Newsletter

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> EDITORIAL

Nowadays, corn (Zea mays), originating from Central America, is one of the most important crops in the world. Worldwide production was around 818 million tons in 2009 (rice and wheat: 685 million tons each, sorghum: 56 million tons; FAOSTAT, 2009). In that year, over 158 million hectares of maize were planted worldwide, with a yield of 5.16 tons grain/ hectare. The main advantages of corn are high production of energy and biomass per area, efficient use of water, and corn tolerates a wide range of soil conditions.

Four pre-requisites are needed to guarantee a good fermentation in the silage: a) anaerobic conditions, b) a source of easily-fermentable carbohydrates, c) a relatively low buffer capacity and d) adequate microorganisms, such as lactic acid bacteria (LAB). If we have these four pre- requisites, we forecast that our silages will ferment properly.

Many substrates/ crops can be ensiled, according to their ensilability (ability of a substrate to ensile). Weißbach (1967) developed an equation for numerically evaluating the ensilability (ensilability coefficient) of a crop in function of its sugar content, buffer capacity and dry matter content. Corn is characterized by relatively high quantities of fermentable sugars (water soluble carbohydrates) and low buffer capacity related to its low protein content. Some time ago a forum on the internet discussing the topic of the need for an inoculant for corn silages polarized participants into "defenders" and "detractors". Back to the previous question: do we need an inoculant for corn silages?

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Competence Center Microbials

Biomin® BioStabil product line

Many farms in the world do not include silage inoculants as standard practice for corn silage production. This is mainly based on the fact that corn silages show relatively low pH values upon opening the silo. This is due to the high sugar content in the material, as well as the low buffer capacity and the relatively high epiphytic micro flora on the crop at harvest. However, it is very common to find aerobic instability in corn silages. Therefore, we have two different topics to discuss: a) fermentation and b) aerobic stability*.

Do we really need inoculants for corn silages?

written by Yunior Acosta Aragón

FERMENTATION IN CORN SILAGES:

The ensiling phase, in which covered silages have higher losses, is at the beginning of the aerobic phase. Depending on compaction, a certain amount of oxygen remains inside the material and the endogenous enzymes are active. A sufficient decrease of the pH value is required in order to stop the activity of the endogenous enzymes and prevent losses.

**: results after the inoculation of corn silages with the inoculant Biomin® BioStabil Mays (4 g/ton, at least 100 000 cfu/g of silage)*

We cannot improve compaction with a silage inoculant, but it is possible to improve the acidification using homofermentative LAB (hoLAB, for example, *L. plantarum* and *E. faecium*, as in Biomin® BioStabil Mays). In several laboratory trials, using silage inoculants with different opening times, we found that acidification can be improved (faster and deeper) on the second day in the case of whole plant corn silages (*Diagram 1*).

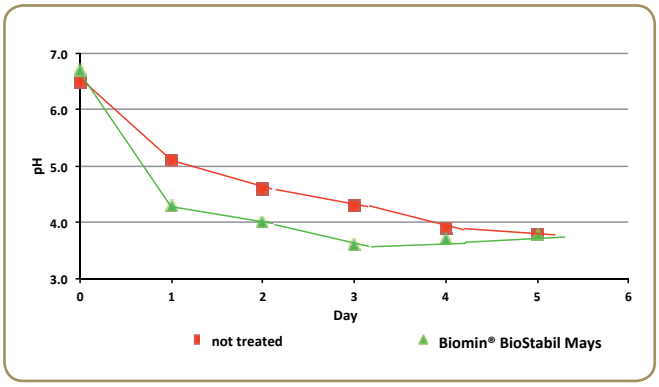

Diagram 1. *Dynamic in the acidification of whole plant corn silages with Biomin® BioStabil Mays*

The area delimited between the two curves denotes differences in acidification, which marks the end of the endogenous catabolic plant enzyme activity. This may be the explanation as to why higher energy contents are found in corn silages at the opening of the silo (*Diagram 2*).

