WINTER PERFORMANCE OF BEEF WEANERS FED UNTREATED AND FORMALDEHYDE-TREATED WILTED LUCERNE SILAGES AND HAY

G. H. SCALES
Tara Hills High Country Research Station, Omarama

T. N. BARRY
Invermay Agricultural Research Centre, Mosgiel

SUMMARY

Formaldehyde plus formic acid-treated silages were made from wilted lucerne and fed to weaner cattle. Concentrated applications (0.10% HCHO and 0.13% HCOOH of fresh lucerne) were compared with dilute applications containing the same quantities of HCHO and HCOOH but diluted by adding water. Lucerne hay was also made from the same area as the silages.

Formaldehyde plus formic acid treatment decreased protein degradation and organic acid fermentation, there being small differences between the concentrated and dilute applications.

Cattle fed treated silages consumed slightly more dry matter than those fed untreated silage but liveweight gains did not differ significantly from animals fed either untreated silage or lucerne hay.

There was a significant linear relationship between silage DM consumption and DM content ($r = 0.73$), with increases in consumption of 1.45 kg/head/day for each 10% increase in DM % within the range of 26 to 54% DM.

It was concluded that there was little advantage in treating wilted lucerne silages with formaldehyde plus formic acid additives at the rates described.

INTRODUCTION

It is generally accepted that animal production from untreated direct cut silage is poor, owing mainly to low voluntary consumption. Although wilting ensiled herbage has been shown to increase feed consumption in cattle (Gordon *et al.*, 1961; Thomas *et al.*, 1961; Forbes and Jackson, 1971) there is evidence that increases may not always occur (Thomas *et al.*, 1968).

Voluntary consumption of silage is negatively correlated with organic acid production and the degree of protein breakdown (McLeod *et al.*, 1970; Valentine and Brown, 1973). The use of formaldehyde prior to ensiling has been shown to reduce protein breakdown and organic matter fermentation (Barry and Fennessy,

1972: Brown and Valentine, 1972) resulting in increased voluntary intake (Barry *et al.*, 1973). However, more recent work has shown that formaldehyde and formic acid used in combination will more effectively reduce silage fermentation and increase animal production (Valentine and Brown, 1973; Barry, 1974).

Much of the formaldehyde work has been conducted with grass silages. Hence the purpose of this experiment was to compare the performance of weaner beef cattle fed wilted lucerne silage treated with both dilute and concentrated applications of formaldehyde plus formic acid, with untreated wilted lucerne silage, and with lucerne hay.

EXPERIMENTAL

Conservation Procedures

A 28 ha area of regrowth lucerne (*Medicago sativa*) was cut at the 10% flowering stage with a sickle bar mower in early March, 1974. After wilting from approximately 24 to 35% DM (range 26 to 54%), the lucerne was picked up with a flail-type forage harvester and subsequently made into three experimental silages.

Concentrated and dilute solutions of formaldehyde plus formic acid were applied from an applicator mounted on the forage harvester. The application rate for the concentrated silage was 3.8 l/tonne of fresh herbage (0.33 formic : 0.67 commercial formalin) and 10.6 l/tonne for the dilute silage (0.67 water : 0.33 formalin plus formic). The rates were calculated to add equal quantities of formaldehyde (0.27% of DM) and formic acid (0.34% of DM) to each silage, but with more total water in the dilute treatment. The third experimental silage was untreated.

The two treated silages were made into a 23 tonne stack and separated with a plastic sheet. After good consolidation the top was covered with 0.13 mm PVC sheets, although no ground sheet was used in order to reduce costs. Vacuuming was not considered desirable in the treated stack. The 23 tonne untreated stack was completely encased in plastic sheeting and vacuumed for an hour daily for 10 days following ensiling.

Because of low lucerne yields (1.3 tonnes/ha) harvesting took up to four days, resulting in different wilting periods hence varying layers of dry matter content in all stacks.

Hay was made from the same area in conjunction with the silage operations using a sickle bar mower. After crimping, the lucerne was baled at 75% dry matter and stored under cover.

Animals

Sixty Hereford and Friesian × Hereford weaner heifers of approximately 200 kg initial liveweight were randomly allocated to four groups and placed on 300 m^2 feedlots for a 40-day winter feeding period. The silages were group fed *ad libitum* daily in wooden troughs and the hay in a rack. All mould was removed before feeding and refusals recorded daily. During the 63-day post-feeding period all weaners were maintained on lucerne hay for 40 days before turning out on to spring grazing on an oversown hill block.

