191PER -1.194 MEID + 0.578MEIG	0.992
	(0.413) (4.745) (16.507) (5.093) (0.085) (0.929) (1.500)	
50 WITH BM	Y=-0.0.98 + 1.033DDMI + 23.596DPI + 0.326FGR + 0.110PER -1.541MEID - 0.109MEIG	0.988
	(0.078) (6.251) (13.442) (0.618) (0.023) (1.573) (0.180)	
O with COM	Y=0.388 - 1.375DDMI - 0.054DPI + 0.289FGR + 0.013PER + 0.546MEID - 0.147MEIG	0.983
	(0.098) (2.764) (7.950) (3.562) (0.016) (0.779) (1.005)	
25 with COM	Y=0.475 + 6.768DDMI - 5.599DPI + 1.118FGR - 0.003PER - 1.466MEID - 0.386MEIG	0.997
	(O.O61) (1.564) (3.217) (1.378) (0.009) (0.405) (0.392)	
50 with COM	Y=0.398 + 10.339DDMI - 17.834DPI - 0.191FGR - 0.001PER - 1.843MEID - 0.011MEIG	0.991
	(0.088) (5.118) (8.482) (0.660) (0.019) (1.024) (0.192)	

*P<0.05 **P<0.001 ***P<0.001
Figures in bracket are standard errors of regression coefficient (SE_b)

and Bowland (1971), Cooke *et al*. (1972a and b) and Fetuga *et al.* (1975). The gains of pigs across the groups can generally be inferred to be dependent on the nutrient intakes and their efficient utilization for growth.

CONCLUSION

The result of this study showed that COM protein enhanced performance than did the BM protein. However, with the inclusion of COM protein, the weaner pigs could tolerate 25% MO replacement of maize (13.66% of feed). This is therefore, an indication that maize offal and chicken offal meal have tremendous potentials as alternative feed sources to alleviate the problems of feeding weaner pigs in the face of scarcity and high prices of the conventional feedstuffs.

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