

# STARCH AND CELL WALL DIGESTIBILITY

## The decisive parameters for dairy cattle maize

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As it always has been, successful milk production is based on the staple food, since feed costs represent about 50 % of the entire costs of milk production. This becomes clear especially in years with low milk prices. In this area it makes sense to optimise operating procedures and to increase the staple feed performance. Every year the industry analyses of the various state control associations show that the most successful businesses often have a high proportion of maize in the ration and the lowest staple feed costs. Even the choice of species of maize may make a decisive contribution here. Species, which are identified with the mark, „Milk Index“ stand for a particularly high quality of feed.

It is of great importance that high-yield cows are fed with nutrients rich in sugars and starches, since starch is a primary source of energy for the cow. As well as its nutritional value, starch causes a rapid drop in the pH value in the silo, so that maize with high starch content can easily be fermented in the silo.

### What is a good fodder value?

Depending on variety, the energy in maize comes proportionally from the starch or from the cell walls, in other words, from the stalks and the leaves. Whereas starch is almost 100 % digestible, the digestibility of the cell walls varies from 50 % to 70 %, depending on species. Therefore, a good fodder value is derived in maize from good digestibility of the cell walls and the highest possible starch content. Because of the cow's restricted capacity to absorb, it must be ensured, especially in maize-dominated rations, that the cell walls of the maize used are as highly digestible as possible, for the rule-of thumb is: Approximately 60 % of every mouthful of maize consumed by the cow consists of cell walls.

Cell walls are digested in the rumen and in comparison to starch take longer to digest. Whereas cell walls remain in the rumen for between 1 and 24 hours, in order to be broken down, the cell contents in starch and sugar are for the most

part broken down within a few hours. Thus the cell walls contribute to providing the cow with constant energy, which puts less strain on the metabolism. High starch contents in maize silage produce a very high level of energy, but are meaningfully sustainable only when the slow supply of energy from the cell walls is also present in equivalent amounts. This is also the reason why feeding purely on starch, such as cereals, can in excess lead to rumen acidosis.

The practical value of the digestibility of the cell walls has been explained by means of a fodder analysis, conducted by the BLGG AgroXpertus testing laboratory in the Netherlands. In value testing for silo maize in the Netherlands great stress has already been placed on the quality of the fodder and in contrast to German analyses the fodder analyses from the Netherlands contain further information and data, which is illustrated in the following.

### Energy and starch content, cell wall digestibility

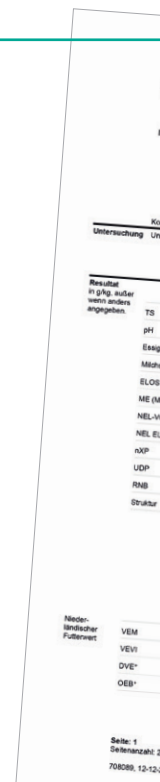
One of the most significant parameters is the energy content. This is expressed in Germany in **MJ NEL** (Netto-Energie-Laktation), in the United Kingdom as **NEI** (Net energy lactation) and in the Netherlands as **VEM** (Voeder Eenheid Melk). Ultimately, this is where the starch content, sugar

content and also the fat content are found, since these are the nutrients, which supply energy to the cow. In order to produce 1 kg of fat and protein adjusted milk (4 % fat, 3.3 % protein), approximately 460 VEM units are required.

A second point, which is observed by every farmer and fodder adviser, is the **starch content**. In this silage it is at the very high level of 39.6 %. In particular, starch gives the cow quickly available and easily digestible energy. It is broken down either in the rumen or in the small intestine and ultimately converted via glucose to lactose, the sugar in milk. Therefore, starch is the most important component in milk.

The higher the overall digestibility of the silage, the more energy maize silage delivers. This is reflected in the **VOS** (Verdauliche Organische Substanz) or **DOM** (digestible organic matter) parameter. This includes both starch and cell walls, the digestibility of which is strongly dependent on variety.

The digestibility of cell walls can be proven by the **NDF digestibility (%NDF)** value. Cell walls consist of hemicellulose, cellulose and lignin. The proportion and the distribution of these components determine digestibility. During ripening the starch content of maize increases and



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Quelle: Futtermittelanalyse BLGG AgroXpertus, Messago Ernte 2014, Meppen

Ergebnis	Ziel	Mittel	Ergebnis	Ziel	Mittel
366	320-360	348	31	35-50	36
3,9	3,9-4,2	3,9	78,6	75-78	76,4
12	10-16	14	6	< 6	7
48	40-60	48	69	75-85	71
765	680-700	688	74	80-90	78
4,3	10,7-11,3	11,3	64	42-60	57
2,8	6,5-7,4	6,9	31	25-35	35
7,2	6,5-7,4	6,9	168	180-200	179
51	130-140	134	< 12	1-15	13
7	18-26	19	396	320-400	348
-3,8	-11,0 - -7,0	-9,2	28	25-34	29
1,4	1,7-2,0	1,7	109	70-120	103
			329	370-420	377
			67,4	30-70	50,8
			181	190-220	205
			14	14-20	16

cell wall digestibility decreases. With higher temperatures the ripening process is faster. Thus, once the maize has flowered, high temperatures have an adverse effect on cell wall digestibility.

Varieties with good stay green capacity mean that the plants remain green for longer and thus NDF digestibility increases and the proportion of lignin is small (ADL). In this investigation the MESSAGO variety silage had digestibility of 57.4 %. This is 3.6 % above the average value for the tested samples (53.8%). It can generally be stated that 1 % more cell wall digestibility produces an extra

15 NEI (VEM). When converted to NEL this gives: 0.1 MJ NEL more per percentage point digestibility of the NDF. (Schotthorst Feed Research).

