EVALUATION OF BREWERS' DRIED GRAINS AND PALM KERNEL MEAL AS MAJOR SOURCES OF NITROGEN FOR GROWING CATTLE

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Palm kernel meal (PKM) and brewers' dried grains(BDG) were evaluated as cheaper alternatives for groundnut cake (GNC) Or cottonseed cake (CSC) as a major protein source for growing cattle. Calves were fed the various diets either individually or in groups. Average daily gain, feed intake and feed conversion efficiency between calves supplemented with CSC or BDG were not significantly (P > .05) different. Both dry matter (DM) and nitrogen (N) digestibilities were not significantly (P > .05) affected by the treatments but there was a tendency towards reduced DM digestibility of the BDG treatment. The growth and feed intake of calves supplemented with PKM were not significantly (P >0.05) different from those of calves supplemented with either GNC or CSC. Calves fed the high PKM diet required significantly (P< 0.05) less feed than those on the zero PKM diet. There was a slight but non significant decrease in DM digestibility of the PKM diets. Problems of palatability were recorded with the PKM supplemented groups which were counteracted by molasses inclusion. There was a tendency towards better feed efficiency for calves fed the PKM diets.

Key words: Cattle, protein supplements, digestibility

Factors that hinder livestock production in Nigeria (as well as in many developing countries) are many and critical. Among these are the continuous rise in prices and scarcity of some of the conventional protein sources. There is also a great demand for such protein sources as feed for monogastrics and there is therefore an urgent need to find alternative sources of protein which are cheap and also of low nutritive value for monogastric animals or man. Both brewers' dried grains (BDG) and palm kernel meal (PKM) fall into this class.

Brewers' grains are a major by-product of brewing which in Nigeria are used for land fill, as manure or disposed of as a waste. The dry product, the BDG, has been tested in monogastric feeds; Ademosun (1973) concluded that BDG should not be included at more than 10% or 30% in chick starter or grower diets respectively whereas the results of Babatunde et al (1975a) showed that pigs could tolerate up to 15% of BDG in the diet, Preston et al (1973) evaluated the energy value of BDG for cattle and obtained a net energy value comparable to that of corn, With a brewery or two in each of the 19 States of Nigeria, the potential exists for large scale production of BDG for animal feeding.

PKM on the other hand is the main by-product of the palm oil industry and Nigeria is a major producer of palm oil. Large quantities of the meal are therefore produced and about 75% of our PKM was, until recently, being exported. However, since the efforts of the Federal Government to make Nigeria self sufficient agriculturally and on account of the embargo on feed stuffs exportation, PKM is increasingly available from the large commercial oil millers and the small and local crushers. While a number of workers (Nwokolo et al 1977) have evaluated this product for monogastric feeding very little information exists in the literature (over the past 40 years) on its use as feed for ruminants, especially beef cattle feeding. Collingwood (1958) reported increased butterfat production when PKM was fed to dairy cattle. Babatunde et al (1975b) on the other hand reported poorer feed efficiency, reduced growth rate and feed intake for pigs fed PKM as the major protein source and concluded that it should not be used as the sole protein concentrate in pig diets.

Since both BDG and PKM are readily available and cheaper than the conventional GNC and CSC, it was desirable to evaluate these products as major protein sources in the diets of growing cattle.

Materials and Methods

Five days prior to the start of each study, the cattle were treated for intestinal parasites with Thibenzole (Merck, Sharp and Dohme), kept indoors and fed native grass (Andropogon and Hyperrhania spp predominating). Except for experiments 1 and 5 where animals were fed twice daily and in groups, all others were individually penned in roofed barns and fed the experimental diets once daily in the morning on the concrete floor. Initial, interim and final weights were taken shrunk ie without feed and water for about 16 hr. Analyses of feed and faeces for proximate components were determined according to AOAC (1970). The protein contents of the diets are shown in the tables of composition and in most cases the rations were balanced such that the test products provided at least half of the total crude protein (CP) intake. All the data were subjected to the analyses of variance (Steel and Torrie 1960).

Experiment 1: Eighteen steer calves (6 Bunaji and 12 Friesian x Bunaji) averaging 208 kg were allotted by weight to the three dietary treatments. This study lasted 62 days and the treatments comprised, on a dry matter basis, of 60% Elephant grass silage (Pennisetum purpureum, Schum, 35.3% DM and 5.4% CP) and 40% milled supplement containing either CSC, urea or BDG. The composition of the supplements is shown in Table 1.

