

DRIED BIOGAS SLURRY AS A NUTRIENT SOURCE IN GROWING PIG DIETS

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Abstract: Two feeding experiments were conducted to evaluate the effects of including dried biogas slurry (DBS) on the performance of growing pigs. In each experiment, 36 growing pigs were limit-fed diets containing 0, 5, 10, and 20% DBS substituted (w/w) for coconut oil cake and rice bran. The results suggest that DBS is potentially useful as a nutrient source in growing pig diets. The inclusion of up to 10% DBS in diets had no adverse effect on gain and feed efficiency, whereas 20% DBS inclusion depressed performance which may be attributed to its high fibre and low available energy contents. The merits of biogas slurry over the raw manure and the practical limitations to its use are discussed.

1. Introduction

The need to develop renewable sources of energy has generated much interest during the recent decades in biogas production from animal manures. The slurry (solid by-product) from biogas digesters is generally utilized as a fertilizer for crops as in fish ponds. Because the biogas slurry contains moderate amounts of protein,⁷ it is possible that the dried slurry could be used as an animal feeding stuff.

Extensive reviews are available on the refeeding of various forms of animal manure,^{3,4,5} but corresponding data on the feeding value of biogas slurry is almost non-existent. The experiments reported herein were carried out to evaluate dried biogas slurry (DBS) as a source of nutrient in growing pig diets.

2. Materials and Methods

2.1 Source of DBS

The DBS samples used in this study originated from a continuously-fed Indian-type field scale biogas digester maintained at the piggery of the University of Peradeniya. Fresh manure was washed daily into the digester from pigs housed in semi-open concrete-floored pens. The pigs were fed on a low-quality swill (8-10% crude protein, 10-16% crude fibre) and limited quantities of a mixture of rice bran and coconut oil cake. The solid effluent from the digester was removed, initially sun-dried on a concrete floor to 86-88% solids content and finally dried overnight in an Unitherm oven at

60°C. The resultant hard crumbs were ground into a semi-powdery form before incorporation into the diets.

Prior to the commencement of each feeding trial, the DBS was bulked and representative samples were taken for the analysis of proximate components.¹ Representative samples of rice bran and coconut oil cake were also subjected to similar analyses.¹

2.2 Feeding experiments

The study consisted of two separate feeding experiments. In each experiment, thirty-six crossbred barrows were divided into three groups on the basis of weight. The average weight of pigs in Experiments 1 and 2 were 15.5 and 18.3 kg, respectively. Pigs within each weight group were assigned to one of twelve pens, so that there were three pigs per pen. The four treatments were then randomly allocated to three pens each.

The composition of the experimental diets is shown in Table 1. They were designed to contain 0,5,10 and 20% DBS, the DBS replacing coconut oil cake and rice bran in the control diet. Each five parts of DBS replaced (w/w) three parts of coconut oil cake and two parts of rice bran. The diets were iso-nitrogenous but not iso-caloric since the digestible energy value of DBS was not available.

Pigs were housed in concrete-floored pens. The diets were limit fed twice daily in equal amounts. The amount of feed to be given was determined by the animal group consuming the least during a 30-minute feeding period at each weighing. Feeding levels were held constant until next weighing. Body weights were recorded at weekly intervals. The experiments were of eight weeks duration. Diets were mixed with water immediately prior to feeding to improve consumption and to reduce wastage. Water was freely available at all times.

Average daily gain and feed to gain ratio were computed on a pen basis. The data were subjected to analysis of variance and the treatment means were compared using the Tukey's procedure.⁸

Table 1. Percentage composition of pig grower diets used in the feeding trials

	Control	Level of DBS (%)		
		5	10	20
Maize	25	25	25	25
Coconut oil cake	40	37	34	28
Rice bran	25	23	21	17
DBS	-	5	10	20
Fish meal (50% CP)	6	6	6	6
Skim milk powder	2	2	2	2
Bone meal	1.5	1.5	1.5	1.5
Vitamin-trace mineral premix ^a	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
<u>Analysis (dry matter basis)</u>				
Crude protein (%) ^b	18.2	18.1	18.3	18.2
Digestible energy (Mcal/kg) ^c	2.88	-	-	-

^aSupplied (per kilogram of premix): 6,600,000 IU vitamin A, 528,000 IU vitamin D₃, 880 IU Vitamin E, 1.98 g riboflavin, 4.4 g calcium panthothenate, 8.8 g niacinamide, 22.0 g choline chloride, 8.8 g vitamin B₁₂, 1.32 g vitamin K, 5.28 g manganese sulfate, 1.98g copper carbonate, 0.99 g calcium iodate, 0.55 g cobalt sulfate and 0.22 g zinc oxide.

^bDetermined value.

^cCalculated value.

3. Results and Discussion

The compositional data of DBS confirm its moderate nutritional potential for non-ruminants (Table 2). The crude protein content of DBS samples used in Experiments 1 and 2 were 16.6 and 14.7%, respectively. The crude fibre contents of the samples were however, high averaging 18.5%. The high ash content was related to sand contamination, as indicated by the high levels of acid-insoluble ash. The blocking of biogas digesters by sand is a common practical problem and contamination with sand may be expected to be more severe under field situations. But preliminary observations have shown that considerable reduction in contamination could be achieved by 'scoop shovelling' instead of directly washing the manure into the biogas digester.

