

Evaluation of Inoculated Lablab Silage for Growing Dairy Heifers

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ABSTRACT: A summer grown forage legume crop – Lablab (*Lablab purpureus*) harvested in autumn, was ensiled as plastic wrapped, large round bales. Of the 30 bales produced, 13 were inoculated with a bacterial inoculant containing *Lactobacillus plantarum* and *Enterococcus faecium*. Inoculant was premixed at 30 g/litre water, cultured overnight (18 hours) then sprayed onto cut forage during the baling and wrapping procedure at 1 litre per tonne of silage. A replicated feeding experiment was conducted in July - August 1998 (5 weeks), using 24 eight month old Holstein Friesian heifers group fed non-inoculated or inoculated silage to appetite plus 2 kg rolled sorghum grain/heifer.day. Chemical composition and nutritive value of well preserved bales of control and inoculated silages were similar ($P>0.05$) with 50% DM and 26 g N and 6.8 MJ ME per kg DM. Lactic acid and acetic acid concentrations were 11.4 v. 11.4 and 4.90 v. 3.75 g/kg DM for control and inoculated silages respectively ($P>0.05$). Heifers preferentially selected leaf from the silage offered and maintained liveweight gains of 0.70 and 0.61 kg/day respectively ($P>0.05$) during the silage feeding period. High DM and low WSC content of the parent forage may have reduced the opportunity for the bacterial inoculant to have effect.

Key Words: Lablab Silage, Nutritive Value, Heifers, Liveweight Gain

INTRODUCTION

Summer growing grass pastures in subtropical Australia provide insufficient digestible nutrients for optimum dairy production. Animal production can be further reduced by advancing pasture maturity and senescence in autumn (Cowan *et al.*, 1993). Problems of low forage quality and availability can increase with increasing distance from the coast, as rainfall diminishes. Forage cropping is an option for dairy farmers in these areas to improve water use efficiency and maximise dry matter production (Minson *et al.*, 1993). Conservation of excess forage as silage to fill feed gaps and maintain a consistent level of feed for higher productivity, is an additional management option.

Growth of dairy heifers is often less than optimum for herd replacement (Moss, 1993; Moss *et al.*, 1996), being restricted on many farms by lack of high quality forage in autumn and winter. Silage could be used to achieve greater live weight gains by heifers. Round bale silage technology allows smaller quantities of forages to be ensiled, and is ideally suited to the conservation of small batches of surplus growth from forage crops.

Nutritive value of the conserved feed must be considered if ensiling is to be economic. Protein and digestible energy levels of tropical pastures are at best modest making them unsuitable for conservation for production feeding (Moss *et al.*, 1984). Annual summer growing legumes can provide higher levels of protein (Hendricksen, 1981; Ehrlich *et al.*, 1996) and may be grazed or conserved to provide higher quality feed when needed (Mullen and Watson, 1989; Ehrlich and Casey, 1998). While the process of ensiling forage is well understood, there are still some limitations in retaining nutritive value of the parent material. This is apparent in the ensiling of legumes, particularly tropical legumes which have a high buffering capacity and low water-soluble carbohydrate (WSC) content (Kaiser, 1984). This can inhibit lactic acid production

and the rapid decline in pH, resulting in a poor fermentation dominated by undesirable bacteria. Microbial inoculants may overcome this limitation by increasing rate of fermentation and hence ensilage of the crop (Harrison *et al.*, 1989).

In this study effects of using a lactic acid bacterial culture at ensiling on composition and nutritive value of silage made from a summer crop of Lablab (*Lablab purpureus*) harvested as round bale silage were investigated. Its value as the sole forage source for yearling dairy heifers was examined in a short feeding experiment.

MATERIALS AND METHODS

The experiment was conducted at Mutdapilly Research Station, 80 km south west of Brisbane (latitude 27° 46'S; longitude 152° 40'E; altitude 40 m). Average rainfall is 800 mm per year occurring mainly through summer. A forage crop of Lablab (*Lablab purpureus*) planted into a cultivated seed bed in mid-October 1997 was grown with natural rainfall to harvest on 12 March 1998, (149 days).

Weather conditions at harvest were fine and warm (max ~30°C). The crop was mature when cut mid-afternoon using a mower-conditioner. It was raked next morning (2 windrows combined) and wilted for ~40 hours before baling early the following morning, yielding about 5.2 t/ha (at 400 kg/bale as weighed). Of the 30 bales produced, 13 were treated with a microbial inoculant ("Silac", Genesearch Pty Ltd, Arundal, Qld) containing *Lactobacillus plantarum* and *Enterococcus faecium*. It was mixed at 30 g inoculant per litre of water, allowed to stand overnight (18 hrs) to multiply, then sprayed onto cut forage at 1 litre/tonne of fresh silage during baling. Round bales were plastic wrapped mid- afternoon and stored under cover.

