Aerobic stability of high-moisture corn silages inoculated with lactic acid bacteria and rehydrated with water or acid whey

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Introduction The fermentation of high-moisture corn (HMC) is often restricted because of its relatively low moisture and fermentable sugar contents, and the accumulation of total acids produced is quite low. As result, there is low aerobic stability after opening of the silos. However, this can be minimized using different strategies, as lactic acid bacteria (LAB) application or acid whey application (main sub-product formed in the dairy plants from manufacture of cheese). The acid whey can be not discarded in rivers or ponds because promote serious damages for the environment, increasing the biochemical oxygen demand (Gheri et al., 2003). This product has been used like fertilizer in agricultural systems and in the animal feeding, and has potential to use in the ensiling process. Our aim was to evaluate the aerobic stability of HMC silages inoculated with lactic acid bacteria and rehydrated with water or acid whey.

Material and Methods We used the AG-4051 cultivar in this study. The corn was harvested to ensiling when the grains presented 14% of humidity. The following treatments were applied to the corn: control (untreated); inoculated with Maize All® (*Enterococcus faecium* and *L. plantarum*, 1 x 10^{10} cfu per gram of product, *P. acidilactici*, 1 x 10^{9} cfu per gram of product, amylolitic and cellulolytic enzymes (1.5%), and proteolytic enzymes (2.0%)); rehydration with water or acid whey until reaches 30, 35 or 40% of humidity. The application rate of the inoculant was determined in accordance with the instructions from the manufacturer. Thus, the experiment was conducted in a completely randomized design, with four replicates in a factorial arrangement 3 (rehydration with three different humidity levels) x 2 (silage inoculated or not) x 2 (liquid used in the rehydration). As experimental silos were used PVC tubes with capacity of 4 L. After 30 days of ensiling, the silos were opened, the silage was homogenized and placed in a covered shed and cemented at environment temperature to determine the aerobic stability. We used 4 kg of silage in each replicate in this assay. Temperature of the silage was measured each six hour by a thermometer placed in the center of the mass during the aerobic exposure by 3 days. The ambient temperature was measured by a thermometer distributed near the experimental silos. The aerobic stability was defined as the number of hours that the temperature of the silage remained stable before rising more than 2ºC above the ambient temperature (Taylor and Kung Jr., 2002). During the aerobic exposure, the silages were sampled to determine the pH values. Data were subjected to ANOVA by SISVAR program, and the differences between the means were determined using Tukey test. Significant differences were declared at 5%.

Results and Discussion We observed lower temperatures (P = 0.0017) and pH values (P = 0.0003) when the HMC silages were rehydrated just until 30% of humidity, independent of the liquid used or inoculant application (Table 1). Soluble sugars are an energy source for yeasts in aerobic and anaerobic conditions, and are fermented into ethanol, mainly in silages with low-moisture (Kung Jr. et al., 2007). However, the profile of organic acids was similarly among the treatments in this work, and the acetic acid concentration ranged of 0.1 to 0.2%

(DM basis). Thus, the moisture in this case it is more important to control the action of spoilage microorganisms. There was increase in the temperature of the HMC silages during the aerobic exposure (Figure 1). This result occurs because of the action of spoilage microorganisms, which are undesirable and inevitable after the silo opening (Woolford, 1990).

Table 1 Characteristics of HMC silages inoculated with LAB and rehydrated with water or acid whey in different levels of humidity during the period of aerobic exposure.

Item	Treatments		
	30%	35%	40%
		Temperature (ºC)	
Water	23.21^{Ab}	27.74^{Aa}	28.50^{Aa}
Acid whey	23.64^{Ab}	25.49^{Ba}	26.12^{Ba}
Inoculant			
Control	23.70^{Ab}	26.71^{Aa}	26.99^{Ba}
Maize All	23.15^{Ac}	26.24^{Ab}	27.91^{Aa}
		pH	
Water	4.11^{Ac}	4.56^{Ab}	5.13^{Aa}
Acid whey	4.06^{Ab}	4.37^{Aa}	4.43^{Ba}
Inoculant			
Control	4.06^{Ab}	4.53^{Aa}	4.66^{Ba}
Maize All	4.10^{Ac}	4.40^{Ab}	4.90^{Aa}

Means followed by same letter (uppercase in the column and lowercase on the line) do not differ by Tukey test.

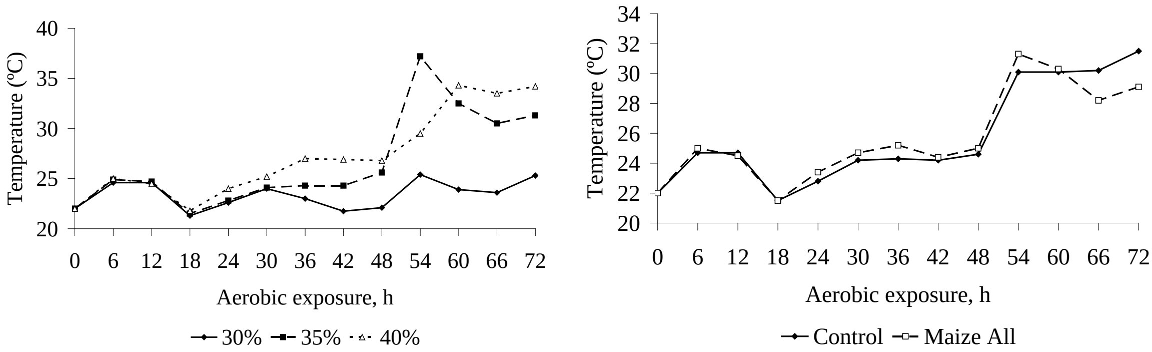

Figure 1 Temperature of HMC silages rehydrated with water or acid whey at different levels of humidity during the period of aerobic exposure.

Conclusions The HMC silages inoculated or not with lactic acid bacteria and rehydrated with water or acid whey present characteristics similarly during the period of aerobic exposure.

References

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