THE ENSILING OF MIXTURES OF CANE AND FORAGE

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Two laboratory-scale experiments-were undertaken to assess the feasibility of en siring mixtures of sugar cane and forages. In experiment 1, *Glycine wightii* was ensiled for 1 month, alone or with 10% derinded cane, both treatments with 0, 2.5, 5.0 or 7.5 g formaldehyde/100 g crude protein in glycine. The pHs were consistently lower for silages with derinded cane, but all silages appeared to be well-preserved, although glycine alone, without formaldehyde, had the highest degree of fermentation. The rate of DM degradation in dacron bags suspended in the rumen was not affected by formaldehyde treatment. In experiment 2, *Canavalia ensiformis* appeared to provide a source of urease capable of increasing the rate of release of ammonia from urea, but mixtures of cane and canavalia were successfully ensiled without urea. Thus, there appear to be advantages in ensiling mixtures of cane and forage compared to ensiling either alone.

Key words: *Glycine wightii*, derinded cane, silage, *Canavalia ensiformis*, formaldehyde treatment

Ensilage is a fermentation process of feed crops which enables their conservation during seasons of peak yield for use in periods of scarcity. Efficient ensiling requires anaerobic conditions to produce a rapid fall in pH due to the fermentation of sugars to organic acids. In the absence of sufficient soluble carbohydrates, undesirable secondary fermentation takes place with the breakdown of lactic acid to butyric acid (McDonald et al 1969), while too high a concentration of sugar (e.g. high Brix sugar cane) promotes the growth of yeasts which ferment sugars to alcohol (Ravelo et al 1977). Thus it appears advisable to add a source of carbohydrates when ensiling forages and to provide a buffer when ensiling sugar cane. Ammonia and urea have been used as buffers, with the latter being less efficient, due to its slow rate of conversion to ammonia (Alvarez & Preston 1976).

An alternative method for ensuring an acceptable silage is the use of additives such as formaldehyde or formic acid to reduce the degree of fermentation (McDonald et al 1969). In the present study, conducted with laboratory size silos, the addition of derinded sugar cane to forage (*Glycine wightii*) was compared with addition of different levels of formaldehyde (experiment 1).

The objective of the second experiment was to assess the efficiency of the forage *Canavalia ensiformis*, which contains the enzyme urease (Skerman 1977),in increasing the rate of release of ammonia from urea and the consequent effect on the quality of sugar cane silage.

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Materials and Methods

Experiment 1: The *Glycine wightii* (28.0% DM, 15.4% crude protein in the DM) was ensiled in plastic containers with tightly fitting lids, which held approximately 5 kg fresh material. The 8 treatments were: 4 levels of formaldehyde addition to*Glycine wightii* alone or mixed with derinded cane (10% of fresh weight). Formaldehyde was added at levels of 2.5, 5.0 and 7.5 g/100 g crude protein in glycine. The formaldehyde was added as formalin (37% w/v formaldehyde) with each level being diluted to 200 ml with water. The silos were opened after one month and pH and dry matter (in oven at 100°C for 24 hr) were determined. Samples were also taken for measurement of volatile fatty acid and ammonia concentration and for determination of rate of dry matter digestion in the rumen, using dacron bags (0rskov et al 1980). Volatile fatty acid concentration was measured by titration after distilling an extract prepared by soaking 12.5 g silage in 100 ml 0.6 N HCl for 24 hr. Ammonia concentration was measured by distilling an extract prepared from 12.5 g silage boiled in 100 ml hot water for 10 min., then extracted in a domestic liquidiser for 30 seconds and finally filtered.

Experiment 2: The nine treatments compared were three ratios of sugar cane (25.9% DM, 15 °Brix) to *Canavalia ensiformis* (25.3% DM 9.7% CP) (60:40 70:30; 80:20) without urea and with 0.75 and 1.5% urea added as a 50% solution in water. The silos used were described in experiment 1, as were the procedures for measuring volatile fatty acid and ammonia concentration. Pre ensiling samples were taken for determination of dry matter and pH. Core samples were taken at 2, 5 and 7 days for pH measurements and for dry matter, total N, volatile fatty acids, ammonia and pH after 3 weeks.