The high energy content of maize silage is reflected in the **OEB (unstable protein)** parameter. To put it briefly, the OEB represents the relationship between protein and starch in the silage and ultimately also in the rumen. Since maize silage shows low protein content, the value is negative (-44). and the higher the energy content of maize silage, the more strongly negative is the OEB value. Conversely, this value is positive for grass silage. In general, care should be taken in a TMR that this value is balanced through protein from grass silage or other protein-rich fodder, so that both the protein and the starch in the ration can be exploited to the best advantage.

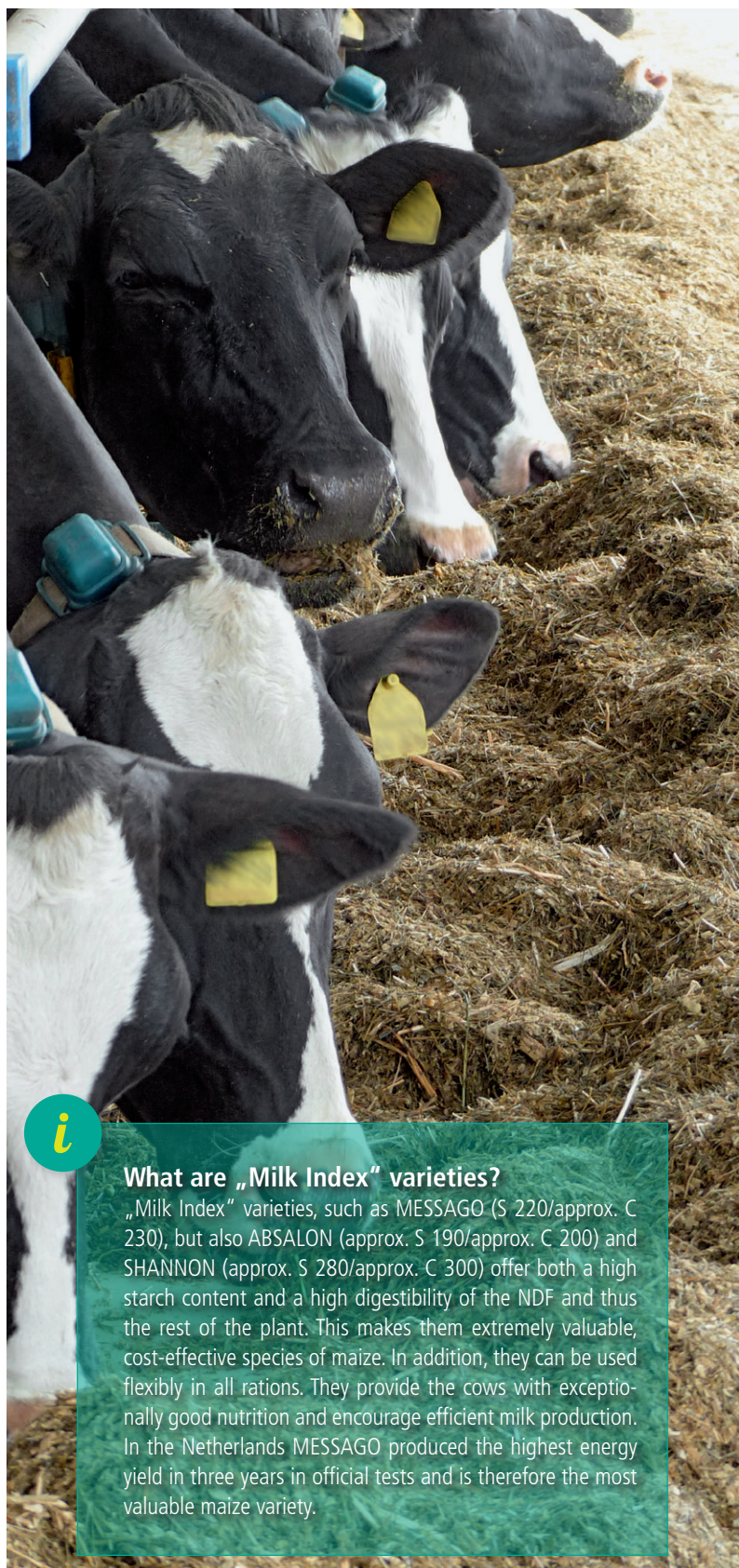
The **FOSp** or **FOM** (fermentable organic matter in the rumen) explains the proportion of organic matter, which can be fermented by the microbes in the rumen. The higher the overall digestibility of maize silage, the higher also is the fermentable organic matter and the more energy is available to the rumen microbes.

## Summary

It becomes clear from the remarks that the quality of maize silage can be analysed by means of various parameters, which are ultimately expressed to a large extent in energy content. It is however, important to know, when planning the overall ration, how the energy content fits together. By reason of differences in species, but also differences in years and the change in the silage over time, regular fodder analyses are indispensable. This is the only way to produce a balanced ration.



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## What are „Milk Index“ varieties?

„Milk Index“ varieties, such as MESSAGO (S 220/approx. C 230), but also ABSALON (approx. S 190/approx. C 200) and SHANNON (approx. S 280/approx. C 300) offer both a high starch content and a high digestibility of the NDF and thus the rest of the plant. This makes them extremely valuable, cost-effective species of maize. In addition, they can be used flexibly in all rations. They provide the cows with exceptionally good nutrition and encourage efficient milk production. In the Netherlands MESSAGO produced the highest energy yield in three years in official tests and is therefore the most valuable maize variety.