Experiment 2: This involved the use of 24 calves (12 Bunaji and 12 Friesian x Bunaji) of both sexes with an average initial weight of 103 kg. The calves were assigned at random to the treatments on the basis of breed, sex and initial weight. The ration compositions were similar to those used in experiment 1 but a fourth treatment (Table l) was added and the study was for 81 days. The basal elephant grass silage contained 30.5% DM and 5.1% CP.

Experiment 3: Digestion study. Digestibilities of the diets used in experiment 1 were also determined with sheep. Twelve rams of the Yankasa breed averaging 23 kg were randomized to the three treatments, during each of two collection periods. Each lamb received 708 g dry matter (420 g silage and 288 g supplement) fed once daily in the morning for the 10 day preliminary period immediately followed by a 7 day collection period. Faecal collection and handling were by standard procedures.

Experiment 4: In this study lasting 86 days, 24 female calves (12 Bunaji and 12 Friesian x Bunaji) were used. They were randomized to the four treatments (Table 2) on the basis of weight and breed. The basal corn silage (29% DM and 6.5% CP) was fed at 60% and the supplement at 40% on a dry matter basis. Diets were formulated to differ in the levels of palm kernel meal in the supplements (Table 3) and were 0, 30, 45 and 60% for treatments 1, 2, 3 and 4 respectively.

Table 1:
Percentage composition of the supplements fed in experiments 1, 2 and 3 (DM basis)

Ingredients	Treatments[a]			
	1 CSC	2 Urea	3 BDG	4 BDG-Urea
Cottonseed cake	48.90	-	-	+
Guinea corn	44.35	88.15	-	33.55
Brewers' dried grains	-	-	90.40	55.88
Urea	-	4.85	2.60	3.57
Sugarcane molasses	5.00	5.00	5.00	5.00
Bone meal	1.50	1.75	1.73	1.75
Potassium chloride	0.25	0.25	0.25	0.25
Vitamin A[b]	+	+	+	+
Commercial mineral block[c]	+	+ .	+	+
Ration CP	12.2	11.1	12.1	11.9
CP intake contributed by major protein ingredients, %	57.80	40.80	51.5	61.3
Calculated crude fibre content of rations	28.6	23.4	34.7	30.4

[a] Treatments 1, 2 and 3 were the only ones tested in experiments 1 ant 3
[b] Added to provide 20,000 IU/head/day
[c] Was provided ad lib and contained 8.5% Ca, 4% P, 108.2ppm Mg, 346.1ppm Fe, 86.5ppm Cu, 64.9ppm Mn, 21.6ppc Co, 21.6ppm Zn and 5.4ppm I

Table 2:
Percentage composition of supplements fed in experiment 4 (DM basis)

	Treatments			
	1	2	3	4
Palm kernel meal	0.0	30.0	45.00	60.00
Guinea corn	40.0	23.27	15.0	27.00
Cottonseed cake (delinted & undecorticated:)	37.20	24.23	17.63	10.95
Sugarcane molasses	20.00	20.00	20.00	20.00
Bone meal	2.05	1.75	1.60	1.30
Salt	050	0.50	0.50	0.50
Trace minerals	0.25	0.25	0.25	0.25
Ration CP	10.55	10.70	10.75	11.15
CR intake contributed by major protein ingredients, %	(CSC) 43.40	(CSC) 28.87	(CSC) 21.07	(CSC) 13.41
	-	(PKM) 22.28	(PKM) 33.51	(PKM) 45.82
Calculated crude fibre content of rations	23.04	22.61	22.37	22.12

Table 3:
Percentary composition of supplements fed in experiment 5 {DM basis)

	Treatments	
	1 GNC	2 PKM
Guinea corn	82.62	32.16
Palm kernel cake	0.00	66.81
Groundnut cake	15.85	0.00
Bone meal	1.00	0.50
Salt	0.50	0.50
Trace minerals	0.03	0.03
Ration CP	12.06	12.02
Percent of CP intake contributed by major protein ingredients	(GNC) 34.74	(PKM) 62.40
Calculated crude fibre content of rations	18.08	20.67

Experiment 5: Twenty four male calves (8 Bunaji and 16 Friesian x Bunaji) averaging 270 kg were allotted by weight and breed to the two dietary treatments in two replicates. The calves were fed their experimental diets at the ratio of 40% elephant grass silage (28.3% DM and 5.9% CP) to 60% milled supplement for the 53 days of the study. Composition of the supplements is shown in Table 3 and the treatments were based on either GNC or PKM as sources of nitrogen.

Experiment 6: Digestion study. Twelve Yankasa rams of average initial weight of 22 kg were used in two faecal collection periods to determine the digestibilities of the diets used in experiment 4. The rams were randomized to the treatments and were individually fed the experimental diets at 2.8% of their body weight in dry matter. A preliminary period of 14 days preceded a 7 day collection period. As with experiment 3, standard procedures were adopted for both the collection and handling of the faeces.

