THE DIGESTIBILITY OF NUTRIENTS BY YOUNG PIGS FED DIETS IN WHICH BREWERS' DRIED GRAIN (BDG) REPLACED MAIZE

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ABSTRACT

Twelve crossbred (Large White x Landrace) barrows and gilts of average initial liveweight of 19.6 kg were used in a trial lasting 28 days. The digestibility of nutrients of diets in which BDG replaced 0, 25, 50 or 75% of the dietary maize was studied, and the treatments were replicated three times. The trial consisted of two phases of 14 days each, in which pigs were fed at 4 and 6% of their body weights respectively. Each phase consisted of a 7-day adjustment period followed by a 7-day collection period of total urine and faeces.

Average daily feed and weight gain decreased linearly (P<0.01) while feed: gain ratio increased linearly (P<0.01) as level of BDG replacing maize increased. Pigs in period II grew significantly at a higher rate (P<0.01) but had significantly poorer feed conversion efficiencies (P<0.01).

The digestibilities of dry matter, energy, nitrogen, ether extract, crude fibre and ash were all depressed linearly (P<0.01) as the level of BDG replacing maize increased. Feeding the pigs at 4% body weight level resulted in better digestibilities of dry matter, nitrogen, crude fibre, ether extract and ash.

Key Words: Pigs, BDG, Digestibility

INTRODUCTION

There have been intensive searches for new or alternative inexpensive feed sources for pigs in Nigeria within the past few decades. These searches have, amongst others, led to the use of such agro-industrial by products like brewers' spent grains (BSG), brewers' dried grains (BDG) when dried. This is a residue obtained from the production of beer from barley or other cereal grains.

Brewers' grains are reported to contain about 2 times the nutrient contents of the original grains except for the starch that was converted to alcohol (Kissel and Prentiss, 1979; Mowat, 1980) Jensen *et al* (1976) noted that as a result of the utilization of the starch in the original grains for alcohol, low metabolizable energy values were to be associated with the use of the spent grains in monograstric diets. Kernegay (1973) had earlier reported the DE and ME values of BDG in pigs as 2.28 Mcal/kg representing 50.1 and 47.4% of GE, respectively. The report also gave the digestibility of BDG protein as 72.4% with NPU value of 29.6%. Perry (1980) and Pond and Maner (1974) have reported that although the protein content of brewers' grains was high, it did not contain a good balance of amino acids. Babatunde *et al* (1975) fed Brewers' dried grains (BDG) 0, 5, 10 and 15% in growing pigs diets and reported significant depressions in crude fibre digestibility values; without significant effects on the digestibilities of dry matter, crude protein, ether extract, nitrogen-free extract and energy.

The present study investigates the digestibility of nutrients of practical diets in which BDG replaced maize with a view to explaining the response pattern observed when pigs are fed high BDG diets.

MATERIALS AND METHODS

Twelve (12) crossbred (Large White x Landraçe) barrows and gilts of average initial weight of 19.60 kg were randomly assigned to metabolism crates. There were 4 dietary treatments (Table 1) replicated three times in a randomized block design.

The 28-day trial was made up of 2 phases, of 14 days each, during which the pigs were fed at 4% and 6% of bodyweight, respectively. Each phase consisted of a 7-day adjustment period followed by a 7-day total collection of faeces and urine. At the end of the collection period the faeces were thawed, thoroughly mixed and samples taken for proximate analysis. Faeces were collected and weighed daily and then pooled in cold storage.

Similarly urine was collected in buckets containing 25ml hydrochloric acid and 25ml of Toluene. At the end of the collection period, the pooled urine was stirred, made up to a known volume and an aliquot was taken for nitrogen analysis. Refused or wasted feed was collected daily on cardboards placed directly under each feeder and the amount pooled for each phase.

