Inoculant effects on ensiling and *in vitro* gas production in lucerne silage

R.E. Muck[1], I. Filya[2] and F.E. Contreras-Govea[1]
[1]*U.S. Department of Agriculture, Agricultural Research Service, U.S. Dairy Forage Research Center, Madison, Wisconsin 53706-1108 U.S.A. Email: remuck@wisc.edu* [2]*Department of Animal Science, Uludag University, Bursa, Turkey*

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Introduction Inoculants are the most common additives used in making silage. While inoculant effects on fermentation and dry matter (DM) recovery are understood, animal performance effects are often greater than expected. *In vitro* analyses may help uncover how inoculants affect rumen fermentation and ultimately dairy cattle performance. Our objective was to study how inoculation of lucerne silage affected *in vitro* gas production.

Materials and methods Lucerne was ensiled in two trials (first (48% DM) and second cutting (39% DM)) in 1-l and 500-ml Weck® jars, respectively. Each trial had fifteen treatments (Table 1), four silos per treatment. Eight inoculants were commercial products, the others were single strains provided by two companies. All inoculants were applied at 10^6 colony-forming units (cfu)/g crop (not label rates). Silages were stored for a minimum of 30 d at 22°C. *In vitro* gas production was measured on 1-g samples of the wet-ground (Büchi mixer) silage in 160-ml serum bottles. *In vitro* analysis was carried out at 39°C, and gas pressure was measured at 3, 6, 9, 24, 48 and 96 h (Weimer *et al.*, 2005). At 96 h, the bottles were opened, and pH was measured. Treatment differences were determined using the MIX procedure of SAS®; silage characteristics (pH, lactate, acetate, ethanol, fibre fractions, crude protein) were correlated with gas production using the CORR procedure.

Results In first cutting, the epiphytic lactic acid bacteria population at ensiling was $1.5x10^5$ cfu/g, and all inoculants except *Enterococcus faecium* C reduced pH relative to that of the control (Table 1). The commercial homofermentative inoculants produced the largest reductions in pH. In second cutting, the epiphytic population ($2.7x10^7$ cfu/g) at ensiling was high. The commercial homofermentative inoculants were the only treatments producing lower pH values than the control. We expected inoculants would improve *in vitro* DM digestibility and increase gas production. Surprisingly inoculants had either no effect on 96-h gas production per g DM or gas production was reduced (Table 1). In first cutting, gas production was correlated positively with silage pH (0.62, $P<0.02$), negatively with lactic acid concentration (-0.56, $P<0.04$). In second cutting, gas production was correlated positively with acid detergent lignin (0.62, $P<0.02$) and hemicellulose concentrations (0.57, $P<0.03$).

Table 1 Silage pH and *in vitro* gas production (96 h) for the first and second cuttings (Buch - commercial *L. buchneri* inoculants, Comm - commercial homofermentative inoculants)

	First Cutting		Second Cutting	
Treatment	pH	Gas (ml/g DM)	pH	Gas (ml/g DM)
Control	5.081	190	4.422	205
Buch A	4.825	186	4.642	203
Buch B	4.899	188	4.651	198
Comm A	4.497	185	4.336	208
Comm B	4.429	186	4.399	201
Comm C	4.335	182	4.287	205
Comm D	4.511	178	4.418	187
Comm E	4.377	184	4.318	192
Comm F	4.507	184	4.397	198
E. faecium C	5.144	190	4.470	195
E. faecium Q	4.578	185	4.445	192
L. pentosus	4.657	178	4.464	197
L. plantarum	4.462	176	4.425	189
P. pentosaceus A	4.569	184	4.463	198
P. pentosaceus E	4.577	189	4.459	197
S.E.M.	0.017	3.24	0.018	3.63

Conclusions These results indicate that inoculation of lucerne at ensiling affects *in vitro* fermentation, but differences in gas production could not be consistently explained by fermentation products or fibre fractions.

Reference

Weimer, P.J., B.S. Dien, T.L. Springer & K.P. Vogel (2005). *In vitro* gas production as a surrogate measure of the fermentability of cellulosic biomass to ethanol. *Applied Microbiology and Biotechnology* (In press).