Results

The mean crude protein, crude fibre, ether extract and ash values of the BDG and PKM used in these studies were on a dry basis, 21.4, 14.8, 2.9, 4.0 and 20.0, 8.5, 6.7 and 4.6 respectively.

Experiments 1 and 3: Results of experiment 1 are shown in Table 4. There were no significant (P >05) differences among the treatments for average daily gain, feed intake and feed conversion. However, there was a tendency towards improved gain and feed efficiency for both the CSC and BDG supplemented groups over the urea control group.

DM and N digestibilities were not affected significantly (P>.05) by the treatments. However, for the BDG treatment, the digestibilities of the two components tended to be reduced, the effect being more pronounced with DM.

Experiment 2: There was no significant difference (P>0.05) in average daily gain among calves fed the CSC, BDG or BDG-urea (treatments 1, 3 and 4) supplemented diets. No significant (P >0.05) difference was detected for this parameter among calves fed the urea control diet and those fed the BDG and BDG-urea diets "treatments 2,3 and 4). However, calves on the CSC treatment significantly (P< 0.05) grew faster than those on the urea control. The feed conversion of calves fed the CSC, BDG and BDG-urea supplemented diets was not significantly (P>0.05) different

Table 4:
Results of experiments 1 and 3

	Treatments			
	1 CSC	2 Urea	3 BDG	SE[a]
No of steers	6	6	6	-
Average initial weight, kg	204.0	208.1	212.1	-
Average daily gain, kg*	0.86	0.66	0.80	0.09
Average daily feed intake, kg*	7.40	7.51	7.59	-
Feed conversion* (kg feed/kg gain)	8.60	11.37	9.48	1.19
DM digestibility, %	64.0	64.1	55.1	2.75
N digestibility, %	70.4	.67.4	66.8	2.55

[a] Standard error.
* Not significant (P> 0.05)

Table 5:
Results of experiment 2

	Treatments[a]				SE
	1 CSC	2 Urea	3 BDG	4 BDG-Urea	
No of calves	6	6	6	9	
Average initial weight, kg	103.0	99.2	107.5	101.0	
Average daily gain, kg	0.31a	0.13b	0.25a,b	0 20a,b	0 04
Average tally feet intake, kg	2.59	2.48	2.27	2.36	0.20
Feed conversion	8.35	19.08d	9.08c	11.8c,d	2.70

a,b,c,d Means in the same row with different superscript are significantly different from one another (P< 0.05)

nor was there any significant difference in this parameter between calves fed the urea (control) and BDG urea supplemented diets (treatments 2 and 4). However, calves on the CSC and BDG treatments were significantly (P <.05) more efficient than those on the urea control. Average daily feed intake was not affected by the treatments.

Experiments 4 and 6: Average daily gain and feed intake (Table 6) were not significantly affected (P >.05) by the various levels of PKM in the diets. However calves fed the high level of PKM (treatment 4) were more efficient (P<.05) than those fed the control (treatment 1) diet. Feed conversion of calves supplemented with the control (treatment 1) and the high PKM (treatment 4) diets were not significantly (P >.05) different from those on the low and medium PKM supplemented diets (treatments 2 and 3). Levels of dietary PKM did not significantly (P >.05) influence both the DM and N-digestibilities. However, DM digestibility for the PKM treatments was slightly reduced compared to the control. In general, N-digestibility was low and this may be related to the high crude fibre level of all four diets (Table 2).

Experiment! 5: As in experiment 4, neither average daily gain, nor feed conversion was significantly (P >.05) affected by the treatments (Table 7). Calves fed the PKM diet however grew faster than those that received the GNC diet. This was mainly due to the superior performance of one pen (heavy cattle). Intake was slightly depressed by the inclusion of PKM but the tendency towards better feed efficiency noted for the PKM supplemented groups in experiment 4 was also recorded.