Results and Discussion

Experiment 1: All the silages appeared to be well-preserved, with relatively low levels of ammonia and total volatile acids (Table 1). The highest concentrations (151 mequiv VFA/100 g DM) were in glycine alone, without formaldehyde. There appeared to be an interaction between formaldehyde and cane, since in the presence of formaldehyde, volatile fatty acid concentration in glycine and cane were higher than for glycine alone-(Figure 1). The pHs were consistently lower for the silages with derinded cane reflecting the higher content of soluble sugars, possibly fermented to lactic acid, which unfortunately could not be determined.

The DM disappearance in the rumen expressed as 1/2 time (Table 1) was not significantly affected by formaldehyde treatment. Workers in temperate climates have reported an effect of formaldehyde in decreasing DM digestion (Gill et al 1979), but this was measured in vivo where any free formaldehyde present could adversely affect bacterial fermentation in the rumen. Dacron bag results do not take account of this effect and are therefore inconclusive, but indicate no detrimental effect.

Thus, while glycine can be successfully ensiled without treatment, the degree of fermentation can be decreased by addition of formaldehyde or a more stable pH achieved by the addition of 10% derinded cane.

Experiment 2: The changes in pH during the ensiling process are presented in Figure 2. There were marked differences in pH due to urea level but no significant effect of cane:canavalia ratio except at the 0.75% urea level.

Table 1:
Chemical composition and dry matter degradability of Glycine silages

Treatment		pH	%DM	Total VFA (mequiv/100 g DM)	NH_3 (% DM)	1/2 Time (h)[1]
Glycine	0% formaldehyde in CP	4.5	37.0	151	1.12	34.2 ± 5.74
	2.5	4.5	37.0	60	0.88	41.0 ± 11.69
	5.0	4.5	35.4	49	0.80	36.5 ± 2.27
	7.5	4.7	41.5	27	0.52	34.4 ± 3.65
Glycine + 10% cane	0% foramldehyde in CP					
	2.8	4.2	36.4	97	0.96	43.7 ± 5.42
	5.6	4.2	36.4	71	0.89	54.5 ± 6.70
	8.4	4.3	35.4	59	0.84	52.8 ± 11.40
		4.3	36.4	44	0.89	35.0 ± 5.91

[1] $T_{1/2}$ is the time (h) for the disappearance of half the DM incubated in dacron bags.

Figure 1 :
The effect of addition of formalin on cane on the VFA composition of Glycine silage