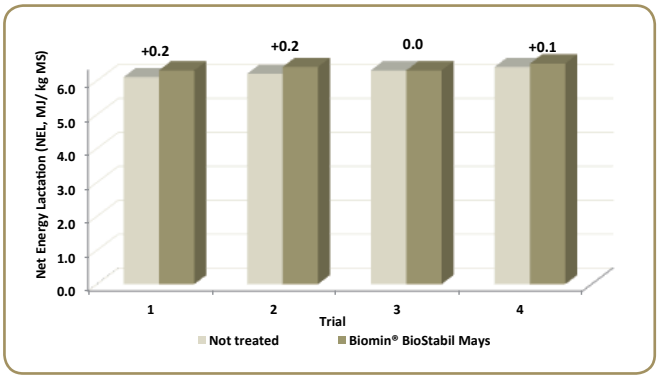

Diagram 2. *Net Energy Lactation in whole plant corn silages with Biomin® BioStabil Mays*

Those differences of +0.1 - +0.2 MJ of NEL/kg of DM, although small, can make the difference between a good silage, without additives, and a better silage treated with a silage inoculant as Biomin® BioStabil Mays.
What the use of this inoculant means economically, expressed as Return On Investment (ROI), is shown in *Diagram 3*.

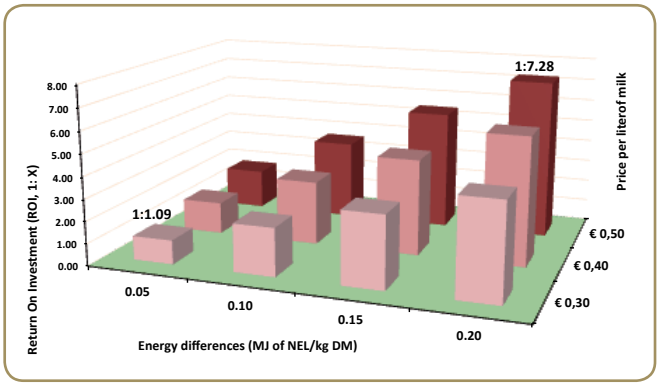

Diagram 3. *Return On Investment (ROI) in the use of Biomin® BioStabil Mays in whole plant corn silages*

Even with an only slightly improved energy recovery (0.05 MJ NEL/kg DM), and a relatively low milk price (€ 0.30/l), there is a ROI (1 : 1.09). Considering the best conditions in *Diagram 4* (energy difference of 0.20 MJ NEL/kg DM and milk price of € 0.50/l), the ROI could reach 1 : 7.28.

AEROBIC STABILITY OF CORN SILAGES:

It is generally recognized, by the scientific community and producers, that aerobic instability is the main problem in corn silages. The better the silage ferments, the more problems regarding its aerobic stability. This is the reason why the farmer has to be very careful in selecting the appropriate silage inoculant for corn.
The use of silage inoculants, with acetic or propionic acid producing strains, can improve the shelf life of the silage. Nevertheless, the use of propionic bacteria appears to be less suitable in the improvement of silage aerobic stability, due to the fact that these bacteria are only able to proliferate and produce propionate if the silage pH remains relatively high (Weinberg and Muck, 1996). Therefore the use of acetic acid bacteria is preferred, especially in corn silages, in which the pH values remain very low (3.7 – 4.0). Homofermentative LAB produces mainly lactic acid, which is a good energy source for the growth of yeasts and molds. Therefore, no improvement in the aerobic stability should be expected when using silage inoculants which contain only hoLAB.
Lactobacillus buchneri is, without a doubt,the most frequently used heterofermentative lactic acid bacterium (heLAB). However, other heLAB are available and produce a similar effect in improving the aerobic stability, for example, *L. kefiri* or *L. brevis* (Acosta Aragón *et al.*, 2009; Li and Nishino, 2009; Schoendorfer *et al.*, 2009; Wilkinson, 2005). Compared with non-treated silages, improvements in aerobic stability within 2 – 4 days of using inoculants containing *L. brevis* (Biomin® BioStabil Mays) have been found (*Diagram 4*).

