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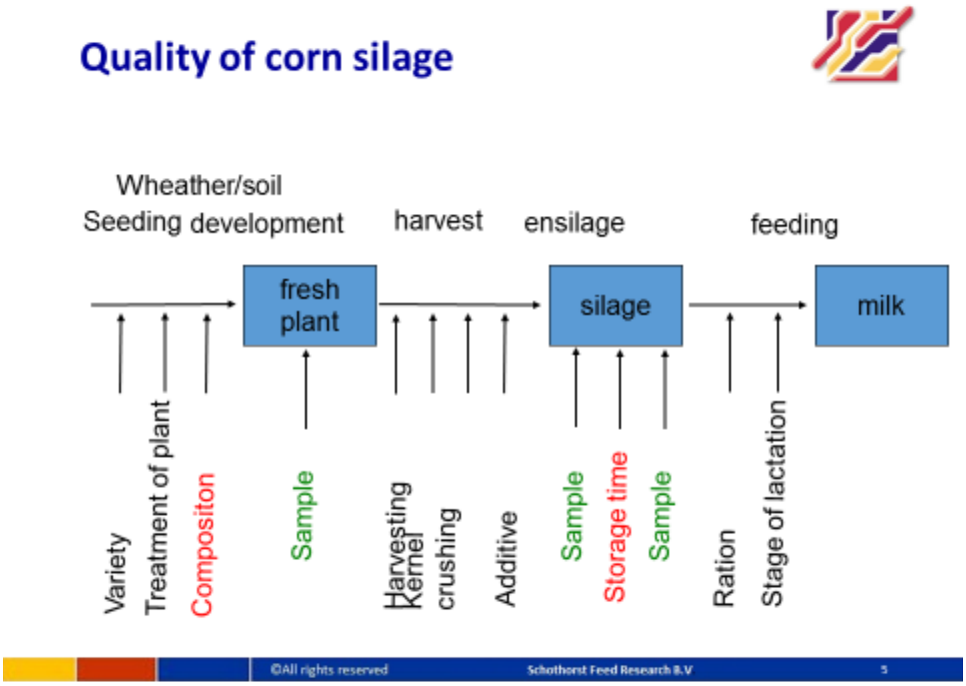
CHANGES IN FEEDING VALUE OF CORN AND GRASS SILAGES DURING THE ENSILING PERIOD FOR RUMINANTS

Formulating a balanced ration for ruminants is a challenge without a precise knowledge of the nutrient content of the roughage. Corn silages are an important part of the diet for dairy cows. Whole plant corn silage is used since the 30thies of the last century in the Netherlands. Due to improvements in genetics it is possible to grow and harvest a good quality of corn silage also in the Netherlands but during the first years of growing corn the certainty of achieving a corn silage of good quality after harvest was not guaranteed. Improving the yield per hectare was the first objective of the corn breeding companies before 1985. In the late 1980s breeding began to aim at increasing the nutritional value next to certainty of harvest. Nowadays also corn varieties for biogas production are on the market. There is a large variety of maize breeds to choose from now, from maize with a particular dry matter content and a high starch content to varieties with a high amount of cell wall digestibility. Further variation is made in earliness (very early to medium early) ripening (hard kernel and green crop (Stay Green) to softer kernel and dried –off crop. The choice of which variety to use for farmers depends on a lot of individual farm factors such as % of corn silage in the total diet, amount and quality of land available for corn silage and nowadays legislation has also a big influence as dairy farmers are stimulated by the government to have their cows grazing in the pasture during the summer period. This reduces the amount of corn silage which the farmer can grow.

Corn silage is low in protein. The nutritional quality of corn silage depends therefore mainly on the energy level in the dry matter, energy from starch and digestible cell walls. Starch can be fermented in the rumen and delivers volatile fatty acids or is digested enzymatically in the intestine, which makes a big difference for the cow. Corn starch is highly digestible, the differences in cell wall digestibility are bigger between varieties. Corn digested in the intestines is bypass starch, it stimulates milk production and protein content in early lactation and can lead to fattening of the cows later in lactation. As the maize crop is maturing in the field before harvesting the amount of bypass starch increases. The quality of a corn silage crop is usually determined by taking a good sample after 6 weeks after ensiling, when the silage clamp is considered to be stable. At harvesting, chopping length of the corn silage is usually a choice between an optimal ensiling process (Chopping length between 6 to 8 mm) and optimal chewing and rumination process (longer chopping is preferable, until 16 to 19 mm). Coarse chopping also leads to more selection of the cows in the corn silage, this leads to feed losses. The digestibility of starch is also usually lower when corn silage is chopped coarse. New developments in harvesting (e.g. schredlage), corn breeds, new products which are used to improve the ensiling process and also the improved genetic capacity of dairy cows to produce milk need to be taken into consideration when feeding dairy cows. Schothorst Feed Research is constantly improving its feed evaluation system for ruminants and the corresponding nutritional requirements for high producing dairy cows, young ruminants and beef cattle.