Weekly monitoring of pig performance in terms of weight gains and feed intakes were also carried out. Proximate chemical analyses of feeds, faeces and urine were carried out according to the procedures of A.O.A.C. (1970) and energy determined using Parr's Adiabatic bomb calorimetre. Statistical analyses of data were by variance procedures described by Cochran and Cox (1967) and means compared using the Duncan's Multiple Range test (Steele and Torrie 1960).

RESULTS AND DISCUSSIONS

The growth rate of pigs decreased linearly ($P<0.01$) as the level of maize replaced with BDG increased in the diet of pigs (Table 2). However, there were no significant differences between the 0, 25, and 50% maize replacement diets. pigs in phase II grew significantly ($P<0.01$) faster than in phase I. This could be related to the level of feeding the pigs during phase I compared to phase II. Davies and Lucas (1972) and Calabotta *et al* (1982) observed that feed (energy) restriction tend to reduce growth rate. The replacement of maize BDG, a low energy, bulky feedstuff, reduced the available energy especially at the higher replacement levels. feed intake of pigs was linearly depressed ($P<0.01$) as the level of maize replaced increased. There were however, no significant difference between the control and the 25% maize replacement diets. The feed: gain ratios increased linearly ($P<0.01$) as the level of BDG increased in the diets. The pigs exhibited better ratios in phase I compared to phase II. The reports of Vanschoubrock *et al* (1982) also indicated improved feed conversion ratios at restricted feeding levels as in this trial.

The digestibility of dry matter (Table 3) decreased linearly and quadratically ($P<0.01$) as the level of BDG increased in the diets. Babatunde *et al* (1975) however observed insignificant decreases in dry matter

Table 1
Composition and chemical analysis of diets

	% Maize Replaced			
Ingredients	0	25	50	75
Maize	65.78	49.33	32.89	16.45
BDG	—	16.45	32.89	49.33
Soybean Meal	28.02	28.02	28.02	28.02
Soy oil	3.00	3.00	3.00	3.00
Bone Meal	2.25	2.25	2.25	2.25
Salt	0.50	0.50	0.50	0.50
D.L. Methionine	0.15	0.15	0.15	0.15
L-Lysine Hydrochloride	0.15	0.15	0.15	0.15
Vit-Min. Premx	0.15	0.15	0.15	0.15
TOTAL	100.00	100.00	100.00	100.00
Chemical Composition (Analysed)				
Dry Matter, %	91.50	92.50	92.22	93.89
Crude Protein, %	21.44	22.13	23.75	26.13
Cross Energy, Kcal/kg	4200	4170	4140	4120
Crude Fibre, %	4.45	7.85	10.02	12.91
Ether Extract, %	6.64	7.15	7.34	8.18
Ash, %	5.93	6.77	5.83	6.44
Nitrogen Free Extract, %	52.99	48.60	45.28	40.23

Contributed the following per kg of diet: Vit. A 12,000 I.U. Vit. D_3 1200 IU; Vit E. 3.61 IU: Vit. K, 1.8 mg; Vit. B_2 3.6mg; Nicotinic acid, 18.0mg; Ca-d-pantothenate, 9.6mg; Biotin, .036mg; Vit.B_{12} .012mg. Choline chloride, 120mg.; Chlortetracycline, 48mg. Mn, 24mg.; Zn, 96mg.; Hu, 60mg; I, 1.8mg. and Co., .48.

Table 2
Performance characteristics of young pigs fed diets in which BDG replaced maize

Period	0%	25%	50%	75%	Mean	SE
			Average Daily Gain, g.d.e.			
I	581.0	428.7	453.7	324.0	446.6	46.06
II	647.7	638.0	357.3	271.3	478.6	51.51
Avg.	614.4[a]	533.4[ab]	405.0[ab]	279.7[c]	462.6	103.02
			Average Daily Feed Intake g.d,e.f.			
I	954.0	955.0	953.3	944.7	951.8	40.45
II	1703.7	1610.0	1392.7	1205.0	1477.9	41.74
Avg.	1328.9[a]	1282.5[ab]	1173.0[bc]	1214.9	83.48	
			Feed: Gain Ratio d, e, f.			
I	1.65	2.25	2.13	2.92	2.24	0.17
II	2.85	2.57	3.91	4.54	3.47	1.83
Avg.	2.25[a]	2.41[ab]	3.02[bc]	3.73[bc]	2.85	0.65

