Ruminal fermentation of sheep fed corn silage inoculated with microbial additives

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Introduction

An obligatory heterofermentative lactic acid bacteria (LAB), *Lactobacillus buchneri*, has been suggested as an additive to improve the aerobic stability of silages, mainly of corn silage, due to troubles during feedout of silos, when mishandled. Usually, heterolactic fermentation is deemed as undesirable compared with homolactic fermentation because the dry matter losses are greater. Otherwise, *L. plantarum*, a homofermentative LAB can be combined with *L. buchneri* in an attempt to decrease the fermentation losses and also protein degradation by greater production of lactate and, enhance the aerobic stability of silages. Nowadays, these LAB have been studied as their ability to change ruminal fermentation, well as to provide a probiotic effect. Thus, the aim was to evaluate the ruminal fermentation of sheep fed corn silage inoculated with *L. buchneri* alone or combined with *L. plantarum*.

Methods

Corn plants were inoculated with $1x10^5$cfu of *L. buchneri* NCIMB 40788/ g of fresh forage (LB) or $1x10^5$ cfu *L. buchneri* combined with $1x10^5$ cfu *L. plantarum* MA18/5U/g of fresh forage (LBLP), remaining a untreated as control silage. One stack silo containing 10 tonnes were prepared for each treatment (closed for 165 d). After opening the silos, silage samples were collected weekly for analysis. Two trials were developed simultaneously. *Trial I*: Thirty crossbred lambs (Dorper x Santa Ines) with average initial body weight (BW) of 20.4±3.8 kg were divided into ten blocks with three treatments per block: Control, LB and LBLP silage. Feed offered was 80% of corn silage (each treatment) and 20% of concentrate on a DM basis (11.5% of soybean meal; 1.0% of cottonseed meal; 1.4% of wheat meal; 3.2% of corn meal; 2.5% of citrus pulp and 0.4% of mineral supplement). Lambs were fed *ad libitum* twice daily. Feed orts were weighed and DM intake was measured daily. On the 57th trial day, when the animals BW were 31.4±5.1 kg, a digestibility study was conducted over three days. *Trial II*: Six crossbred wethers (Dorper x Santa Ines) with ruminal cannula, with average body weight of 40.5±1.8 kg were used. Animals were housed in pens fitted with individual feed and water access. Three experimental periods of 10 days were applied; nine days for diet adaptation and one day to collect rumen fluid. The animals received a similar diet as was offered to *Trial I* animals. Wethers were fed *ad libitum* once daily. On the tenth day, ruminal fluid was collected before feeding, 3, 6, 9 and 12 h later. Rumen fluid was analysed for pH, ammonia nitrogen and volatile fat acids (VFA). All data were analyzed as a mixed model using MIXED procedure of SAS (v. 9.0). The effect of treatment was considered fixed and animal considered random. Ruminal fermentation data were analyzed using a mixed model with repeated measures, where the treatment was fixed effect and animal and period random effect. Significance was declared at $P<0.05$.

Results

LB silage showed the highest concentrations of DM (334 g/kg), whereas the lowest was observed in the LBLP silage (229 g/kg) and control silage (317 g/kg), but the differences observed were probably due to the DM content of corn plant at ensiling. Inoculated silages showed lower OM (LB: 958 g/kg DM; LBLP: 956 g/kg DM) content than control silage (965 g/kg DM), being a reflection of a more extensive fermentation in these silages. As expected the highest lactic acid content was found in the corn LBLP silage (93 g/kg DM *vs*. Control: 67 g/kg DM and LB: 62 g/kg DM) and both inoculated silage showed greater acetic acid (LB: 42 g/kg DM; LBLP: 55 g/kg DM) content than control silage (27 g/kg DM). Regardless of silage the pH values were similar (Control: 4.1; LB: 4.0; LBLP: 4.1). Inoculations on corn silage with *L. buchneri* alone or combined with *L. plantarum* increased significantly the DM (Control: 1001 g/d; LB: 1056 g/d; LBLP: 1058 g/d), OM (Control: 958 g/d; LB: 1015 g/d; LBLP: 1023 g/d) and NDF (Control: 411 g/d; LB: 442 g/d; LBLP: 446 g/d) intake. The higher DM intake of inoculated silage by lambs may be the result of interaction between LAB fed in the silage with rumen microorganisms enhancing rumen functionality (Weinberg *et al.* 2007). Otherwise, the apparent digestibility of DM (Control: 71.9 %; LB: 68.3 %; LBLP: 67.2 %) and OM (Control: 72.5 %; LB: 70.0 %; LBLP: 68.1 %) was the lowest in the lambs fed