A digestibility trial was conducted on the four forages using 12 Merino wether hoggets fitted with faecal collection equipment. A 10-day preliminary period preceded the 7-day collection period.

Chemical Analysis

Samples were taken before ensiling and during feeding. Methods of chemical analysis have been described by Barry and Fennessy (1972). With the exception of the chemical composition data, all silages were oven dried at 55°C for 24 h. Values attained were within 1% of toluene distillation derived values.

RESULTS AND DISCUSSION

Chemical Analysis

Contents of dry matter in silages were little affected by the formaldehyde plus formic acid treatments (Table 1), although total N in treated silages tended to be lower than either untreated silage or lucerne hay.

There was evidence of protein degradation in the untreated stack where less than half the total nitrogen comprised true pro-

TABLE 1: CHEMICAL COMPOSITION OF THE DIETS

	Herbage Ensiled	*Untreated Silage*	*Formaldehyde + Formic Acid Silage*		*Lucerne Hay*
			Dilute	*Concentrated*	
Dry matter (%)	35.3	32.3	35.6	33.7	87.0
Total N (% DM)	2.9	3.3	3.1	3.0	3.3
True protein (% total N)	78.4	49.3	58.4	62.5	86.0
pH	5.7	5.0	5.4	5.4	—
Buffer capacity (meq/100 g DM)	17.2	43.4	23.5	28.9	—

tein. Concentrated applications of formaldehyde plus formic acid reduced protein degradation slightly more than dilute applications, which is consistent with the findings of Hemsley *et al.* (1973) that formaldehyde-protein binding increases with formaldehyde concentration.

Formaldehyde plus formic acid additives reduced levels of fermentation in treated stacks as evident by the higher pH and substantially lower buffer capacity. However, the reduction in fermentation rates are not as great as have been obtained with direct cut silages (Valentine and Brown, 1973; Barry, 1974). It is possible that organic matter fermentation has already been substantially reduced by the wilting process, since it has been shown that removal of water from silage will suppress clostridial bacteria responsible for organic matter fermentation and protein degradation (Wieringa, 1958).

TABLE 2: EFFICIENCY OF SILAGE CONSERVATION

% of DM Conserved	*Untreated Silage*	*Formaldehyde + Formic Acid Silage*	
		Dilute	*Concentrated*
Waste (%)	2.5	21.7	10.5
Storage loss (%)	19.6	0	4.1
Dry matter fed (%)	77.9	78.2	84.5

Stack Temperatures and Dry Matter Losses

Initial 13-day mean stack temperatures were high (treated 32.4° C, untreated 33.3°C) probably owing to excessive time involved in establishing the stacks. However, during feeding, temperatures were 8 to 11°C indicating minimal secondary fermentation. Wastage in treated stacks was higher than in untreated stacks (Table 2), although treated values were slightly inflated owing to the smaller stack size involved. The necessity of airtight conditions for good preservation of wilted lucerne is in agreement with the results of Gordon *et al.* (1961). However, the low storage losses in treated silages counterbalanced the higher wastage losses due to moulding.

Voluntary Consumption

Treatment of silage with formaldehyde plus formic acid increased the consumption of both dry matter and organic matter

TABLE 3: VOLUNTARY CONSUMPTION, APPARENT DIGESTIBILITY AND EFFICIENCY OF FEED CONVERSION

	Untreated Silage	*Formaldehyde + Formic Acid Silage*		*Lucerne Hay*
		Dilute	*Concentrated*	
Voluntary Consumption (kg/head/day):				
DM	6.1	7.1	6.6	6.8
OM	5.3	6.1	5.8	5.9
Digestibility of dry matter (%)	65.5a	56.9b	69.5a	59.7b
Feed efficiency (kg DM/kg LWG)	9.6	9.9	10.7	9.6

Means bearing the same letter do not differ significantly at $P < 0.05$. CV % of DDM = 4.9.

by approximately 11%, but failed to increase the efficiency of liveweight gain (Table 3).

The digestibility of silage treated with a dilute solution of formaldehyde and formic acid was significantly lower ($P < 0.05$) than either the concentrated or untreated silages which may be associated with fungal problems since the dilute silage showed a marked tendency to mould on exposure to air.

