Improving lucerne forage quality and utilization by using novel silage inoculant

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Keywords: Lucerne, silage, quality, utilization, inoculant.

Introduction

Lucerne (*Medicago sativa* L.) is a protein-rich forage that farmers often combine with energy-rich feed sources to dairy cattle. Lucerne ensiles poorly, however, due to low sugar concentration and high buffering capacity. Ensiling is improved by wilting the crop and using an appropriate silage inoculant. The principal goal of inoculants is to improve fermentation quality, to preserve as much of the nutritive value of the crop at harvest as possible for the livestock consuming the resulting silage and to increase production (Meeske *et al.* 2000, Muck 2012).

The objectives of this study were to determine the effects of SiloSolve MC containing *Lactobacillus plantarum* DSM16568, *Enterococcus faecium* NCIMB 11181 and *Lactococcus lactis* (NCIMB 30117) on fermentation end-products, DM recovery, and aerobic stability of lucerne big bale silage. Furthermore, silage intake and dairy cow performance were compared with untreated silage.

Methods

Primary growth of lucerne at budding stage was mown with a disk mower-conditioner and wilted for 24 h without tedding to a dry matter (DM) concentration of about 350 g/kg. The crop was baled by using a round baler (LELY WELGER RP 245). The bales were 1.2 m wide and 1.2 m in diameter. The inoculant SiloSolve MC from Chr. Hansen A/S contained *Entrococcus faecium* (DSM 22502/NCIMB 11181) *Lactococcus lactis* (NCIMB 30117) and *Lactobacillus plantarum* DSM16568 and was applied during the baling process at 2 g per ton of fresh matter thereby supplying >1.50 x 10^5 colony forming units (CFU) per g forage. Forage treatments were: no additive (Control) and SiloSolve MC. Bales were tagged, weighed and transported to the final storage site within two hours of baling. Five randomly selected bales from each treatment were weighed and core-sampled on day 90 after baling and analysed for DM, pH, volatile fatty acids (VFA), lactic acid, ammonia-N, and ethanol. Enumeration of lactic acid bacteria (LAB), yeast and mould was also done. The selected bales were unwrapped and kept in an open shed and exposed to ambient temperature for 18 d. Two thermocouple wires were inserted to the centre of each bale and bale temperature was monitored 6 times daily. On removal of the plastic film and at the end of the aerobic stability test (after 18 d.) all visible mould colonies on the bale surface were located and scored. Results of 5 replications per treatment were analysed by using a non-parametric Wilcoxon Kruskal-Wallis test.

Bales were fed to Lithuanian Black and White cows in an intake- and production study. Thirty six multiparous cows were blocked in pairs according to milk production, days in milk, lactation number, live weight and condition score. Within each pair, cows were allocated to the control or inoculated silage treatment. There was an adaptation period of 21 days followed by a measurement period of 92 days. Cows were individually fed *ad libitum* twice daily with silage as the only forage source. All cows received 7.1 kg of concentrate daily. Milk samples were collected twice daily (6 AM and 17 PM) on a weekly basis and analyzed for fat, protein, lactose and urea content, bacterial contamination, inhibitors and content of *Clostridium perfringens*. The zootechnical part of the trial was analysed in SAS by using a factorial analysis of variance (GLM-ANOVA) with start weight as co-variate.

Results

The composition of concentrates, control lucerne silage and inoculated lucerne silage was: metabolizable energy: 12.5, 9.0 and 9.3 MJ/kg DM; crude protein: 135, 215 and 229 g/kg DM; NDF: 198, 362 and 349 g/kg DM; ADF: 90, 277, 264 g/kg DM. Lucerne big bale silage treated with SiloSolve MC was better fermented and had improved hygienic quality compared to untreated control silage. The concentrations of DM (corrected for volatiles), DM loss, water-soluble carbohydrates, lactic acid, acetic acid, butyric acid, ethanol, ammonia-N and pH were 335 g/kg, 47 g/kg DM, 10.2 g/kg DM, 72 g/kg DM, 20.6 g/kg DM, 0.9 g/kg DM, 4.4 g/kg DM, 43 g/kg N and 4.4 for SiloSolve MC silage and 323 g/kg, 88 g/kg DM, 6.1 g/kg DM, 32 g/kg DM, 20 g/kg DM, 6.4 g/kg DM, 59 g/kg N and 4.9 for untreated control silage, respectively. SiloSolve MC resulted in a higher production of lactic acid thereby suppressing the buffering effect of legumes (Adesogan and Salawu, 2002). One potential cause of the higher ethanol concentration of the control is clostridial and yeast fermentation, as suggested by Pahlow *et al.* (2003), but in our experiment clostridia were not detected (<1.0 cfu/g) in either treatment. Therefore, the higher ethanol concentration of untreated silage presumably resulted from the activity of yeast. Reduction in the number of yeast (2.07

Table 1. The effect of an inoculant SiloSolve MC added to big bale lucerne silage on intake, milk yield and composition and milk hygiene quality.

	Control	SiloSolve MC
Feed intake		
Silage (kg DM/day)	12.25	12.72**
Concentrates (kg DM/day)	7.13	7.13
Total (kg DM/day)	19.38	19.85**
Animal performance		
Milk production (kg/day)	25.76	26.78
Energy-corrected milk production (kg/day)	26.39	27.75**
Fat (%)	4.16	4.24**
Protein (%)	3.15	3.17**
Lactose (%)	4.61	4.63*
Urea (mM)	3.11	3.20*
Feed conversion ratio (ECM/DMI)	1.36	1.40**
Bacterial contamination (X 1000 cfu/ml)	28.04	22.35**

log cfu/g) and mold (2.66 log cfu/g) was detected in the inoculated silage compared with untreated silage (1.18 log cfu/g and 1.87 log cfu/g, respectively). The number of lactobacilli of inoculated silage increased significantly (P<0.05) compared untreated silage. The scores of visible surface molds growth upon removal of the plastic film and after the aerobic stability test were 0 and 1.8 for for SiloSolve MC treated silage and 0.4 and 4.2 for untreated control silage respectively. The aerobic stability of lucerne silage inoculated with SiloSolve MC was improved by 8 days (14 vs. 6 days).

There is a significant number of reported cases where animal performance on silage as been increased by using silage inoculation (Muck 2012). In our experiment, the intake of SiloSolve MC inoculated silage was significantly higher than that of the untreated silage. Treatment with SiloSolve MC also resulted in 1 kg more milk per cow and day. SiloSolve MC also resulted in increased butter fat and protein content and improved feed conversion ratio (Table 1).

Conclusion

Lucerne silage treated with SiloSolve MC resulted in lower DM loss, and improved silage quality and animal performance.

References

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