Conference Proceedings

The XIIth International Silage Conference

Silage Production in relation to animal performance, animal health, meat and milk quality

July 5-7, 1999
Uppsala Sweden

SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES
SLU

OUDE ELFERINK, STEFANIE J.W.H.[1], FRANK DRIEHUIS[1], JANNEKE KROONEMAN[2], JAN C. GOTTSCHAL[2], & SIERK F. SPOELSTRA[1]. [1]DLO Institute for Animal Science and Health, P.O. Box 65, 8200 AB Lelystad, THE NETHERLANDS. [2]Groningen State University, Dept. Microbiology, P.O. Box 14, 9700 AA Haren, THE NETHERLANDS.

Lactobacillus buchneri can improve the aerobic stability of silage via a novel fermentation pathway: the anaerobic degradation of lactic acid to acetic acid and 1,2-propanediol.

Introduction

Aerobic spoilage of maize silage is a well known problem, which is generally initiated by yeasts. Silage additives aiming to improve the silage quality should therefore not only aid to a rapid silage acidification, but also prevent growth of spoilage yeasts. Silage additives based on *Lactobacillus buchneri* can effectively inhibit growth and activity of spoilage yeasts, and have been used to improve the aerobic stability of silage. Here we show that this inhibition of spoilage yeasts is probably mainly due to the capability of *L. buchneri* to ferment lactic acid to acetic acid and 1,2-propanediol.

Methods

Whole crop maize (37% DM) was treated with water or *L. buchneri* ($1x10^6$ cfu/g) and ensiled in double layered polyethylene bags (5 kg/bag). Two silages per treatment were opened 7, 14. 28, 56, 84, and 137 days after ensiling and analyzed for chemical composition (HPLC + GC), yeast numbers (Malt Extract Agar, pH 3.5), *Lactobacillus* numbers (Rogosa agar, pH 5.4), and aerobic stability. The aerobic stability was determined by measuring temperature increase in silage samples incubated in polystyrene containers with perforated lids at ambient temperature. The aerobic stability was defined as the time needed to increase temperature 1°C above ambient.

Results and Discussion

The effect of *L. buchneri* on the fermentation pattern, microflora, and aerobic stability of whole crop maize silage is shown in fig. 1. During the first month of ensiling there is little difference between the untreated and *L. buchneri* treated maize silage. However, after one month of ensiling the fermentation pattern of the treated silage starts to differ from that of the control silage, because the lactic acid in the silage is being degraded to acetic acid and 1,2-propanediol. Simultaneously, yeast numbers start to decline and the aerobic stability starts to improve. After 4.5 months of ensiling almost all lactic acid in the treated silage has been degraded, while yeasts have almost disappeared, and the silage has obtained a very high aerobic stability. These results indicate that *L. buchneri* is capable of improving the aerobic stability of silage by inhibition of yeasts. An important underlying principle of this effect seems to be the anaerobic degradation of lactic acid to acetic acid and 1,2-propanediol. The stoichiometry of this novel fermentation reaction was studied in pure cultures of *L. buch*eneri (at pH 4). The proposed fermentation pathway is depicted in fig. 2. Recent experiments (not shown) have indicated that the *L. buchneri* also produces other, yet unidentified metabolites with antifungal activity. To which extent these metabolites can help to prevent aerobic spoilage in silage is not yet clear.

Conclusion

Silage inoculation with *L. buchneri* inhibits yeast growth and improves the aerobic stability of the silage. This seems mainly due to the capability of *L. buchneri* to ferment lactic acid to acetic acid and 1,2-propanediol.

