Fermentation and aerobic stability of corn silage inoculated with bacterial additives

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Introduction The high nutritional value of corn silage allow the development of opportunist microorganisms responsible by aerobic spoilage. For improve the fermentation and aerobic stability these silages, the utilization of inoculants with obligate and facultative heterofermentatives bacterias has been studied. Thus, the aim this research was to evaluate the effects of bacterial inoculants on fermentation e aerobic stability of corn silage.

Materials and Methods The whole plant corn was harvested with 35% of DM. The treatments were **Control** (forage untreated), **LB** (forage inoculated with $1x10^5$ CFU *Lactobacillus buchneri* NCIMB 40788/g), **PA** (forage inoculated with $1x10^5$ CFU *Propionibacterium acidipropionici* MA26/4U/g), **BS** (forage inoculated with $1x10^5$ CFU *Bacillus subtilis* AY553098/ g), **LP** (forage inoculated with $1x10^5$ CFU *Lactobacillus plantarum* MA18/5U/g) and the association **LBLP** (forage inoculated with $1x10^5$ CFU *Lactobacillus buchneri*/ g and $1x10^5$ CFU *Lactobacillus plantarum*/ g), **BSLP** (inoculated with $1x10^5$ CFU *Bacillus subtilis*/ g and $1x10^5$ CFU *Lactobacillus plantarum*/ g) and **PALP** (forage inoculated with $1x10^5$ CFU *Propionibacterium acidipropionici* /g and $1x10^5$ CFU *Lactobacillus plantarum*/ g). The inoculants were diluted in distilled water at the rate of 4 mL kg^{-1} of fresh forage and uniformly spray on the fresh forage. An amount of chopped corn (5 kg) from each treatment was packed into 7L silos in quadruplicate, sealed with lid and adhesive tape and stored at ambient temperature. After the fermentation period (96 days), the silos were opened, the spoiled forage was discarded, and the remainder was homogenised and sampled to determine the DM content, pH values, ammonia nitrogen(NH_3-TN), lactic acid, acetic acid, yeasts and molds counts. Silage temperature was measured every half hour by a data logger inserted in the center of mass during the aerobic exposure. Room temperature was measured by data logger distributed near of the experimental silos.The data were analysed as a completely randomised design and subjected to an analysis variance with the Statistical Analysis System (1988). The means were separated by the Tukey´s test, and the significance level was $P<0.05$.

Results and Discussion The levels of NH3/TN and the number of molds did not differ among silages (Table 1). The pH values were lower in control silage and in silage inoculated with *P. acidipropionici* (PA) than silage inoculated with *L. buchneri* and *L. plantarum* (LBLP). The pH values are considered suitable to a desirable fermentation. The control silage showed higher lactic acids levels compared to other silages. The levels of lactate were lower according to Kung e Shaver (2001). The silage added with *L. buchneri* and *L. plantarum* (LBLP) presented higher acid acetic content (2.33% of DM), followed by silage inoculated with *L. buchneri* (1.95% of DM) alone ($P<0.05$). The silage inoculated with the combination *P. acidipropionici* and *L. plantarum* (PALP) showed lower acetate levels (0.87% of DM) than other silages ($P<0.05$). The silages inoculated only with *B. subtilis* (BS) or *L. buchneri* (LB) showed lower number of yeasts, followed by silages inoculated with *P. acidipropionici* (PA) or *L. buchneri* and *L. plantarum* (LBLP) ($P<0.05$). These results are according with the higher production of antifungal compounds by these microorganisms. The silages when inoculated with *L. buchneri* alone or in combination presented more production of acetate, which is an antifungal compound (Ranjit & Kung, 2000). The *P. acidipropionici* (Roughani et al., 2008) and the *B. subtilis* (Todovora & Kozhuharova, 2009) also are known by production of many antifungal compounds. Consequently, the aerobic stability was higher in silages with *L. buchneri* e *B. subtilis* ($P<0.05$).

All silages treated showed increase of temperature above of room temperature after 36 hours of aerobic exposure (Figure 1).