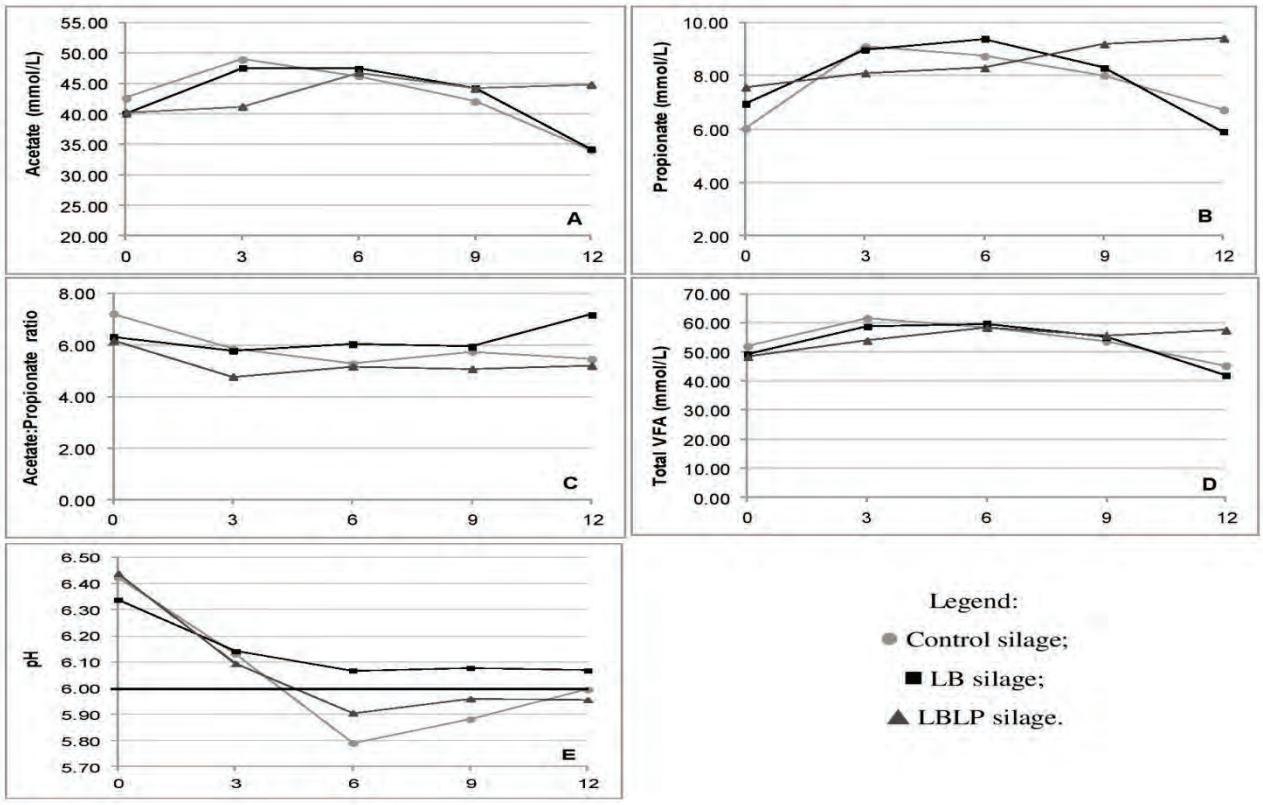

Figure 1. Effect of microbial inoculation to corn silage on ruminal parameters in lambs in the sampling time (0 to 12 h)

inoculated silage. Negative linear relationships were found between intake and digestibility in lambs fed *ad libitum*. Nevertheless, NDF digestibility in the lambs fed LB silage (54.9 %) was similar to those fed control silage (54.2 %) and 4.6% higher than animals fed LBLP silage. This probably is due to ruminal pH of lambs in the LB treatment, which remained, at all sampling times, above 6 (Fig. 1 E), favoring cellulolytic bacteria. The highest lactic acid content in the LBLP silage might have resulted in the greatest propionate concentrations in rumen fluid (Control: 7.88 mmol/L; LB: 8.00 mmol/L; LBLP: 9.00 mmol/L), and the lowest acetate: propionate ratio in the rumen fluid of the lambs fed with this silage (Control: 5.92; LB: 6.33; LBLP: 5.20), since in the rumen to lactate from silage is metabolized primarily to propionate. Acetate, butyrate, total VFA and ammonia N concentrations of rumen fluid were not affected by inoculation of silage.

Conclusion

Inoculation with LAB increased silage intake and significantly changed key rumen fermentation parameters in sheep fed corn silage.

References

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