Aerobic stability of maize silages inoculated with homo and heterofermentative lactic acid bacteria

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Introduction Forage conservation process as silage is predisposed to dry matter losses during fermentation and after silo opening. When exposed to air, silages are susceptible to yeasts spoilage. These microorganisms utilize the lactic acid as substrates and consequently cause pH rises. It leads to a propitious environment for development of aerobic microorganisms. Aerobic degradation increases silage temperature and decreases its nutritive value. High temperatures are usually associated with intense microbial degradation. The use of microbial inoculants, mostly heterolactic bacteria, may reduce silage degradation after oxygen exposure. However, research papers have found inconsistent results. This work aimed to evaluate aerobic stability and dry matter losses of maize silages inoculated with homo and heterofermentative lactic acid bacteria.

Material and Methods The trial was carried out at Universidade Federal do Parana, Brazil. The maize hybrid 30R50H (Pioneer, New Zealand) was harvested at 356 g kg^{-1} of dry matter (DM) content in Castro, Parana, on March 2013. Maize was harvested by a self propelled chopper set to 22-mm particle size. The treatments applied were: TA – control (no additives); TB - *L. plantarum, E. faecium* and *P. acidilactici* (homolactic bacteria combination) plus *L. buchneri*; TC – homolactic bacteria combination plus high dosage of *L. buchneri*; TD – homolactic bacteria combination plus high dosage of *L. brevis*; TE – homolactic bacteria combination plus *L. brevis*. Proportions of each strain are confidential. All treatments were applied at 10^5 CFU g^{-1} of fresh matter. Inoculants were dissolved in distillated water and sprayed over the forage. Forage was compacted at a bulk density of 600 kg m^{-3} in experimental silos made of 20-liter buckets provided with a valve for gases production measurement and a device for gravimetric determination of losses, as described by Jobim et el. (2007). Experimental silos were sealed and stored for 60 days. After opening, aerobic stability was assessed according to the methodology described by Kung Jr. et al. (2000). Samples of 4 kg were placed in open recipients with no compression, and kept for ten days in a closed room where mean temperature was 20.1±1.85 ^oC. Silage and room temperatures were measured every four hours by bulb thermometers inserted in the geometric center of the forage. The assessed variables were: aerobic stability (AS, as the number of hours for silage temperature raising 2°C above room temperature), Maximum temperature reached by the silage (maxT, °C), time to reach maximum temperature (HTmax, hours), accumulated temperature above room temperature (accT, °C), dry matter losses during aerobic exposure (DML). Experimental design was completely randomized with five replicates, considering each silo as an experimental unit. Data were analyzed by ANOVA and means of treatments were compared by Tukey test at probability of 0.05.

Results and Discussion Aerobic stability results are presented in Table 1. The control silage showed the lowest maxT, which was statistically lower than silages added with *L. brevis* (TD and TE). This strain might not have been efficient in inhibiting spoiling microorganisms, leading to a

greater heat production. Silage pH, HTmax and AS were not affected by inoculation. Danner et al. (2008) tested homo and heterolactic bacteria added to silages and verified that *L. rhamnosus* and *P. pentosaceus* inoculation promoted lower aerobic stabilities when compared to control silages. Accumulated temperature was higher in TE than it was in TA, that showed lower accT. This indicates that TE silages have lost more energy as heat than TA during 10 days of aerobic exposure of silages. Dry matter losses, however, were not influenced by inoculation. The bacteria added to maize silages in this trial might not have been effective in avoiding aerobic degradation.

Table 1 Aerobic stability variables of maize silages inoculated with homo and heterofermentative lactic acid bacteria

	Treatment[1]					
Variable[2]	TA	TB	TC	TD	TE	SEM[3]
maxT, °C	24.3^{a}	26.7^{abc}	25.3^{ab}	28.1^{bc}	29.7^{c}	0.52
HTmax, hours	176.0	176.8	178.4	161.6	187.2	3.23
AS, hours	155.2	132.0	151.2	116.0	117.6	5.12
accT, °C	75.4^{a}	114.2^{ab}	96.0^{ab}	148.7^{ab}	191.7^{b}	13.19
DML, g kg $^{-1}$	44.0	58.7	42.0	52.9	60.6	0.69
pH	4.0	4.1	4.0	4.1	4.1.	0.01

[1] TA – control, no additives; TB - *L. plantarum, E. faecium* and *P. acidilactici* (homolactic bacteria combination) plus *L. buchneri*; TC – homolactic bacteria combination plus high dosage of *L. buchneri*; TD – homolactic bacteria combination plus high dosage of *L. brevis*; TE – homolactic bacteria combination plus *L. brevis*.

[2] maxT - maximum temperature reached by the silage; HTMax - time to reach maximum temperature; accT - accumulated temperature above room temperature; AS - time for raising 2 ^{o}C above the room temperature; DML - dry matter losses during aerobic exposure.

[3] Standard error of the mean.

Means in the same line, followed by different letters are different (P<0.05) by the Tukey test.

Conclusions The homo and heterofermentative bacteria added to maize silages were not effective for improving aerobic stability or reduce dry matter losses during aerobic exposure.

References

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