

# Reducing clostridia development in silage

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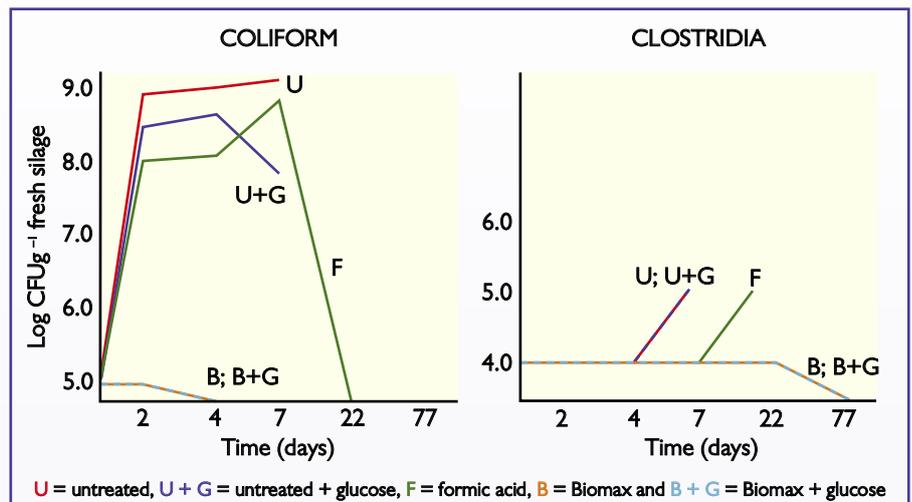
Chr. Hansen is actively involved in the development and production of inoculant silage additives containing specially selected strains of lactic acid bacteria, which are much more efficient at converting crop sugars to lactic acid than the natural lactic acid bacteria found on forage. The application of a high level of efficient and fast growing strains results in the rapid fermentation of crop sugars to lactic acid, which in turn results in a fast pH drop in the silage which is absolutely essential to prevent the growth of spoilage bacteria and thus ensure the long term preservation of the forage as silage.

## Preventing clostridia

The most important spoilage bacteria in silage are clostridia, of which there are two types: the lactate-fermenting clostridia such as *Clostridium tyrobutyricum*, which ferment sugars and lactic acid and the proteolytic clostridia, such as *C. sporogenes*, which ferment amino acids.

Clostridia are mainly a problem in silages made from grasses and leguminous crops and tend to develop under certain conditions, such as high crop moisture and low sugar contents, high crop buffering capacity, where sealing the silage is delayed, where there is high soil and slurry contamination and where high temperatures (optimum 37°C) occur in the silage. Clostridia are undesirable in silage for two reasons:

- They produce butyric acid (which is the typical smell associated with poorly fermented silage and which can taint milk), result in dry matter and energy losses, degrade amino acids and produce potentially toxic amines; the end result being a silage of poor nutritional value.
- There is a link between the occurrence of



**Fig. 1. Development in concentration of coliform and clostridia following different treatments of fresh grass silage.**

where they can lead to late blowing in certain long life cheeses.

## Effect of Biomax

Due to the importance of reducing clostridia in silage, the effect of Chr. Hansen's Biomax on the development of clostridia and on the production of butyric acid (which is the main indicator of clostridial activity) has been extensively researched at several leading research institutes.

Biomax contains *Lactobacillus plantarum* (DSM 4744) and *Pediococcus pentosaceus* (DSM 4745), two lactic acid producing strains that are highly efficient at dominating the silage fermentation.

A good example of the effect of Biomax on silage fermentation, and on butyric acid production in particular, is shown in the results of a trial at the Institute of Grassland

and Forage Research at Braunschweig (Table 1), in which a direct cut 19% dry matter content grass/clover mixture was ensiled after each of the following treatments:

- Untreated.
- Treated with formic acid at a rate of three litres/tonne.
- Treated with Biomax.

The untreated silage underwent a particularly poor fermentation during which all of the lactic acid was fermented to butyric acid by lactate fermenting clostridia. The pH rise, which is typical of butyric silages, was caused by the fact that two moles of lactic acid are fermented to only one mole of butyric acid (which is a weaker acid) and, from an associated increase in ammonia nitrogen, due to the actions of coliform bacteria and/or clostridia. Treatment with either formic acid or Biomax resulted in a much improved fermentation, with the best fermentation occurring in the Biomax treated silage.

## Swedish trial confirms effect

In another trial at the Swedish University of Agricultural Sciences at Uppsala, direct cut timothy grass was subjected to the following two treatments to deliberately obtain a poorly preserved untreated silage:

- The grass was shaded from the sun for

**Table 1. Effect of Biomax on the production of fermentation acids in wet grass/clover silage.**

	Untreated	Formic acid	Biomax
pH-Value	5.30	4.30	4.20
Lactic acid (% of DM)	0	7.59	11.30
Acetic acid (% of DM)	4.83	2.35	3.24
Butyric acid (% of DM)	9.10	0.42	0.28

spores of clostridia in silage and in milk,

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three days to lower its sugar content.

● The grass was inoculated with the silage spoilage bacteria *Enterobacter cloacae* (100,000 colony forming units/g grass) and *Clostridium tyrobutyricum* (10,000 spores/g grass).

The grass was ensiled after each of the following treatments:

- Untreated (U).
- Treated with formic acid at a rate of three litres/tonne (F).
- Treated with Biomax. (B).

In the case of the untreated and Biomax treated silages the grass was ensiled with or without the addition of 1% glucose (+G) on a fresh matter basis.

The addition of Biomax and Biomax + glucose resulted in well preserved silages, while the untreated, untreated + glucose and formic acid treated silages were poorly preserved.

The number of spores of lactate-fermenting clostridia in the Biomax and Biomax + glucose silages remained at the inoculated level of 10,000/g for the first 22 days storage and then declined in numbers between 22 and 77 days storage (Fig. 1).

In contrast, the number of spores in the untreated and untreated + glucose silages began increasing after only four days storage and in the formic acid treated silages after only seven days storage.

This indicates that when conditions are optimal for them, such as a high pH value and a low content of lactic acid, spores of lactate-fermenting clostridia will rapidly germinate and grow in silage.

Spores of clostridia are of course extremely resistant, and we can speculate that they were initially able to survive in a dormant form in the Biomax treated silages, but, that when they tried to germinate in the later stages of ensilage, they were killed by a combination of fermentation acids and the low pH value.

These results demonstrate that Biomax can have a beneficial effect on reducing the development of lactate fermenting clostridia in silage, at least equal to that of three litres of formic acid per tonne.

As with any additive Biomax must be com-



bined with good ensiling techniques on the farm and is not a substitute for bad management.

In addition to improving silage fermentation, independent research trials have also demonstrated that Biomax reduces dry matter losses in the silage, increases the energy content and digestibility of the silage and improves performance when fed to livestock.

## Product quality

Chr. Hansen A/S has been involved with animal health and nutrition products since 1981, with the aim to supply biological additives to the agricultural sector and replacing chemical additives with safer and environmentally friendly biological ones wherever possible.

Chr. Hansen was the first company to achieve FAMI-QS for silage inoculants; an overall certification, which combines ISO 9001 standard, GMP (Good Manufacturing Practice) and HACCP requirements (Hazard Analysis and Critical Control Points) in one certification. In combination with their unique stabilisation technology and 130 years of experience in producing microbial cultures, this ensures product quality and consistency.

Quality is key word and supports the Chr. Hansen vision of improving the quality of food and health for people all over the world. ■

