EFFECT OF A METHANE INHIBITOR ON GROWTH PERFORMANCE AND RUMEN VFA OF STEERS FED SUGAR CANE AND MOLASSES

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Twenty four Zebu bulls of approximately 200 kg liveweight were used in a 3 x 2 factorial design with two replications and two animals in each treatment/replicate. The treatments were three levels of methane inhibitor (ICI 111075) of 0, 1.5 and 3 mg/kg liveweight/d; the other factor was the presence or absence of 750g/d of cotton seed meal (CSM). The basal diet was chopped sugar cane supplemented with a mixture of molasses/urea (20% urea) at the level of 50g/kg of cane; the methane inhibitor was mixed in this solution. In addition, the animals had free access to a standard molasses/urea mixture (2.5% urea). At the beginning of the experiment the level of cane feeding was fixes at 5kg/head/d, later increasing to 7.5kg/d. The experiment lasted 91 days at the end of which samples were taken of rumen fluid with a stomach tube to determine molar VFA. The basic diet without CSM wan known to give inefficient animal performance and it was hypothesized that this would be a good environment in which the methane inhibitor might have significant effects. The addition of CSM represented a diet of superior quality. The results showed a significant improvement in rate of liveweight gain and voluntary consumption index due to the addition of CSM; however there wan no apparent effect of the additive either in the presence or absence of the CSM. there were significant effects of the additive on the pattern of rumen VFA with significant decreases in acetate and increases in butyrate due to the additive. There were no differences due to the addition of CSM.

Key words: Cattle, methane inhibitor, sugar cane, molasses/urea, growth, rumen VFA.

The principal end-products of the fermentation of carbohydrates in the rumen are the volatile fatty acids (VFA) carbon dioxide and methane. Hydrogen is produced during the fermentation of carbohydrate to acetate and butyrate. Some of it is used in the production of propionate and the remainder is fermented, with carbon dioxide, to form methane (Hungate 1966). In some cases, hydrogen gas has been detected but this is not a common path way.

There have been many attempts to manipulate the rumen fermentation with the intention of increasing the production of propionate and reducing the production of methane. There are advantages in both directions, since the production of methane represents a direct loss of energy while propionic acid is an important precursor for gluconeogenesis. It can thus have a protein sparing role since amino acids are the other main source of glucose precursors (Leng 1970).

A number of compounds appear to be effective as inhibitors of methane production. There are analogues such as chloroform and related halogenated compounds. Unsaturated oils which act as alternative electron sinks to methane production have also been used. Although these substances have been effective in suppressing methane, none have invoked consistent responses in animal performance.

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Other compounds act in a more general way on the microbial population. Monensin, an antibiotic and coccidiostat used widely in poultry production, has been the most successful compound used as a feed additive in ruminant diets. Its use in a wide range of feeds has given rise to increases in molar proportions of propionic acid in the rumen VFA and to decreases in methane production (Richardson et al 1976). It has consistently brought about improvement in animal performance especially in feed conversion efficiency (Potter et al 1976; Raun et al 1976). It is thought that the majority of feedlot cattle in North America presently receive this compound in their diets.

Many chemical companies are actively engaged in screening compounds which might bring about similar improvements in rumen fermentation to those described above. One of these substances (ICI 111075), a potent inhibitor of methanogenesis has given encouraging results in fermentation studies both in vitro and in vivo with sheep. The results obtained in this study confirmed the expected changes in rumen VFA but there appeared to be no effect on animal performance.

Material and methods

Treatments, Animals and Design: The treatments in a random block design with a factorial arrangement of treatments (3 x 2) were dietary levels of methane inhibitor (ICI 111075) equivalent to 0, 1.5 and 3 mg/kg liveweight/d, in the presence or absence of 750 g/d of cottonseed meal. There were two animals in each pen, and two pens per treatment. A total of 24 animals were used, these were Zebu bulls with average initial liveweight of 230 kg and approximately 2 years of age at the beginning of the trial which lasted 91 days.

Diets: The animals had free access to molasses containing 2.5% urea (w/w). The roughage component of the diet was chopped whole sugar cane supplemented with a concentrated solution of urea (20% w/w) in molasses at the rate of 50 g/kg of fresh cane. This solution was made up by first dissolving the urea in an equal amount of water and then mixing with final molasses and the appropriate amount of the methane inhibitor. The sugar cane was chopped to a particle size of about 10 mm in a forage harvester (Hesston 2000/150) and given as a single feed each morning at the rate of 6.5 kg/animal. The solution of urea and methane inhibitor was sprayed on top of the cane. Cottonseed meal was given to half of the pens at the rate of 750 g/animal at the same time as the sugar cane each day. The animals also received a daily ration of minerals (equal parts of salt and disodium phosphate) at the rate of 60 g/d.