Table 2. Average chemical composition of dried biogas slurry, coconut oil cake and rice bran (dry matter basis)

Constituent	Dried biogas slurry		Coconut oil cake	Rice bran
	Trial 1	Trial 2		
Crude protein (Nx6.25)	16.6	14.7	21.0	10.5
Ether extract	3.1	3.3	8.6	11.2
Crude fibre	18.5	18.4	12.1	16.8
Ash	11.4	13.5	6.9	12.5
Nitrogen-free extract	50.4	50.1	51.4	49.0
Acid-insoluble ash	6.1	8.2	0.6	5.1

The potential of biogas slurry as a non-ruminant feedstuff has been questioned by Summers *et al.*⁹ on the grounds that a well digested slurry will have minimal 'potentially' digestible carbohydrates left. The DBS samples used in the present study contained an average of 50.2% nitrogen-free extracts, which is generally assumed to be indicative of the digestible carbohydrate fraction.

The variable nature of biogas slurry needs special mention at this point. As could be expected, the composition of slurry would vary depending on the source of manure (animal species) which, in turn, would differ widely according to the type of diet fed to the donor animals. For example, preliminary evaluation of biogas slurry from cattle manure have shown it to be a poor quality feed for non-ruminants containing crude protein contents of less than 9% and crude fibre contents as high as 31%.⁷

In Experiment 1, the performance of animals fed diets containing 5 and 10% DBS were similar to those on the control diet (Table 3). But the performance tended to be non-significantly ($P > 0.05$) higher at 5% DBS. The significance of this slight growth response is unclear. Although pigs fed diets with 20% DBS gained 11% slower and required 12% more feed per unit of gain than did controls, the differences were not statistically significant.

In Experiment 2, the performance of pigs were unaffected by the dietary inclusion of up to 10% DBS (Table 3). Gain and feed efficiency of pigs fed diets with 20% DBS, however, were significantly poorer ($P < 0.05$) when compared to other treatments.

Table 3. Performance of growing pigs fed diets containing varying levels of DBS

	Avg. initial weight(kg)	Avg. final weight(kg)	Avg. daily gain(kg)	Feed per gain
Experiment 1				
Control	15.4	31.1	0.28 ^{ab}	3.79 ^{ab}
5% DBS	15.6	32.6	0.30 ^a	3.53 ^a
10% DBS	15.4	31.1	0.28 ^{ab}	3.79 ^{ab}
20% DBS	15.5	29.5	0.25 ^b	4.24 ^b
SEM*	0.31	0.60	0.02	0.14
Experiment 2				
Control	18.2	37.2	0.34 ^a	3.37 ^a
5% DBS	18.2	37.8	0.35 ^a	3.27 ^a
10% DBS	18.4	38.0	0.35 ^a	3.37 ^a
20% DBS	18.3	35.1	0.30 ^b	3.82 ^b
SEM*	0.42	0.72	0.02	0.12

* Standard error of mean.

^{a,b} Within each trial, means in the same column with different superscripts are significantly ($P < 0.05$) different.

The weight gains of animals in Experiment 1 were markedly lower than those in Experiment 2. Reasons for this difference are unclear, but may have been due to the extremely hot weather experienced during the experimental period.

The overall results suggest that DBS could be used as a nutrient source in growing pig diets up to 10% level without any adverse effect on growth performance. The pigs appear to have the ability to extract the benefits of microbial protein and vitamin B-complex up to this level of inclusion. A very high content of vitamin B₁₂ (3000 mcg/kg) in DBS has been reported.² The growth depression observed on 20% DBS diets is probably related to the low available energy content, resulting from its high crude fibre content. It is known that animal manures have a low digestible energy content.^{3,4,5} The available energy could be expected to further lowered during the production of biogas.⁶ Thus the low energy content of DBS would be a major factor limiting its high level usage in non-ruminant diets. From the energy point of view, ruminants are the most desirable species for feeding biogas slurry because of the ability of the rumen microbes to utilize fibre components.

The digested slurry has several advantages over the raw manure. The slurry has only a faint odour and is greatly improved in this respect over the

manure. The slurry is also stable on long-term storage. A potential health hazard due to the survival of pathogens in DBS does exist, but studies have demonstrated that anaerobic digestion considerably reduces the number of pathogens present in animal manures.⁹ No health problems were observed in pigs in the present study.

While DBS is potentially useful as a feedstuff for growing pigs, utilization of this material requires some artificial dehydration. Even under sunny and dry weather conditions, sun-drying was found to reduce the moisture content of the slurry to only 12-14%. Cheaper ways of drying the slurry need be evolved before its practical use can be encouraged. An additional factor of concern is the possible wide variability in the chemical composition of the slurry. Considerable variations have been reported with regard to the crude protein (14.9-18.2%), crude fibre (17.4-26.4%) and ash (11.2-20.0%) contents of DBS samples.⁷ This would prevent any general recommendation regarding the potential use of slurry in animal diets.

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