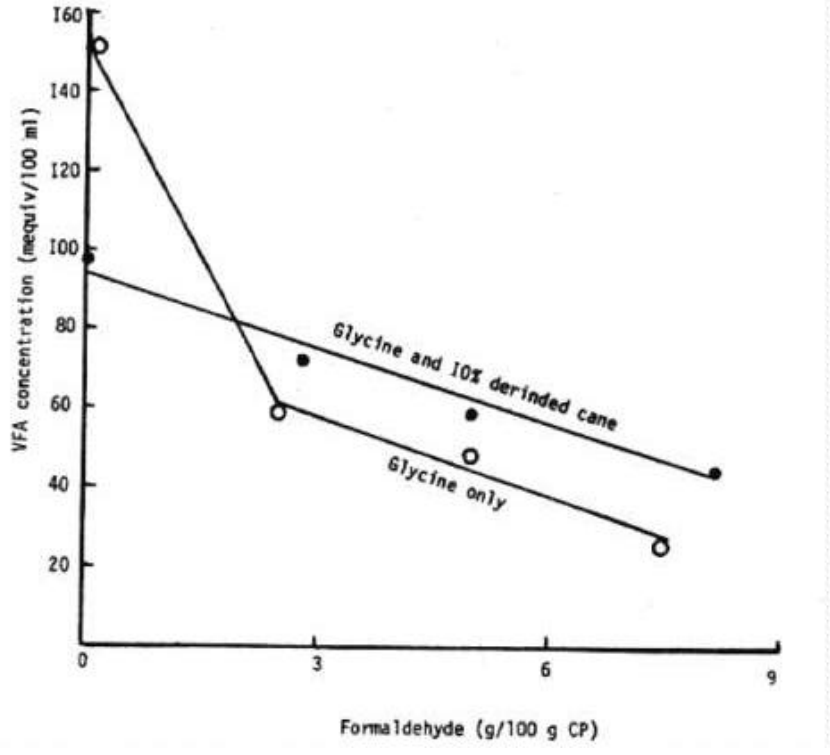

Figure 2 :
Effect of treatment on change in pH with time of ensiling

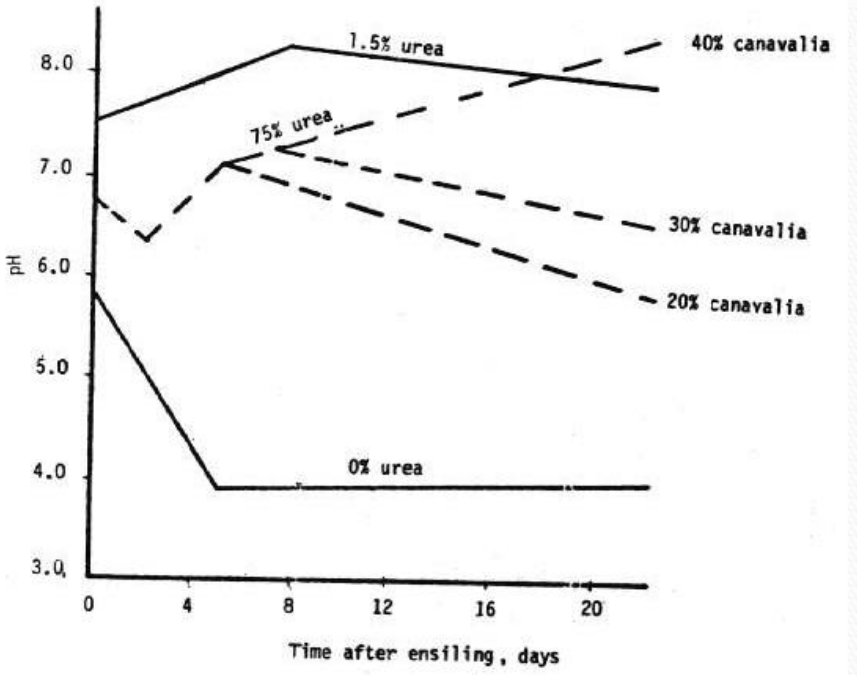

Table 2:
Chemical composition of the silages after three weeks

Treatment		Dry matter (DM) %	VFA (mequiv %)	Ammonia (% DM)	Final pH
Cane:canavalia	Urea %				
60:40	-	18.2	210.8	0.43	4.0
70:30	-	18.2	134.2	0.16	3.9
80:20	-	17.0	168.2	0.16	4.1
60:40	0.75	16.0	276.3	3.96	8.3
70:30	0.75	17.2	275.8	3.58	6.5
80:20	0.75	16.6	307.5	3.43	5.8
60:40	1.5	16.1	221.0	5.39	7.9
70:30	1.5	19.4	570.1	4.55	7.7
80:20	1.5	16.3	664.9	4.40	8.0

In this treatment there appeared to be a positive relationship between percentage of canavalia and final pH. This would suggest that the action of urease was limited by the 0.75% urea level at 20 and 30% canavalia. However, all the silages were well-preserved with no indication of alcohol production, suggesting that the presence of the forage alone was sufficient to prevent the growth of yeasts (Table 2). The addition of urea increased ammonia concentration to an extent likely to limit voluntary intake (Wilkins et al 1971).

There would therefore appear to be advantages in ensiling mixtures of cane and forage compared to ensiling either alone. However, further work is required to test the acceptability of such silages in terms of animal intake.

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