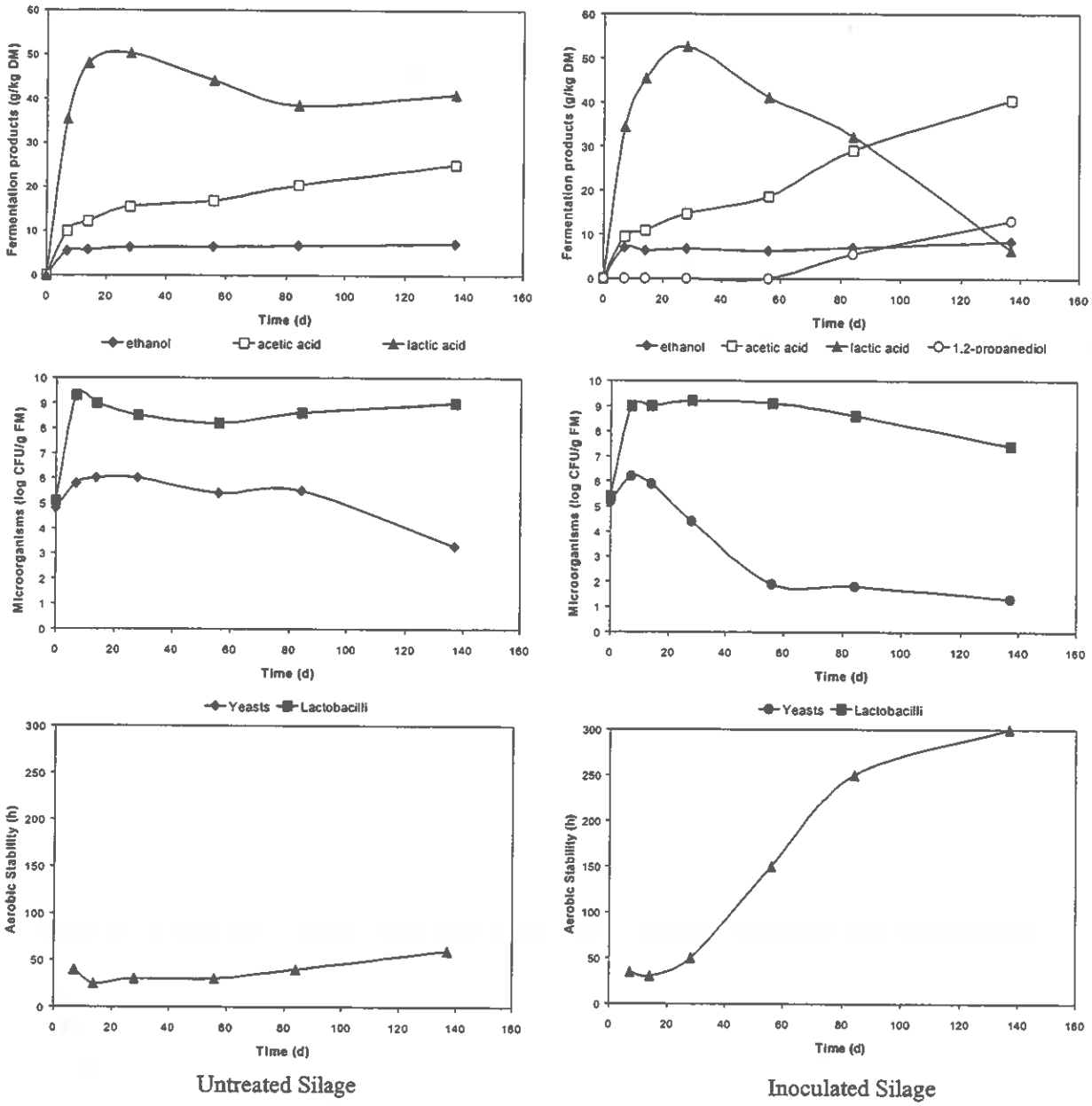

Figure 1: The effect of *L. buchneri* inoculation on silage fermentation, microflora, and aerobic stability of maize silage followed in time.

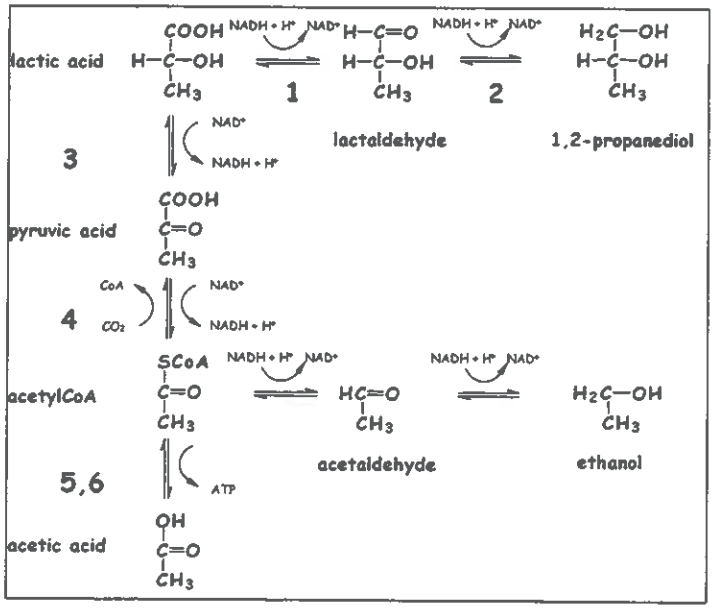

Figure 2: Anaerobic degradation pathway of lactic acid in *L. buchneri*.