Conclusions The corn silages inoculated with *L. buchneri* or *B. subtilis* remain stable for more time.

References

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Table 1. pH values, ammonia N in relation total nitrogen (NH_3/TN), fatty acid levels, number of yeasts and molds in corn silage.

Treatments[1]	pH	NH_3/TN	Acids		Yeasts	Molds	Aerobic stability (h)
			Latic	Acetic			
		(% NT)	(% of DM)		CFU/ g of silage		
Control	3.81^{b}	5.17^{a}	2.63^{a}	0.93^{e}	3.99^{a}	3.80^{a}	23.3^{d}
LB	3.87^{ab}	5.02^{a}	2.44^{b}	1.95^{b}	1.25^{b}	3.85^{a}	100.4^{a}
BS	3.86^{ab}	4.85^{a}	1.91^{d}	1.59^{c}	1.00^{b}	4.00^{a}	78.9^{abc}
PA	3.81^{b}	4.90^{a}	2.47^{b}	1.57^{c}	2.39^{ab}	3.55^{a}	70.3^{bc}
LP	3.87^{ab}	5.56^{a}	2.44^{b}	1.63^{c}	3.86^{a}	3.80^{a}	54.8^{c}
LBLP	3.89^{a}	5.52^{a}	2.42^{b}	2.33^{a}	2.58^{ab}	3.65^{a}	87.1^{ab}
BSLP	3.83^{ab}	5.03^{a}	2.02^{c}	1.32^{d}	3.34^{a}	3.80^{a}	54.2^{c}
PALP	3.85^{ab}	4.64^{a}	2.09^{c}	0.87^{e}	3.89^{a}	3.85^{a}	58.8^{c}
CV (%)[2]	0.90	14.28	1.47	4.94	24.36	4.00^{a}	14.41

*Means followed by equal letters do not differ by Tukey test (P>0.05).

[1]LB: *Lactobacillus buchneri*; PA: *Propionibacterium acidipropionici*; BS: *Bacillus subtilis*; LP: *Lactobacillus plantarum*; LBLP: *L. buchneri* e *L. plantarum*; PALP: BSLP: *B. subtilis* e *L. plantarum; P. acidipropionici* e *L. plantarum*.

[2] = Coefficient of variation.

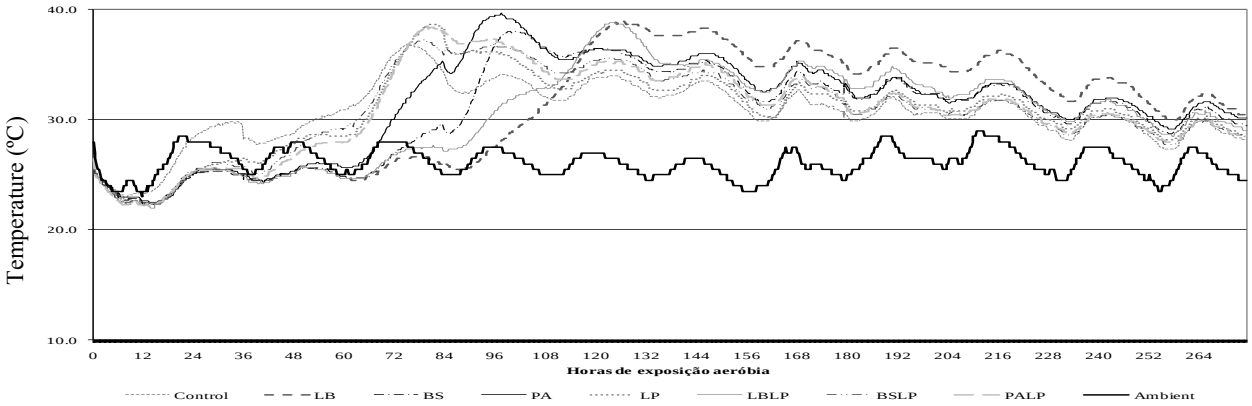

Figure 1. Temperature of silages during aerobic exposure.