

Homemade starter cultures for silage

An effective starter culture leading to rapid pH reduction is required for producing high quality grass silage. Commercial preparations are relatively expensive (up to 2.50 €/t silage) and not always optimally effective. At the ATB Potsdam a method for home-production of high activity starter cultures with technically simple equipment has been developed. Since 1999 the method has been successfully tested at Niederschöna under practical conditions. The result is significant cost reductions (0.58 €/t silage) and clear improvement of silage quality.

The target of ensiling is reducing pH to 4.0 to give a conservation effect and hinder development of undesirable organisms. Ensiling of plant material usually starts through airtight storage and the effect of naturally-available lactic acid producing bacteria. Often, however, this spontaneous process does not occur optimally and the pH is not sufficiently reduced. Results include increased multiplication of undesirable microorganisms which reduce feed quality or make it unusable. Adding starter cultures helps to stabilise the ensiling process. Cost of applying commercial silage aids are an average 1.75 to 2.50 €/t silage. Despite this, ensiling success cannot always be guaranteed with their use because, especially with the microbiological preparations, the microorganisms applied are not always the most suitable ones.

Requirement

Basic aim was the establishment of a practical system for home-production of active silage starter cultures which could be hand-

led by the farmer and meet the following requirements:

- reliable, stable, quality-protecting and sustainable production
- simple and cost-effective plant construction and operation
- good integration of the plant in the farm infrastructure
- applicability of the product with existing equipment
- forage quality improvement
- clear reduction of application costs

Results

The new method is based on the separate cultivation of two lactic acid producing bacteria lines recognised as very suitable for ensiling of grass (*Lactobacillus plantarum* and *Lactobacillus rhamnosus*) in a 120 litre fermenter, the mixing of both cultures and direct application of the active bacteria mix on the harvester during silage cutting. Both cultures are the result of comprehensive screening of 250 lines.

Dr. rer. nat. Christine Idler (cidler@atb-potsdam.de) and Dr. sc. nat. Klaus Richter (krichter@atb-potsdam.de) are members of the scientific staff at the Institute for Agricultural Engineering Bornim e.V., Max-Eyth-Allee 100, 14463 Potsdam. Rainer Partzsch is chairman of the Agrargenossenschaft eG in 09600 Niederschöna, Freiburger Str. 1. Gudrun Neubert and Frank Heber are members of this farm's staff.

A refereed paper for LANDTECHNIK, the full-length version of which can be accessed under LAND-TECHNIK-NET.com