The relationship between silage dry matter content and dry matter consumption is shown in Fig. 1.

Significant ($P < 0.01$) regressions of dry matter consumption on silage DM % were obtained for all silage treatments. Regression slopes of the silages did not differ significantly ($P < 0.05$) and a common linear regression ($Y = 1.54 + 0.145\ X$ where X = DM % and Y = DM consumption kg/head/day; $Sy._x = 0.92$; $r = 0.73$ $P < 0.01$) showed an increase in voluntary DM consumption of 1.45 kg/head/day for each 10% increase in DM % within the range of 26 to 54% DM. Comparable linear relationships were reported by Thomas *et al.* (1961) and curvilinear regressions by Jackson and Forbes (1970) and Forbes and Jackson (1971). While these workers noted little response in dry matter consumption above 35% DM no such decline was evident in the present results.

Liveweight Performance

Liveweight gains of cattle fed untreated and treated silage were not significantly higher than hay fed animals, the usual supplement in high country areas (Table 4).

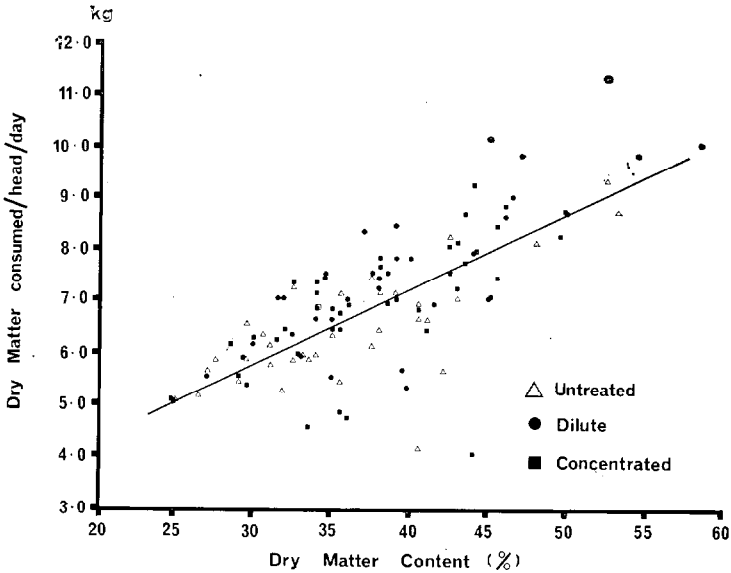

FIG. 1: *Relationship between silage dry matter content and daily dry matter intake per animal.*

TABLE 4: EFFECT OF METHOD OF CONSERVATION ON LIVEWEIGHT GAIN (kg/day)

			Formaldehyde + Formic Acid Silage			
Period	*Length (days)*	*Untreated Silage*	*Dilute*	*Concentrated*	*Lucerne Hay*	*Error CV (%)*
Treatment	40	0.61a	0.72a	0.62a	0.71a	19.3
Post-treatment	63	0.32a	0.29a	0.32a	0.27a	28.2
Total	103	0.43a	0.44a	0.45a	0.45a	14.2

Within each row, means bearing the same letter do not differ significantly at $P < 0.05$.

The lack of response to formaldehyde plus formic acid additives over treated lucerne silage contrasts with the substantial responses reported by Barry (1974) with direct cut grass silages and more recently with wilted grass silages (Barry *et al.*, 1974).

It is possible that the high dry matters (35%, range 26 to 54%) obtained by wilting, minimized organic matter fermentation in untreated stacks, resulting in satisfactory liveweight gains. Forbes and Jackson (1971) reported increased liveweight gains associated with increased dry matter contents of silages.

It would appear that, provided lucerne silage is wilted to at least 35% DM there is little advantage in using formaldehyde plus formic acid additives. However, where wilting is not possible substantial responses to additives can be expected (Waldo *et al.*, 1971; Valentine and Brown, 1973).

It was concluded that there was little advantage in treating wilted lucerne silage with formaldehyde plus formic acid additives at the rates described. Although storage fermentation losses were lower in treated stacks, the wastage resulting from moulding was higher, possibly owing to the lack of airtight storage facilities. The positive relationship between silage dry matter content and voluntary consumption suggests that every attempt be made to wilt lucerne prior to ensiling. Liveweight gains of hay-fed animals did not exceed their silage-fed counterparts, which makes silage an attractive economic proposition due to the lower costs of production and feeding.

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