Improving the Aerobic Stability of Whole-Crop Cereal Silages

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Introduction Whole-crop cereal silages, such as wheat, sorghum, and maize are susceptible to aerobic deterioration, especially in warm climates. This is because aerobic yeasts are the most active at 20-30°C (Ashbell *et al*., 2002). Therefore, it is very important to find suitable additives that inhibit fungi and protect the silage upon aerobic exposure. *Propionibacterium acidipropionici* is propionic acid bacteria (PAB), which produce propionic and acetic acid in silage. Results with these micro-organisms in laboratory studies were promising with regard to aerobic stability. The purpose of the present work was to study the effects of PAB, lactic acid bacteria (LAB) and combinations of PAB + LAB on the fermentation and aerobic stability of whole-crop cereal silages.

Material and methods Wheat at the early dough stage (366 g/kg DM), sorghum at the milk stage (272 g/kg DM) and maize at the one-third milk line stage (358 g/kg DM) were harvested and chopped to about 1.5 cm and ensiled in 1.5-l glass jars (Weck®, Wher-Oflingen, Germany) equipped with a lid that enables gas release only. At the end of the ensiling period, 60 d, the silages were sampled for chemical and microbiological analysis and were subjected to an aerobic stability test, which lasted 5 d, in a "bottle" system developed by Ashbell *et al.* (1991). The following microbial additives were applied to fresh forage at the levels recommended by the manufacturer: control (no additives); *P. acidipropionici; Lactobacillus plantarum;* combination of *P. acidipropionici* and *L. plantarum* (final application rate of 1.0 x 10^6 cfu/g of fresh forage).

Results *P. acidipropionici* increased the concentrations of propionic acid of the silages. This was evident from propionic acid production. The higher amount of acetic acid in the *P. acidipropionici*-inoculated silages was expected because acetic acid is a co-metabolite of the fermentation of carbohydrates and lactic acid by *P. acidipropionici*. However, production of acetic and propionic acid in the *P. acidipropionici*-inoculated silages decreased all yeasts and moulds counts. Propionic and acetic acid are fungicidal agents, and high concentrations of propionate and acetate inhibit yeasts and moulds growth. Table 1 gives the results of the aerobic exposure test of the silages. Silage deterioration indicators are pH change, CO_2 production and an increase in yeast and mould numbers. The *P. acidipropionici*-inoculated silages had significantly higher levels of acetic and propionic acid than the *L. plantarum* or *P. acidipropionici* + *L. plantarum*-inoculated silages (P<0.05). Therefore, yeast activity was impaired in the *P. acidipropionici*-inoculated silages. As a result, *P. acidipropionici* decreased CO_2 production and improved aerobic stability of wheat, sorghum, and maize silages. However, the combination of *P. acidipropionici* + *L. plantarum* did not improve aerobic stability of the silages.

Conclusions The *P. acidipropionici* was very effective in protecting the wheat, sorghum, and maize silages exposed to air under laboratory conditions. The use of *P. acidipropionici*, as a silage inoculant can improve the aerobic stability of silages by inhibition of yeast activity. The combination of *P. acidipropionici* and *L. plantarum* do not look promising in protecting wheat, sorghum, and maize silages upon aerobic exposure.

Table 1 The results of the aerobic stability test (5 days) of the silages

Forage type	Treatment	pH	CO_2 (g/kg DM)	log cfu/g Yeasts	log cfu/g Moulds
Wheat	Control	5.2^{ab}	14.8^{b}	5.2	4.0
	PAB	4.9^{b}	4.1^{c}	<2.0	<2.0
	LAB	5.3^{a}	33.7^{a}	8.6	4.4
	PAB + LAB	4.9^{b}	17.6^{b}	4.7	2.8
	SE	0.245	0.157		
Sorghum	Control	4.8^{a}	20.4^{b}	5.8	4.1
	PAB	4.2^{bc}	6.7^{c}	<2.0	<2.0
	LAB	4.8^{a}	38.3^{a}	8.0	4.3
	PAB + LAB	4.4^{b}	19.7^{b}	5.6	2.9
	SE	0.208	0.135		
Maize	Control	4.4^{ab}	25.6^{b}	6.1	4.5
	PAB	4.1^{b}	5.8^{c}	<2.0	<2.0
	LAB	4.7^{a}	44.5^{a}	8.3	4.8
	PAB + LAB	4.2^{b}	31.9^{b}	5.3	3.0
	SE	0.187	0.112		

Within a column and forage type means followed by different letter differ significantly (P<0.05).

References

Ashbell, G., Z.G. Weinberg, A. Azrieli, Y. Hen & B. Horev (1991). A simple system to study the aerobic deterioration of silages. *Canadian Agricultural Engineering* 34, 171-175.

Ashbell, G., Z.G. Weinberg, Y. Hen & I. Filya (2002). The effects of temperature on the aerobic stability of wheat and corn silages. *Journal of Industrial Microbiology and Biotechnology* 28, 261-263.