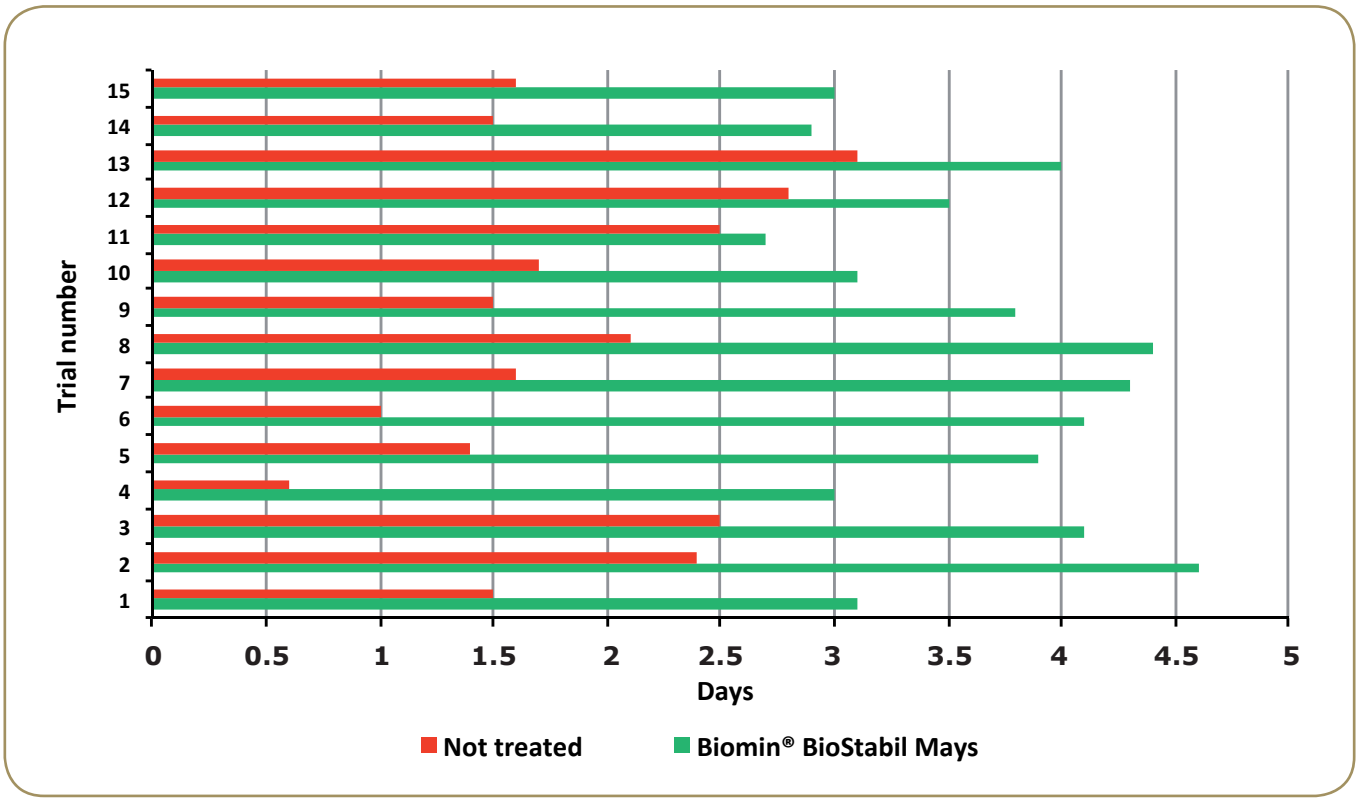

Diagram 4. *Aerobic stability of whole plant corn silages treated with Biomin® BioStabil Mays*

An acetic acid content of 2.0 – 3.0 % in the DM is desired (Spiekers, 2006) in order to guarantee good aerobic stability, but also a good palatability. Undesirable secondary fermentations result in nutrient break-down, to yield much simpler compounds (i.e. CO_2), through heat-releasing processes (exothermal reactions). This heat always leads to nutrient losses. Therefore, measures must be implemented to avoid heat production.

One fundamental aspect influencing aerobic stability is silage packing (i.e., compaction). Packing is closely related to particle size. The higher the dry matter content in the material to be ensiled, the lower the particle size should be.

One additional aspect which must be considered, in order to maintain the nutritional/hygienic quality of the silage, is the quantity of silage offered to the cows per day. In over-dimensioned silos, aerobic instability can occur when silage layers remain in contact with air for extended periods of time. Sometimes, extended periods of time elapse between silage extraction and animal intake; a situation which can also result in aerobic instability. Even though no research has been carried out on this topic, due to difficult practicalities involving the repeatability of such experiments, numerous researchers have also related the uneven cut of the silage face to increased probabilities that aerobic instability will occur.

CONCLUSIONS

Improving silage aerobic stability is an important measure which leads to best preserving nutrients during the ensiling process. Forage silages involve large investments. Therefore, they should be delivered in top quality, and best utilized by livestock. This can be achieved through a) good agri- cultural practices, in particular silage packing, and b) using inoculants containing heterofermentative LAB which provide the silage with acetic acid (1.5 – 3.0 %).

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