Table 6:
Results of experiment 4 and 6

	Treatments				SE
PKM%	1 0	2 30	3 45	4 60	
No of calves	6	6	6	6	-
Average initial weight, kg	114,3	106,5	114.7	112,5	-
Average daily gain, kg	0.31	0.36	0.38	0.41	0.05
Average daily feed intake, kg	2.88	2.52	2.83	2.58	0.37
Feed conversion	9.29	7 00a,b	7.45a,b	6.29 b	0.65
DM digestibility, %	64.1	62.0	62.9	61.2	1.28
N digestibility, %	51.4	50.8	50.7	51.2	1.55

a,b Means in the same row with different superscript are significantly different from one another (P<0.05)

Table 7:
Results of experiment 5

	Treatments		SE
	1 GNC	2 PKM	
No of calves	12	12	-
Average initial weight, kg	271.8	267.3	-
Average daily gain, kg *	0.60	0.81	0.15
Average daily feed intake, kg	6.19	5.38	-
Feed conversion *	10.32	6.64	1.13

* Not significant (P > 0.05)

Discussion

The compositions of the PKM and BDG used in these studies are similar to those reported by NRC (1968) and Oster et al (1977) for BDG and Babatunde et al (1975b) and Gohl (1975) for PKM. The high protein content of BDG reported by Oster et al (1977) was as a consequence of the protein rich malt used in brewing which in turn affected the grains. We cannot account for the fairly low ether extract (EE) value of our BDG. However, low EE values have been reported for Nigerian BDG by some earlier workers (Anon, 1975).

These studies were conducted to determine if PKM or BDG could be used as cheaper replacements for GNC or CSC as major protein sources for growing cattle. Judging from the principal parameters, average daily gain, feed intake and feed conversion, BDG or PKM supported comparable growth to either GNC or CSC.

The result of the BDG study is similar to that of Klopfenstein and Rounds (1975) which was later confirmed by Oster et al (1977). Oster and co-workers (1977) demonstrated no significant differences in average daily gain, food intake and food conversion of growing cattle from 80-240 kg fed two levels of BDG at 17 or 36% of the concentrate mixture versus soybean oil meal (SBM) as protein source. Klopfenstein and Rounds (1975) showed that cattle fed a corncob-based ration gained faster ant more efficiently with BDG as protein source than with SBM, urea or a BDG-urea combination. Their results also showed that steers fed BDG-urea gained faster than those supplemented with urea but not as fast as those on the SBM supplement.

BDG has both low protein solubility and degradability (Wohlt et al 1973 and Crawford et al 19782 and this means that it could leave the rumen relatively unaltered. Even though this makes it attractive as a protein supplement for ruminants, enough ammonia may not be liberated to meet the rumen degradable nitrogen (RDN) requirement of the microflora. To overcome this possible deficiency , some urea was added in treatment 3 of experiment 1 and treatments 3 and 4 of experiment 2. However, no advantage was gained by the urea addition.

In experiment 2, problems of palatability of the BDG dicta were encountered. Calves on the BDG and BDG-urea treatments (3 and 4) did not consume up to half of the supplements fed. However, through gradual introduction of the supplements and adequate mixing of the silage and supplements, the problem was overcome. No serious problem of feed refusal was noticed in experiment 1.

Both the DM and N-digestibility figures are shown in Table 4. Nitrogen digestibility wee identical across treatments in spite of the higher crude fibre content of the BDG diet. However, DM digestibility for the BDG treatment was lower than for the other treatments. This is attributable to the high crude fibre content with its well known depressing effect on digestibility (Babatunde et al 1975). .

The poor performance on the urea treatments in experiments 1 and 2 merely confirmed the well established importance of energy for efficient ammonia utilization (Lewis 1961) since enough energy would not have been released to aid microbial utilization at peak ammonia release from urea. However, the performance of calves fed the urea diet in experiment 1 was better than would normally be expected given the high roughage (60% elephant grass silage) nature of the diet and the slow energy release from roughage compared to grains (Simpson 1965). This improved performance could be attributed to the twice-a-day feeding regime which is known to improve performance and would also account for the improved feed intake.

Despite the report of Oyenuga (1968) which indicated that ruminants could handle PKM better than monogastric animals, very little PKM if any is used in ruminant feeding in Nigeria. Part of the reason for its low popularity in feeding ruminants may also be related to its reported gritty and unpalatable characteristics which affect feed intake (Oyenuga 1968; Babatunde et al 1975b). Moreover, for a long time and up to 1973 the conventional oil cakes (GNC and CSC) were readily available and cheap; there was therefore no pressure to use less conventional ant less tested feedstuffs, however available and cheap.

Our results indicate that despite the slightly depressed digestibility of DM for the PKM supplemented groups, that it supported comparable growth to GNC or CSC. The low N-digestibility figures obtained for all treatments in experiment 6 are most probably the result of the high CF content of the rations which is known to depress digestibility (Babatunde et al 1975a). In addition, the low dietary CP levels may also have contributed to the tow digestibility of N (Umunna and Dakintafo 1978).

