Proper silage fermentation takes three things: ryegrass-dominated leys, an optimum cutting time and good silage management.

HOW FORAGE QUALITY IMPACTS SILAGE FERMENTATION

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Unlike maize, grass does not necessarily ferment well. To achieve good fermentation qualities in grass crops, it is necessary that the ensiled material offers a balanced composition of nutrients.

Forage quality is generally defined by its nutrient composition and energy content. Table 1 shows the key parameters and the target ranges desired for these and which can be expected if the grass is cut at the optimum time. But these figures alone are still no guarantee that the cattle will take it in at satisfying levels. To take a holistic view of forage quality, we must also consider the factors which make the feed palatable. These include the degree of contamination, the amount of herbs and legumes present in the feed and the fermentation quality.

Unlike maize, grass does not necessarily ferment well. This requires a balanced composition of the nutrients. We will outline below the parameters listed in Table 1 that are of particular interest for ensiling. But first, let's take a closer look at the principle of ensiling.

What's important for fermentation?

Ensiling is a biochemical process. It requires the presence of the necessary lactic acid bacteria and silage material that is sufficiently fermentable. Fermentability is primarily influenced by the sugar and dry matter content as well as by the proportion of acid-buffering substances (buffering capacity) present in the material. Sugar is a readily fermentable nutrient and is needed by the lactic acid bacteria to produce lactic acid. Lactic acid lowers the pH value, which inhibits the activity of undesirable microorganisms or ideally, depending on how low the pH falls, suppresses them altogether.

Whether and to what extent the silage pH falls depends not only on lactic acid production but also on the presence of alkaline components in the forage which counteract acidification. In green forage these acid-buffering substances include crude protein, crude ash, minerals and soil-borne contamination. Since nitrogen is the main factor affecting the crude protein content, it is important to adjust N fertilisation to suit the yield requirements, and also cut at the optimum time and avoid contamination. The dry matter content also has a role to play in fermentation. DM levels influence the speed and intensity of the fermentation processes whereas higher DM contents inhibit the activity of harmful microorganisms, especially butyric acid bacteria (Clostridia).

Nitrate in the silage also inhibits butyric acid bacteria and their resting spores. The enzymatic conversion of the nitrate at the start of ensiling produces gases containing nitrogen which prevent the germination of Clostridia spores.

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Nutrients and their influence on ensiling

The sugar, crude protein and dry matter contents consequently play a key role in the ensiling process, in addition to the degree of soiling and observance of the optimum harvesting time. The sugar content of the silage is mainly determined by a high proportion of perennial ryegrass in the crop. Ryegrasses have a higher sugar content than other valuable forage grasses. With regular overseeding, careful attention to grassland management and a cutting regime appropriate for the site and weather conditions, perennial ryegrass can remain the dominant species for several years in long-term leys. Tetraploid ryegrasses generally have higher sugar contents than diploid varieties on average. So it's worth bearing this aspect in mind when buying grass mixes and paying more careful attention to the varietal composition. All these measures help to achieve target sugar levels in the fresh grass that are significantly above 10 % in the dry matter.

Tab. 1: Guideline values for good grass silage for milk and beef cattle

Parameter	Unit	Grass silage
DM	in %	30–40
XP	% i.d. TM	<17*
RNB	g/ kg TM	<6
nXP	g/ kg TM	>135
XF	% i.d. TM	22–25
NDF_{OM}	% i.d. TM	40–48
ADF_{OM}	% i.d. TM	23–27
ESOM	%	>65
Gas formation	ml/ 100 mg TM	>46
ME	MJ/kg TM	from 10.5 or from 10.1**
NEL	MJ/ kg TM	from 6.4 or from 6.1**

Source: Praxishandbuch Futter- und Substratkonservierung, 8th Edition., DLG-Verlag NDF_{OM} and ADF_{OM} without residual ash *: 15% for arable grass silage; **: 1st cut and subsequent cuts

The crude protein level in the grass is between 14 % and 16 % in the dry matter, provided it is cut at the optimum time. The optimal cutting time is just before the onset of heading, when the ears and panicles begin to emerge. As mentioned above, crude protein inhibits the ensiling process due to its buffering effect. However, it would be wrong to conclude that we should aim for the lowest possible crude protein levels. Instead, we need to find a compromise between forage quality on the one hand and ensiling qualities on the other. Applications of nitrogen fertilisation and basal dressings should be tailored to the demand to avoid excessive crude protein levels in the silage. It is also important not to cut too early, since this results in higher concentrations of crude ash and minerals, as well as high protein levels. All these factors influence the buffering capacity and lead to inferior fermenting properties. The optimum cutting time is also a compromise between yield growth and forage quality. The nutritional value of the forage declines significantly with the onset of heading. Protein and energy levels fall, while fibre levels rise. The percentage of crude fibre in the plant is between 21 % and 23 % in the dry matter if the cut is made at the optimum time. Higher fibre levels make it harder to roll and compact the clamp. Poor compaction will delay the start of fermentation since nutrients are initially consumed by aerobic microbes until anaerobic (oxygen-free) conditions are established in the clamp. As a result, valuable nutrients are lost and no longer available in the silage. Heat development in the clamp over the feed-out period is also closely associated with a too high pore volume.

THE NUTRITIONAL VALUE OF THE SILAGE CAN NEVER BE BETTER THAN THAT OF THE GRASS FROM WHICH IT WAS MADE. THEREFORE ANY MEASURE COUNTS THAT CONTRIBUTES TO PRODUCING HIGH-QUALITY GRASSLAND FORAGE.

In view of these losses, the wilting time and the resulting DM levels also have an impact on the ensiling process. The cut grass should be left in the field for as short a time as possible, since efficient wilting reduces respiration and breakdown losses. If 30–40 % DM levels can be achieved in wilting, it will also help reduce losses in the clamp.

Other factors

Aside from the nutritional value of the forage, the ensiling process is influenced by other factors mainly relating to hygiene and contamination. Weather, weed infestation and plant diseases also have an impact. A clean forage requires a healthy and dense grass crop, slurry applied as close to the ground as possible and cutting heights of at least 5cm, ideally 7cm. We generally have little control over the microbial load in the growing grass crop. However, it can be assumed that harvesting grass at a late growing stage will suggest a poor hygiene status. Cutting at the optimum time therefore makes sense not only from the point of view of obtaining good forage quality but also in terms of the microbial load.

The influence of weed infestation on fermentability depends on the plant species. Weeds generally have an adverse effect on fermentability in mixed grass stands. However, it is possible to counteract crop degradation by tailoring the number of cuts to the weather conditions and the site and managing the sward appropriately.

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