FEEDING EXPERIMENT

The feeding experiment was conducted in July–August 1998 and lasted 31 days. Twenty-four Holstein

Friesian heifers, approximately 8 months of age, were stratified on age and live weight and randomly allocated to 2 treatments with two replicates of 6 heifers, based on live weight to minimise competition. For four days prior to commencement of the experiment (covariance period), all groups were fed control silage *ad libitum*, plus 2 kg/day rolled sorghum grain (including a commercial mineral supplement).

During the experimental period heifers in each treatment replicate were group fed either inoculated or untreated (control) lablab silage. Silage was offered to approximately 5% refusals. Rolled sorghum (plus minerals) was pre-fed at 2 kg/heifer.day. Before the silage was fed out using a mixer wagon equipped with load cells, it was chopped for approximately 15 minutes to a length of 7 cm (range 3 to 10 cm). Sorghum was fed first at 8:00 hours each day while silage was being chopped and the silage treatment feeding sequence was altered each day. Lablab silage was fed at a mean allocation of 6.3 kg dry matter (DM)/heifer.day. Refusals were collected and measured prior to feeding on the subsequent morning. Heifers were weighed at commencement of the experiment and weekly for its duration. Liveweight of heifers at the end of the covariate period was used for covariate analysis.

CHEMICAL ANALYSES

Bales were inspected for spoilage (mouldy and rotten silage) on opening and a sub-sample taken before chopping and dried at 80°C for 24 hours for DM determination and proximate analysis. A fresh sample was also taken from 4 random bales for each treatment, sealed with air removed and stored frozen at -15°C.

The 4th of these bales was also sampled on its final day (3) of use and stored frozen. Silage refusals were sub-sampled for DM determination and dried as for fresh silage. DM samples of offered and residue silage were bulked for each treatment replicate for the duration of the experiment, ground (1 mm) and analysed for *in vitro* dry matter and organic matter digestibility (IVDMD, IVOMD), nitrogen (N), neutral detergent fibre (NDF) and acid detergent fibre (ADF). Metabolisable energy values were calculated from the *in vitro* DM/OM determination. Frozen fresh samples were analysed for pH, silage acids (lactic, acetic, propionic, butyric and longer chain VFAs) and nitrogen.

RESULTS

Visual appraisal of most bales on opening during the trial period indicated no apparent affect of inoculant on material preservation. Both control and inoculated silage emitted a similar odour. Visible spoilage occurred as mould in small patches around the edge of the bale, associated with tears in the wrapping plastic. This was witnessed in both treated and untreated bales. Two control bales were discarded due to heavy spoilage (rotten – moist, off odour, colour). One inoculated bale showed signs of moderate spoilage, with approximately 20% mould damage. It was a darker, moister silage than in other bales and had a noticeably higher temperature. Mean pH and concentrations of N, lactic acid, acetic acid, and other volatile fatty acids (VFA) for sampled bales for each silage treatment were similar (Table 1).

Table 1. Nutrient composition (g/kg DM \pm SD) of fresh Lablab silage.

	Day 1*		Day 3**	
	Control	Inoculated	Control	Inoculated
pH	5.0 \pm 0.40	5.1 \pm 0.40	5.0	5.1
Nitrogen (g/kg DM)	26.6 \pm 0.09	26.3 \pm 0.22	21.7	21.5
Lactic acid (g/kg DM)	11.4 \pm 3.56	11.4 \pm 4.48	14.3	11.1
Acetic acid (g/kg DM)	4.90 \pm 1.38	3.75 \pm 1.10	4.8	3.2
Propionic acid (g/kg DM)	0.09 \pm 0.02	0.08 \pm 0.02	0.1	0.06
Butyric acid (g/kg DM)	0.045 \pm 0.021	0.046 \pm 0.034	0.08	0.03

*Day 1, mean of 4 bales at opening, **Day 3 is a single bale on final day of feeding.

Dry matter and proximate analyses of the two silages as fed to heifers were similar (Table 2). Heifers preferentially selected leaf. Residues were predominantly stem with higher DM, lower IVDMD and higher fibre contents than in feed originally offered (Table 2). Silage DM intakes initially and throughout the experiment were slightly but not significantly higher for the inoculated (5.2 kg/heifer.day) than for

the control groups (4.9 kg/heifer.day) ($P > 0.05$) (Figure 1). Daily intake of silage was variable (influenced by rain events), but tended to increase over the period of the experiment (Figure 1). Liveweight gains were not significantly different ($P > 0.05$) at 0.70 and 0.61 kg/day for heifers fed non-inoculated and inoculated silages respectively (Table 3). Live weights of all heifers increased during the feeding period (Figure 2)

Table 2. Proximate analysis of as fed and residual lablab silage (samples oven dried and bulked)

	Offered		Residue	
	Control	Inoculated	Control	Inoculated
Dry matter content (%)	49.3 ^a	50.4 ^a	55.1 ^b	56.1 ^b
IVDMD (g/kg DM) ¹	550	551	485	494
Nitrogen (g/kg DM) ¹	21.9	21.5	17.1	17.7
Metabolisable Energy (MJ/kg DM) ¹	6.8	6.8	6.0	6.1

NDF (g/kg DM) ¹	544	544	618	611
ADF (g/kg DM) ¹	448	444	497	497

a,b Means in rows with differing superscripts are significantly different ($P < 0.05$).

