In situ dry matter degradability coefficients of whole crop barley silage treated with *Lactobacillus plantarum* or mixed with *Pediococcus pentosaceus* plus *Propionbacter freudenreichii*

M Vatandoost, M Danesh Mesgaran, A Heravi Moussavi, A Vakili
Dept. Animal Science. Excellence Centre for Animal Science, Ferdowsi University of Mashhad, P O Box 91775-1163., Mashhad, Islamic Republic of Iran
Email: vatandoost_58@yahoo.com

Introduction Microbial inoculants are applied to forage at the time of ensiling to accelerate the decline of pH during the initial stage of silage fermentation, to preserve plant carbohydrates through homofermentation, and to preserve plant protein by decreasing proteolysis and deamination. Thus, inoculated silages are expected to improve animal performance. Whole crop barley has a low buffering capacity and abundant fermentable carbohydrates and is considered relatively easy to ensile. Results of previous experiments indicated that lactic acid bacteria-based inoculants have the potential to improve the ensilage of whole crop barley (Kung and Ranjit, 2001). The objective of the present study was to determine the chemical composition and *in situ* dry matter degradability of whole crop barley silage treated with one of two different types of inoculants (*Lactobacillus plantarum* or mixed with *Pediococcus pentosaceus* plus *propionbacter freudenreichii* as provide 1×10^5 CFU of lactic acid producing bacteria plus 1×10^4 CFU *propionbacterium* per g of DM).

Materials and methods Whole crop barley was harvested (about 35% DM), chopped, and then ensiled as untreated or treated with different inoculants including *Lactobacillus plantarum* (8×10^{10} CFU (LP8) or 16×10^{10} CFU (LP16) per g of DM) or mixed with *Pediococcus pentosaceus* plus *propionbacter freudenreichii* (5.5×10^{10} CFU (PP5.5) or 11×10^{10} CFU (PP11) per g of DM) for 30 days (n = 4). Standard procedures were used to determine the chemical composition of the samples. The pH of the aqueous silage extract was determined using a pH meter (Metrohm 691, Swiss). NH_3-N concentration was determined in acidified silage extract (5 ml of the extract + 5 ml of 0.2 M HCl) using a distillation method (Kjeltec 2300 Autoanalyzer, FossTecator AB, Hoganas, Sweden). Rumen degradability of the of the silages was determined using an *in situ* procedure (Fathi Nasri *et al.,* 2006). Four sheep (44±5 kg liveweight) fitted with rumen cannulae were used. The bags (10 × 12 cm) were made of polyester nylon cloth with a pore size of 52 µm. About 5 g DM of each sample was placed in each bag, and four bags per treatment were incubated for each time (0.0, 2, 4, 8, 16, 24, 48, 72, 96 h). The equation of $P=a+b(1-e^{-ct})$ was applied to determine the coefficients (a = quickly degradable fraction, b = slowly degradable fraction, c = fractional degradation rate constant).

Results Chemical composition and the degradable coefficients of DM of whole crop barley silages are shown in the Tables 1 and 2, respectively. The data suggest that the inoculants tended to decrease pH and NH_3-N concentration and increase NDF content of the treated compared with untreated silage. Treated silages had a higher slowly degraded fraction compared with untreated samples.

Table 1 Chemical composition of whole crop barley silage treated with *Lactobacillus plantarum* or mixed with *Pediococcus pentosaceus* plus *propionbacter freudenreichii*

Item	untreated	*Lactobacillus plantarum*		Mixed bacteria		s.e.m.	*P* - value
		LP8	LP16	PP5.5	PP11		
pH	4.07^{a}	3.69^{c}	3.97^{ab}	3.98^{ab}	3.88^{b}	0.04	0.01
CP (g/kg DM)	7.98	7.87	7.91	7.86	8.02	0.08	0.21
NH_3-N (mg/dl)	9.10^{a}	8.47^{b}	8.62^{a}	8.79^{a}	8.47^{ab}	0.35	0.02
NDF (g/kg DM)	554^{c}	581^{b}	627^{a}	542^{c}	617^{a}	6.11	0.01

^{a,b,c}Means with different superscript letters in the same row differed ($p < 0.05$)

Table 2 Dry matter degradable coefficients of whole crop barley silage treated with *Lactobacillus plantarum* or mixed with *Pediococcus pentosaceus* plus *propionbacter freudenreichii*

Degradation coefficient	untreated	*Lactobacillus* plantarum		Mixed bacteria	
		LP8	LP16	PP5.5	PP11
a	$0.37^{a} \pm 0.02$	$0.36^{ab} \pm 0.02$	$033^{b} \pm 0.01$	$0.34^{ab} \pm 0.02$	$0.33^{b} \pm 0.02$
b	$0.44^{b} \pm 0.03$	$0.48^{ab} \pm 0.02$	$0.49^{a} \pm 0.01$	$0.47^{ab} \pm .02$	$0.49^{a} \pm 0.02$
c	0.04 ± 0.01	0.05 ± 0.01	0.06 ± 1.01	0.06 ± 0.01	0.05 ± 0.01

a = rapidly degradable, b = slowly degradable, c = fractional degradation rate constant
Mixed bacteria: *Lactobacillus plantarum* plus with *Pediococcus pentosaceus* and *propionbacter freudenreichii*

Conclusions The results of the present study indicate that whole crop barley silage treated with *L. plantarum* has a lower pH and NH_3-N concentration compared with untreated silage. This finding supports the results of Kung and Ranjit (2001). Therefore, we conclude that *L. plantarum* prevented proteolysis during ensiling. In addition, the increase in both b and c coefficients of DM degradation might help to enhance the digestibility and dry matter intake in ruminants.

References

L. Kung, Jr. and N. K. Ranjit. 2001. Journal of Dairy Science. 84, 1149–1155.