Row means with different superscripts are significantly different ($P<0.05$).
d. Significant linear effect of treatment ($P<0.01$).
e. Significant effect of period ($P<).01$).
f. Significant period x treatment effect ($P<0.01$).

Table 3
Apparent nutrient digestibility co-efficient of diets in which BDG replaced maize

	% Maize Replaced					
	0	25	50	75	Mean	SE
			Apparent Dry Matter Digestibility % e,g,h			
I	90.70	84.21	76.70	73.10	81.18	1.04
II	87.93	80.90	72.38	73.10	78.59	2.19
Avg.	89.34[a]	82.56[b]	74.54[c]	73.10[c]	79.89	4.38
			Apparent energy digestibility, % e,h.i.			
I	76.68	76.04	70.02	57.75	70.12	2.16
II	80.55	79.20	75.04	69.62	76.10	2.58
Avg.	78.62[a]	77.62[b]	72.53[ab]	63.69[b]	73.11	2.06
			Apparent nitrogen digestibility, % e,f,i			
I	89.07	83.13	80.43	80.84	83.87	1.09
II	85.79	79.31	76.82	80.89	80.70	1.52
Avg.	87.43[a]	81.22[b]	78.63[b]	80.87[b]	82.29	3.04
			Apparent crude fibre digestibility, % e,f.			
I	72.16	59.37	43.69	47.11	55.58	2.74
II	64.04	51.01	33.36	48.15	49.14	3.99
Avg.	68.10[a]	55.19[ab]	38.53[c]	47.63[bc]	52.36	7.98
			Apparent Ether Extract Digestibility, % e,f.			
I	86.81	81.73	74.02	72.93	78,87	2.22
II	83.00	78.26	69.26	74.28	78.20	2.31
Avg.	84.91[a]	80.00[a]	71.64[b]	73.61[b]	77.54	4.63
			Apparent ash digestibility, % e,f,h.			
I	72.05	69.67	51.76	58.89	63.09	1.48
II	64.11	63.54	43.64	51.59	55.72	2.12
Avg.	68.08[a]	66.61[a]	47.70[c]	55.59[b]	59.41	4.24

Row means with different superscripts differ significantly ($P < 0.05$).

e — Significant linear effect of treatment ($P < 0.01$).
f — Significant quadratic effect of treatment ($P < 0.01$).
g. — Significant quadratic effect of treatment ($P < 0.05$).
h. — Significant effect of period ($P < 0.01$).
i. — Significant effect of period ($P < 0.05$).

digestibility when diets containing 0 to 15% BDG were fed to growing pigs. The decline in dry matter digestibility may be related to the increasing dietary levels of crude fibre as BDG was increasingly included in the diets (Kenelley and Aherne 1980, Kuan *et al* 1983; Frank *et al* 1984). Kenelley and Aherne (1980) obtained a 20% decline in dry matter digestibility when 10% dietary fibre was fed to pigs. Similarly, the results of this trial indicated an 18.8% decline in dry matter digestibility with 12.9% fibre in the diet. With the feeding of pigs at 4% body weight during phase I improved ($P < 0.01$) digestibility of dry matter was obtained compared to feeding at 6% body weight in phase II. With the lower level of feeding perhaps more time was available for proper and efficient digestion of the dietary dry matter.