Measurements: The animals were weighed at 14d intervals and the rate of liveweight gain calculated as the regression coefficient of liveweight against time. Feed residues were recorded daily in the case of sugar cane and at intervals of two weeks in the case of molasses (2.5% urea).

In the last week of the experiment, samples of rumen fluid were taken by stomach tube to determine the molar proportions of VFA (Rowe et al 1979).

Results

Animal performance: Mean values for initial liveweight, daily live weight gain and feed intakes for the individual treatments are given in Table 1. The data in Table 2 are the means and statistical analysis for the effects of the two principal treatments, namely the effect of the level of the cottonseed meal. There were no differences in liveweight gain, feed intake or feed conversion rate which could be ascribed to the! level of additive used in this trial. There were, however, significant improvements in animal performance brought about by including cottonseed meal in the diet.

Table 1:
Mean values for change in live weight and feed intake for Zebu bulls fed chopped whose sugar cane, molasses/urea with or without 750 g/d of cotton seed meal and with different concentrations of additive (ICI 111075) (91 days: 4 animals/treatment)

Cottonseed meal, g/d	0			750		
Additive, mg/kg liveweight	0	1.5	3.0	0	1.5	3.0
Live weight, kg						
Initial	225	226	215	223	2 26	222
Daily gain	.364	.453	.256	.696	.637	.057
Feed intake, kg/d						
Sugar cane	6.50	6.50	6.30	6.30	6.50	6.50
Molasses	3.79	3.90	4.00	3 78	4.00	3.89
Urea	.427	.410	.433	.427	.433	.427
Cottonseed meal				.750	.750	.750
Total dry matter	5.15	5.20	4.95	5.50	6.10	5.90
Consumption index[1]	2.22	2.12	2.24	2.21	2.87	2.30
Conversion[2]	14.3	11.5	19.5	7.90	9.58	6.98

[1] 100g DM intake/100 kg liveweight/d
[2] DM intake/gain in live weight

Table 2:
Mean values for effects of level! of additive, and of cottonseed meal on performance of Zebu bulls fed sugar cane and molasses/urea

	Level of additive, g/kg LW				Cottonseed meal, g/d		
	0	1.5	3.0	SEx(P)	0	750	SEx(P)
Liveweight gain, g/d	530	545	557	214(.98)	358	730	1754.10)
DM intake, kg/d	5.32	5.62	5.42	0.27(.76)	5.08	5.83	0.22(.08)
Consumption index[1]	2.21	2.41	2.16	.12(.23)	2.21	2.38	0.10(.18)
Conversion[2]	12.1	10.5	13.5	4.5(.79)	15.9	8.20	4.05(.15)

[1] g DM intake/100kg liveweight/d

[2] DM intake/gain in live weight

Table 3:
Mean values (± SEx) for molar proportions (%) of VFA in rumen fluid from bulls fed sugar cane and molasses/urea with or without the additive (ICI:111075)

	Control (n=8)	Additive[1] (n=16)	Probability
Acetate	76.9 ± 1.1	68.5 ± 1.3	.001
Propionate	17.6 ± 1.2	20.3 ± 0.6	.16
Butyrate	5.1 ± 0.9	9.8 ± 0.9	.002

[1]Means for all animals receiving the additive

The improvement in liveweight gain appeared to be due to a combination of both a higher voluntary intake and a greater efficiency of utilization of the ingested feed. These effects of the cottonseed meal are similar to those reported previously by Silvestre et al (1977) and Meyreles et al (1979).

Rumen fermentation: Mean values for the molar proportion of the principal VFA are given in Table 3. There were highly significant differences in the proportions of acetate and butyrate with decreases in the former and increases in the latter associated with the feeding of the additive. There was an indication (P=.16) of an increase in the molar proportion of propionate in animals receiving the additive.

Discussion

The results of this experiment confirm the previous observations of the effects of the compound on rumen fermentation pattern (Stanier and Davies unpublished observation: Boyle and Davies 1977).

The absence of any change in animal performance when the compound was given could be interpreted as indicating that the degree of increase in rumen propionate was perhaps not sufficient to influence animal performance. A more likely explanation is that animal performance on sugar cane diets is not easily changed by manipulating the ratios of the energetic end-products in the rumen, but rather has to do with making more total energy available to the animal, either through increases in voluntary intake or providing bypass energy for digestion at the level of the duodenum (Preston and Leng 1979). The effect of the cottonseed meal (which we believe to be a good source of bypass energy and bypass protein) supports this hypothesis since the amount given represented only some 11% of the total dry matter intake, yet it brought about a 100% increase in the rate of liveweight gain (from 358 to 730 g/d).

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