Fig 1 Factors affecting the quality of corn silage



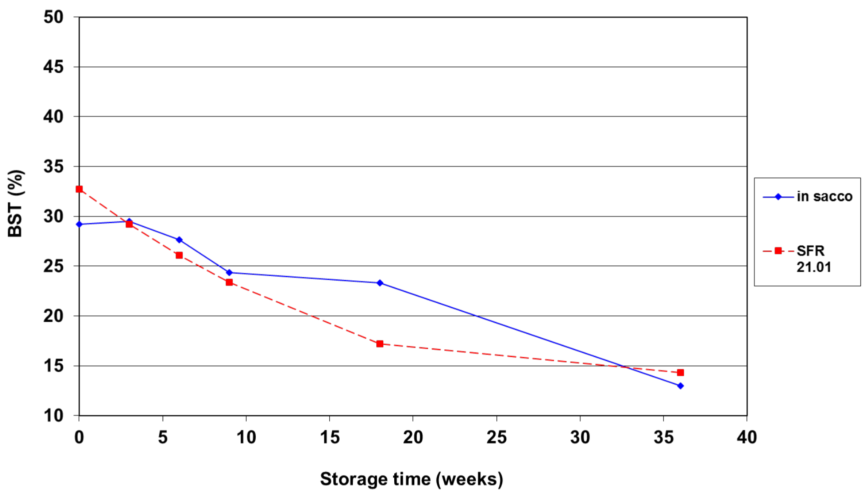
The increase in digestibility of corn silages has led to an increase of the energy density in the corn silage. The quality of corn and grass silage is not constant every year, and even after ensiling the quality is not stable. As roughage is usually the cheapest part of the diet every farmer is trying to harvest the best quality of roughage every year. Taking the roughage as a basis the correct amount and composition of concentrates is calculated to obtain the most optimal ration.
The composition and feeding value of corn and grass silages is commonly determined once a year by taking a sample from the silage four to six weeks after harvest when the fermentation processes in the clamp are considered to be stable. Common practice is that the values of one analysis are used in diet calculations throughout the feeding period of the silage. However, the composition and feeding value of maize silages may change with storage time. Compared within one season from 2 to 10 months after harvest, the degradable crude protein and starch content increases with time and this effect was larger with high dry matter contents of the maize silages (Newbold et al., 2006).
Schothorst is doing already for years trials with ensiling corn and grass silages and this trial is describing the results of the latest two trials. Corn starch granules are embedded in a protein matrix and the strong linkages result in a relatively slow degradation of maize kernels. In the silage, the composition of the maize kernel will change due to the effects of moisture, fermentation acids, and proteolytic enzymes and hence the crude protein solubility starch degradation increases during storage of high moisture corn (Hoffman et al., 2011) and maize silage (DeBoever et al., 2010). Based on in vitro experiments, Eurofins Agro showed a decrease of bypass starch with storage time in spring and summer. This decrease in bypass starch is predicted based on the analyses after 4-6 weeks and could be used to adjust the feeding value of maize silages in spring and summer. This experiment aims to determine the effects of rumen degradation and bypass starch of maize silages and to evaluate the prediction based on the sample taken after 4-6 weeks.
Besides starch, the effect of storage time on crude protein and NDF is interesting for explanation and for determining the feeding value. On practical farms, maize silages are regularly fed directly after harvest. Microbial fermentation produces fermentation acids (mainly lactic acid), the pH decreases, and moisture is leaking from the clamp. Sometimes undigested maize kernels are found in the manure indicating a high starch bypass fraction and low digestibility. In this experiment the composition and rumen fermentation

of CP and starch of whole maize plant was determined direct at harvest and after 2, 4, and 6 weeks of ensiling. During the storage time the amount of bypass starch in the clamp is reduced and the amount of fermentable starch increases. Together with the Eurofins Agro lab 13 clamps were selected in the Netherlands and analyzed. Results of the chemical analysis and the in- sacco incubation trials revealed several changes in chemical and nutritional composition. It was found that the dry matter content of the corn silages is reduced during storage, probably due to conversion of carbohydrates in fermentation products as CO_2 which is lost during analysis. The ammonia content increases steadily which indicates a loss of protein during storage. The content of acetic acid also increases while the amount of lactic acid remains with most clamps stable during storage.