The digestibility of dietary energy was observed to decrease linearly ($P < 0.01$) with increasing amount of BDG in the diet of young pigs during phases I and II and for both phases combined. However, energy digestibility was similar up to the point where 50% maize was replaced by BDG for the two phases combined. Kornegay (1973) and Babatunde *et al* (1975) had earlier reported decreases in energy digestibility with increased dietary BDG. Kuan *et al* (1983) and Frank *et al* (1984) have also reported linear decreases in energy digestibility with increased fibre in the diets of pigs. Unlike the results for dry matter digestibility, there was observed an improved ($P < 0.05$) energy digestibility when pigs were fed at 6% body weight daily during the second phase.

The digestibility of dietary nitrogen decreased both linearly and quadratically ($P < 0.01$) as the level of BDG replacing maize increase during the two phases combined. However, there were no significant differences ($P > 0.05$) amongst the BDG treatments. The result agreed with the findings of Kornegay (1973) and Babatunde *et al* (1975) who reported decreased nitrogen digestibility as BDG increased in the diet of pigs. The feeding of pigs sat 4% of body weight resulted in better digestibility ($P < 0.05$) of nitrogen compared to feeding at the 6% body weight. At higher level of feeding, more feed was consumed by the pigs and as a result of the bulky nature of the high BDG diets there was a reduction in the retention time which must have affected the digested of the dietary nitrogen.

The digestibility of fibre was insignificantly better when pigs were fed at 4% body weight compared to feeding at 6% body weight. this may be related to better retention of feed, and improved digestive activity in the stomach at the low level of feeding. Although the feeding of young pigs at 4% or 6% of body weight during phases I and II did not significantly affect the digestibility of ether extract. However, ether extract digestibility was slightly better at the lower level of feeding. For the two phases combined ether extract digestibility decreased linearly ($P < 0.01$) as the level of dietary maize replaced by BDG increased. This may be related to the increasing dietary levels of crude fibre in the test diets as BDG increasingly replaced maize in the diets. Kuan *et al* (1983) also observed depressed ether digestibility with the inclusion of fibre in the diets of pigs. Babatunde *et al* (1975) however, observed an insignificantly higher digestibility of ether extract when up to 15% BDG was fed to pigs.

The digestibility of crude fibre decreased linearly and quadratically ($P < 0.01$) as BDG level increased in the diets. Babatunde *et al* (1975) also observed significant decreases in crude fibre digestibility when 0, to 15% BDG was fed to Pigs. Other workers (Gargallo and Zimmerman, 1980; Pond *et al* 1981 and Frank *et al* 1984) have also reported significant linear decreases in crude fibre digestibility with increased dietary fibre.

The digestibility of ash was significantly better ($P < 0.01$) during phase I when pigs were fed at 4% body weight compared to feeding at 6% body weight. For the two phases combined the digestibility of mineral matter (ash) decreased both linearly and quadratically ($P<0.01$) as level of BDG increased in the diet of pigs. The level of fibre in these diets increased as the level of BDG replacing maize increased and this may be associated with the depressed mineral matter of digestibility of the BDG diets. Branch *et al* (1977) and Moser *et al* (1982) have also reported depressed digestibility of mineral matter as the level of fibre increased in diet of pigs.

The feeding of pigs at 4% body weight during phase I resulted in improved feed conversion efficiency, as well as better digestibilities of dry matter, nitrogen and ash. The digestibilities of energy was however significantly depressed during this phase. The direct substitution of BDG for maize resulted in a situation whereby the dietary nitrogen increased tremendously at higher levels of substitution this must have masked or prevented the crude fibre from showing its full effect on the performance and digestibilities of nutrients. Excess amino acids could probably have been catabolized for the supply of some energy, hence the response obtained may differ if diets were isonitrogenous. However, the results of this trial seem to suggest that the replacement of up to 25% of dietary maize by BDG in corn-soy diets did not significantly depress the performance and nutrient digestibility and perhaps utilization by young pigs. However, when higher levels of maize are replaced by BDG in practical diets, the digestibilities of most nutrients especially dry matter, energy, nitrogen and crude fibre would be significantly depressed.

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