At the initial stages (first 4 weeks) of experiment 4, animals did poorly on diets supplemented with PKM. This was solely due to feed refusal most of which was supplement. The experiment was re-designed and restarted with 20% sugarcane molasses incorporated to improve palatability. This solved the problem of feed refusal as can be verified by the relative intakes of the diets. In experiment 5, we deliberately left out molasses to see if we could, under group feeding conditions, encourage intake. Slight difficulties were encountered with feed refusal but with careful adjustment of the roughage to concentrate ratio such that the PKM supplement was gradually introduced to the required level in about 12 days, this was overcome. Careful and adequate mixing of silage with the supplement was found beneficial Sortirg became fairly difficult since the supplement tended to adhere to the "wet" silage and also formed a small part of the total volume of the daily feed allowance.

In all these studies, both light (young) and heavy (older) cattle were used to evaluate these product., The use of the young stock was deliberate since their protein requirments are more critical. Yet both BDG and PKM supported similar growth to GNC or CSC. The gains recorded for cattle in experiment 2 and 4 though generally low are however within the range obtained with cattle of similar size and given similar feed in our other studies.

Given the wide price differential between GNC or CSC (N280; N1 =US$1.65) and BDG or PKM (about N60 and N70 respectively) per metric ton and assuming similar labour costs, the economic advantage in using the by-products is attractive, Our data suggest that both PKM and BDG are good and cheaper replacements for GNC and CSC as major protein sources for growing cattle. Care is called for when both products specially PKM is used since feed refusal is common, and always a possibility. The use of molasses to improve acceptability is highly recommended.

References

Ademosun A A 1973 Evaluation of brewers' dried grains in the diets of growing chicken. British Poultry Science 14:463-468

Anon 1975 Livestock Feed Study Report Federal Livestock Department, Kaduna, Nigeria.

AOAC 1970 Official Methods of Analysis of the Assocation of Official Analytical Chemists 11th Edition Published by the Association of Official Analytical Chemists, Washington DC

Babatunde G M, Fetuga B L, Oyenuga V A 6 Ayoade A 1975a Industrial by-products and farm wastes for pig feeding in Nigeria I The effects of graded levels of brewers' dried grains and maize cobs in the diet of pigs on their performance characteristics and carcass quality Nigerian Journal of Animal Production 2: 119-133

Babatunde G M, Fetuga B L, Odumosu O & Oyenuga V A 1975b Palm kernel meal as the major protein concentrate in the diets of pigs in the tropics Journal of the Science of Food and Agriculture 26:1279-1291

Campbell J R, Howe W M, Martz F A & Merilan C P 1963 Effects of frequency of feeding on urea utilization and growth characteristics in dairy heifers Journal of Dairy Science 46:131-134

Collingwood J C 1958 Palm kernel meal In Processing plant protein foodstuffs Ed A M Altschul Academic Press, New York

Crawford R J. Hoover W H, Sniffen C J & Cooker B A 197'; Degradation of feedstuff nitrogen in the rumen vs nitrogen solubility in three solvents Journal of Animal Science 46:1768-1775 :

Gohl B 1975 Tropical Feeds: : Feeds Information Summaries and Nutritive. Values, FAO, Rome

Klopfenstein T & Rounds W 1975 Nebraska Beef Cattle Report EC75-218 University of Nebraska Institute of Agriculture and Natural Resources

Lewis D 1961 In Digestive Physiology and Nutrition of the Ruminant Butterworths, London

National Research Council, National Academy of Sciences 1968 Nutrient requirements of sheep 4th revised edition, Publication 1693, Washington DC

Nwokolo E N. Bragg D B & Saben 11 S 1977 A nutritive evaluation of palm kernel meal for ':se in poultry rations Tropical Science 19, 147-154

Oster A, Thomke S & Gyllang H 1977 A note on the use of brewers' dried grains as a protein feedstuff for cattle Animal Production 24:279-282

Oyenuga V A 1968 Nigeria's Feeds and Feedingstuffs 3rd edition Ibadan University Press

Preston R L, Vance R D & Cahil V R 1973 Energy evaluation of brewers' grains for growing and finishing cattle Journal of Animal Science 37:174-178

Simpson O C 1965 Influence of rate of ammonia and energy release on protein synthesis by rumen bacteria PhD Thesis.University of Nebraska, Lincoln, Nebraska

Steel E G D & Torrie J H 1960 Principles and Procedures of Statistics, McGraw Hill New York

Umunna N N & Dakintafo A 1978 Optimum crude protein requirement of growing Zebu and Friesian x Zebu crossbred cattle in Nigeria Proceedings 4th World Conference of Animal Production, Buenos Aires, Argentina

Wohlt J E, Sniffen C J & Hoover W H 1973 Measurement of protein solubility in common feedstuffs Journal of Dairy Science 56:1052-1057

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