Keywords

Silage, starter cultures, fermentation, self-made production

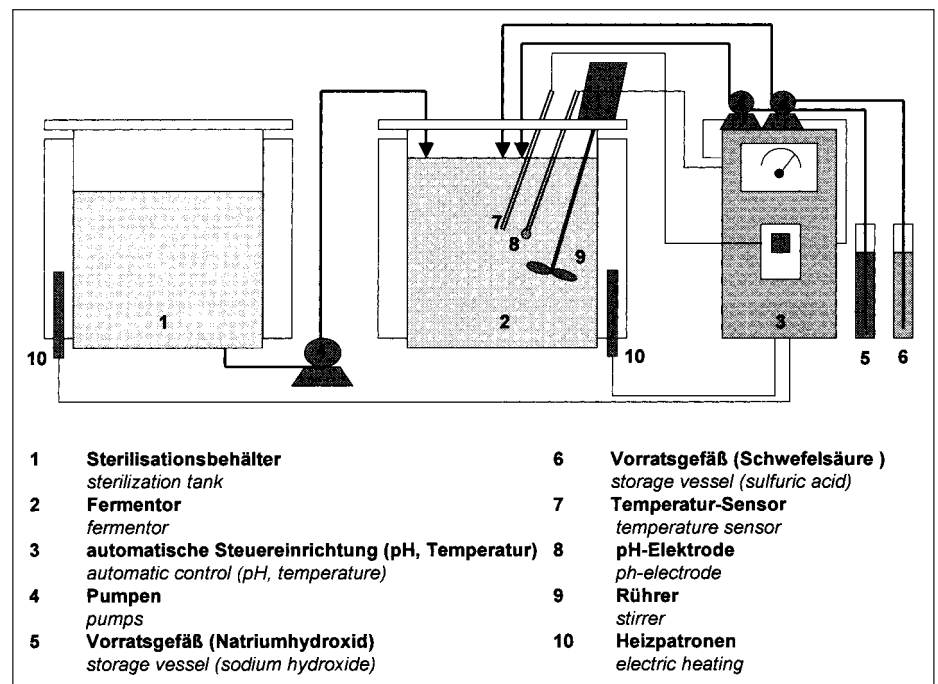


Fig 1: Schematic diagram of the plant for producing active starter cultures



Fig. 2: Production plant installed in Niederschöna cooperative farm

Production plant

Main parts of the production plant are a heatable double-skinned container for the sterilisation of the nutrient medium, an intermittently driven mixer-fermenter and a pH and temperature level control system. *Figure 1* shows a diagram of this.

To keep investment costs down, used dairy stainless steel containers were modified using own-labour for use as fermenter and sterilisation tank (*fig. 2*). The plant was simply constructed for reliable operation and for ability to be safely managed by a trained operator. The production method comprises the individual steps fermentation preparation, fermentation and subsequent treatment of the product. The first step comprises cleaning and sterilisation of all equipment parts, the production and sterilisation of the nutrient solutions and the production of the inoculum in an agitator. This is followed by the fermentation with rapid multiplication of the microorganisms. The third step includes the storage of cell suspension in a coolroom and its dilution to a solution strength appropriate for application. The cultures can be stored without loss for up to four weeks so that production can be timed for culture availability before the beginning of silage harvest.

Application

The starter cultures are applied via dosing equipment (Pieper, Wathenow) on the harvester including a 400 l tank. The dosage rate is controlled by sensor depending on the

thickness of the harvested grass layer. The cell suspension is diluted with non-chlorinated well water so that a total $2 \cdot 10^5$ KbE/g silage is applied, this being the recommended application concentration for grass silage.

First operation of the equipment was in spring 1999 on the Niederschöna cooperative farm and since then only the home-prepared starter cultures have been used in the production of first to fourth cut greencrop silages, depending on weather and silage quality as well as the condition of the application equipment. When weather conditions have been difficult, a chemical solution has been used as additive. An annual 1570 ha of greencrop and maize are harvested for silage on the cooperative farm and fed to 1120 milk cows, 300 calves as well as 800 followers. Between 1999 and 2001 good and very good silages have been produced through the use of the homemade silage cultures. Annual average milk production per cow has been continually improved from 7039 to 8223 kg.

Costs

On average, two batches of the starter culture have been produced per year. Investment for the plant was 10225 € only. This was because main components (fermenter, steriliser, coolroom) were already available with required reconditioning carried out by own-labour. With an annual 15000 t of grass harvested, specific cost has been 0.58/t of silage. This cost is substantially lower than that where commercially available silage aid substances are used.



Fig. 3: Forage harvester with device for spraying the harvested grass with starter culture suspension; 1 storage tank for starter culture suspension, 2 dosage pump, 3 spray nozzle

Outlook

The method presented here for production of starter cultures was developed especially for use on large farms. The starter cultures multiplied here are, however, not only suitable for the production of high quality feed silage but also for the conservation of degradable raw material industrial/energy crops to ensure availability for round-the-year processing.

Literature

- [1] Idler, Ch.: Verbesserung der Konservierung von Futtermitteln durch Einsatz von Impfkulturen. 1994/7 Forschungsbericht
- [2] Idler, Ch., K. Richter und F. Idler: The use of lactic acid bacteria as starter cultures for the conservation of green forages. Vortrag auf der Internationalen Konferenz „Field Technologies & Environment“ von 24./25. September 1998 in Raudondvaris, Littaun, Proceedings, S. 121-126
- [3] Richter, K. und Ch. Idler: Ensiling of green biomass with homemade starters to make raw material available for a Green Biorefinery throughout the year. 2nd Int. Symposium on „The Green Biorefinery“, 13./14. Okt. 1999, Feldbach, Österreich, Proceedings, S. 100-114