Change in feeding value of corn

During storage time the amount of bypass starch is reduced while the amount of fermentable carbohydrates increases. This means that the corn silage becomes higher in rumen energy and more microbial protein can be formed and the amount of rumen bypass protein is decreased. Total energy for the cow is reduced due to the fermentation losses.

Table 2 the amount of bypass starch during 40 weeks in a corn silage.

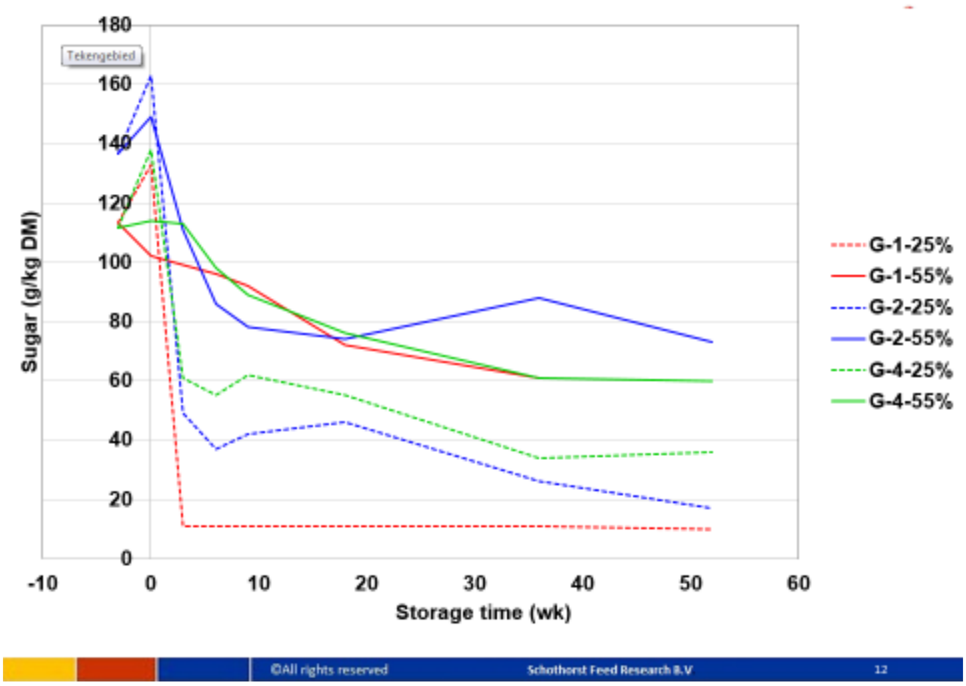


Change in feeding value of grass silage

Also for grass silage we expected a reduction in chemical and nutritional parameters during the storage time. The stability of the silage depends on moisture content, sugar content, adequate consolidation, compacting and sealing. If the silage is fermented well the pH has decreased to 3.8 to 5.0 In the season 2013 a lot of very wet silages were harvested resulting in silo's containing a high content of lactic acid. As lactic acid also can contribute to rumen acidosis the nutritive value of these silages had to be adapted.
A storage trail was conducted in 2014 with 12 samples from 3 cuts during the spring and summer and ensiled at three dry matter percentages: 25 (wet) 40 (average) and 55 (dry). These samples were preserved in lab silo's and analyzed after 3, 6, 9, 18 and 36 weeks by opening each time on of the lab silo's per dry matter category. The sample's were analyses for chemical composition, pH, ammonia and acids.
Results are shown in figure 3. The silages with a high dry matter content usually had a high pH but kept a high amount of sugar. The pH in the wet silages was reduced considerably but the amount of lactic acid was considerably higher and the amount of sugar was reduced markedly compared to the silages with a

high dry matter. This can be explained by the fact that lactate producing bacteria produce are more active if a silage is wet and more lactic acid is produced from the sugar in the grass silage.
The fermentation process in one of the wet silages failed, the amount of sugar was used by lactic producing bacteria but the pH drop was not low enough and proteolytic bacteria like Enterobacteria can grow and degrade protein. During the storage time the sugar content of all the silages went down from an average of 100 gram per kg dry matter to 80 gram or lower, especially for the wet silages. Even after 40 weeks of storage the reduction of sugar content continued although at a slow pace. The acetic and lactic acid content increases especially at wet silages. These nutritional effects of nutritional changes in silages during storage time are now taken into account when formulation rations for ruminants.

Figure 3 Results of the different lab silages during storage time.



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