Effect of maturity stage and application of *Lactobacillus buchneri* on dry matter losses and aerobic stability of corn silage

L.G. Rossi[1], L.B. Costa[1], C.H.S. Rabelo[1] and R.A. Reis[1]
[1]*São Paulo State University, Jaboticabal, São Paulo 14884-900, Brazil. Email: luisrossi@zootecnista.com.br*

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Introduction Under unfavorable ensiling conditions (e.g. plants with high moisture content), microorganisms such as enterobacteria, clostridia and yeasts may domain the fermentation process increasing dry matter (DM) loss (Pahlow et al., 2003). However, whole-crop corn plant ensiled with a desired DM content (i.e. 30–35%) is expected to have a desirable fermentation process, but lower aerobic stability (Wilkinson and Davies, 2012). In order to improve the aerobic stability of silages, *Lactobacillus buchneri*, a heterofermentative bacterium, has been successfully used as a silage inoculant by producing acetic acid (Driehuis et al., 1999; Kleinschmit and Kung, 2006). Thus, our objective was to evaluate the effect of different maturity stages and inoculation with *L. buchneri* on DM loss and aerobic stability of corn silages.

Materials and Methods The whole-crop corn forage (hybrid 2B 710 PW Dow AgroSciences®) was harvested with approximately 23%, 29% and 33% DM at a stubble height of 20 cm, using a pull-type New Pecus forage harvester (Nogueira, São João da Boa Vista, SP, Brazil). Forage was cut to 10 mm, and kernels were processed. Four piles of corn forage for each treatment were individually treated with water (20 L/t; untreated), and another four piles for each treatment were individually treated with *L. buchneri* CNCM I-4323 at 1×10^5 cfu/g fresh forage (inoculated; Lallemand Animal Nutrition, Goiânia, GO, Brazil). The inoculant was dissolved in distilled water (20 L/t) and sprayed onto fresh forage as silos were filled. Mini-silos (PVC tubes) were used as experimental silos, and they remained stored at room temperature for 120 d. Mini-silos were weighed before and after ensiling to determine DM loss. After the silos were opened, a portion of silage (~2.5 kg) from each replicate in each treatment was removed from the silos and placed into plastic buckets in a room under controlled temperature (20–25°C) to determine aerobic stability. Temperature of silages and of the ambient were recorded every half hour by dataloggers, during a period of 10 d. Aerobic stability was defined as the number of hours that the silage temperature remained stable before increasing more than 2°C above the ambient temperature. In addition, the sum of accumulated daily temperatures was calculated as the sum of the difference between the silage and ambient temperatures after 10 d (ADITE 10) of aerobic exposure (O'Kiely, 1999). Thereafter 10 d of aerobic exposure, DM loss was also determined. Data were analysed using the MIXED procedure in SAS software (v. 9.4; SAS Institute Inc., Cary, NC), and differences between means were determined using the PDIFF option of LSMEANS. Significant differences were declared at $P \leq 0.05$.

Results and Discussion As expected, maturity stage affected DM content of silage ($P < 0.001$), but inoculation did not have any effect ($P = 0.90$; Table 1). During fermentation, neither maturity stage ($P = 0.11$) or nor inoculation ($P = 0.07$) altered DM loss. However, after the silos were opened, it was observed an interaction between maturity stage and inoculation ($P = 0.02$), where inoculation reduced DM loss in silages produced with 29% DM content, but not for those produced with 23% and 33% DM content. Although DM loss during aerobic exposure was affected by treatments, any effect was detected on total DM loss ($P \geq 0.12$). Moreover, we observed an interaction between maturity stage and inoculation ($P < 0.001$) for aerobic stability and ADITE 10. Inoculation of silages produced with 33% DM content resulted in higher aerobic stability, followed by those silage inoculated with 23% DM content. Similarly, silages produced with 23% and 33% DM content and inoculated with *L. buchneri* had lower values of ADITE 10. *Lactobacillus buchneri* is a heterofermentative bacterium recognized to produce higher amount of acetic acid by anaerobic degradation of lactic acid (Oude Elferink et al., 2001). As acetic acid has antifungal properties, it was not a surprise to find higher aerobic stability in the inoculated silages, with exception of the corn silage produced with 29% DM content. However, the higher aerobic stability was not accompanied of a lower DM loss, for unknown reasons.

Table 1 Dry matter losses and aerobic stability of corn silages produced in different stages of maturity and inoculated or not with *Lactobacillus buchneri*

DM at ensiling	23%		29%		33%		SEM	*P*-value		
Inoculant	No	Yes	No	Yes	No	Yes		DM	I	DM × I
DM content, % as fed	23.0	23.0	29.1	28.6	32.3	32.6	0.415	<0.001	0.896	0.589
Losses, % DM										
Fermentation	6.23	8.45	2.47	9.37	4.70	3.06	1.56	0.112	0.073	0.054
Aerobic exposure	18.8[a]	11.1[ab]	20.1[a]	9.05[b]	9.95[b]	13.8[ab]	2.58	0.452	0.034	0.025
Total	25.0	16.7	22.0	18.4	14.6	16.8	2.58	0.125	0.143	0.153
Aerobic stability, h	58.0[c]	194[b]	38.3[c]	43.6[c]	39.7[c]	240[a]	10.5	<0.001	<0.001	<0.001
ADITE 10, ºC	1149[c]	290[b]	1006[c]	1125[c]	1562[d]	-287[a]	141	0.016	<0.001	<0.001

[a-d]Means in the same row with different superscripts differed ($P < 0.05$).

Conclusions Inoculation of corn silage produced in different maturity stages did not affect fermentative losses; however, inoculation of silages produced with low and regular DM content (i.e. 23% and 33%) increased aerobic stability and reduced aerobic deterioration.

References

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