¹ Bulked samples. No statistical analyses could be conducted.

Table 3. Silage intake and performance by heifers fed non-inoculated or inoculated lablab silage

	Control	Inoculated	P value
Initial live weight (kg)	227	227	ns
Prior liveweight gain (from birth) (kg/day)	0.67	0.67	ns
Trial liveweight gain (kg/day)	0.70	0.61	ns
Final live weight (kg)	251	248	ns
Silage DM Intake (kg/ day)	4.9	5.2	0.10

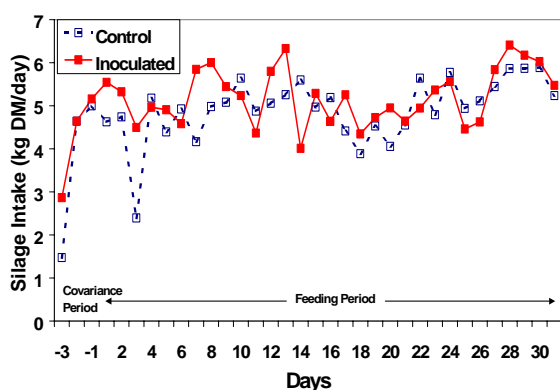


Figure 1. Effect of bacterial inoculant at ensiling on intake of lablab silage by young Holstein Friesian heifers

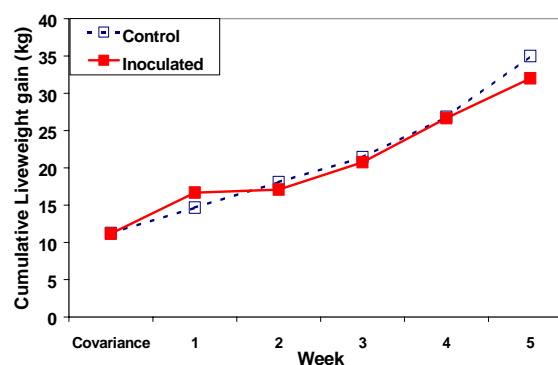


Figure 2. Effect of silage treatment on cumulative liveweight gain by yearling Holstein Friesian heifers

DISCUSSION

Though mean values for chemical composition and nutritive value of untreated and inoculated silages were very similar, there was substantial variability in pH and nutrient content among both non-inoculated and inoculated silage bales. Comparison of N analyses of fresh silage (Table 1) with oven dried (Table 2) suggests volatile N levels in control and inoculated silages were similar at 4.7 and 4.8 g/kg DM respectively. Discarded control bales were not tested, but an inoculated bale with moderate spoilage had pH 6.5 and 45.3 g/kg total N. A second fresh sample (day 3) analysed 21.5 g/kg N suggesting higher levels of volatile N in this bale. Lack of difference between well preserved bales of inoculated and untreated silages found in our study might be related to the type of silage (wrapped bale) investigated. The crop was baled at a high dry matter content (~50%) and

Lablab silage was used effectively as the forage source for growing heifers. As a sole diet its protein (15-18% CP) was adequate, but its high NDF, ADF and low ME (6.8 MJ ME/kg DM) would limit heifer performance (Moss, 1993). With grain and mineral supplementation as recommended (Moss, 1993) heifers achieved liveweight gains within the desired range for dairy replacement heifers (0.6-0.75 kg/day) (Moss *et al.*, 1996). Other studies also have found little difference in silage composition to inoculants but observed improved animal production (McAllister *et*

speed of acidification and fermentation might be less critical than for higher moisture silages. This raingrown crop was of advanced maturity when harvested and low WSC levels may have provided little opportunity for the inoculant to have effect.

Tropical legumes are difficult to ensile (Kaiser, 1984) because high buffering capacity and low WSC contents can slow their rate of fermentation allowing undesirable bacteria to multiply with resultant spoilage. Barker and Levitt, (1969) added a molasses solution to tropical legume pastures to improve ensiling. Bacteria used the WSC as an energy source to multiply, allowing fermentation to proceed. Tropical pasture silages have a high acetic to lactic acid ratio (Barker and Levitt, 1969; Moss *et al.*, 1984). Our Lablab silage contained more lactic acid, but high DM of this round bale silage would have favoured a better fermentation and inhibited acetic acid production.

et al., 1995). However, no significant differences in animal production or intake were observed in this study.

CONCLUSION

Lablab silage with grain is a suitable diet for dairy replacement heifers. In this study, there were no significant differences in composition of well preserved bales of inoculated and non-inoculated

silages, or performance by animals to which they were fed. Intake of treated silage tended to be higher, but in this short experiment, did not result in higher liveweight gain.

ACKNOWLEDGMENT

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