

Good forage as a guarantee for high performance

MAIZE SILAGE: HOW TO ACHIEVE HIGH QUALITY?

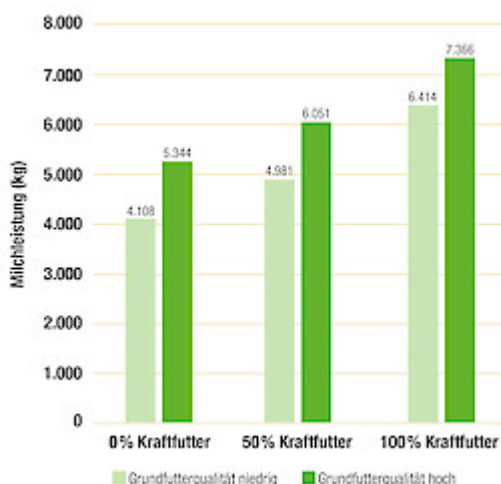


A high nutrient density from the basic feed contributes significantly to the economic success on dairy and fattening farms. With higher silage quality, not only the nutrient concentration increases, but also the basic feed intake and thus the performance and health status of the herd. The quality of maize silage is determined by a number of different factors: from the choice of variety, the time of harvest, the right ensiling to the right preservation: a lot has to work together harmoniously in the production of high-quality forage. We reveal how this can be achieved.

This is why high quality forage is important

The objective is simple: cattle farmers want to achieve the highest possible performance of their animals with the help of the **basic feed**. To achieve this, the quality of the basic feed, such as maize silage, must be right. A **high energy density** is just as important as an **appropriate content of Starch and a good digestibility of the residual plant**. Sensory properties and fermentation success are also crucial for high feed intake.

Aprerequisite for high performance is a **high total feed intake**. Since the proportion of concentrate in a ration suitable for ruminants is limited to a maximum of 50%, the level of the basic feed intake determines the performance of the animals. High quality as a prerequisite for maximum **basicfeed** intake reduces metabolic diseases. A good energy supply reduces the negative energy balance at the beginning of lactation in high-performance cows. This results in fewer ketoses and their secondary diseases. Finally, the risk of acidosis is minimised by a high basic feed intake in all ruminants, as the supply of **raw fibre** and structure is improved.



The illustration shows that feeding high-quality forage is accompanied by an enormous increase in milk yield (mod. after Gruber et al., 1995; © Deutsche Tiernahrung Cremer).

Finally, good digestibility of the **basic feed** is important for a high activity of the rumen microbes, which is the basis of digestion in ruminants.

Fundamentals of high maize silage quality

It all starts with the **choice of variety**, which should be based on the location of the field, the prevailing weather conditions, the soil quality and the feeding objectives of the farm. Many factors are important during **harvesting**. These include, for example:

- the **maturity stage** of the maize kernels and the residual plant,
- the optimum **chop length** of the crop,
- good **crushing of the maize kernels**,
- a high degree of **compaction** of the material,
- a quick, complete and **airtight covering** of the silo.

If the crop is not **ensiled immediately and in the best possible way**, there is a risk of quality loss.

The quality of the silage is determined by the starting material and its further processing. An overview of relevant maize variety types and their growth and ripening behaviour can be found [here](#).

Things to know about harvesting and processing maize silage

Distinguish types of ripening

Distinguishing between ripening types

Maize plants can be divided into different ripening **types** (early to late). These can be further subdivided depending on the proportion of cobs and the ripening behaviour of the remaining plant. The type of ripeness has an effect on the development of the maize plants and the optimal harvest time. For varieties with a high proportion of cobs and slow ripening (e.g. "Stay Green" types), 33 - 35% dry matter (DM) in the whole plant should be aimed for.

Maturity group	Maturity number	daily average temperature (May-September)
early	S or K 170-220	14,0-15,0 °C

medium early	S or K 230-250	15,0-15,5 °C
medium-late	S or K 260-290	15,6-16,4 °C
late	S or K 300-350	16,5-17,4 °C

The maturity of maize is determined with the help of the so-called "maturity number" (formerly: FAO number). The letters S and K indicate whether the maize is silage maize or grain maize. The three-digit number then subdivides the maturity groups in detail. The gradation is in steps of ten, each reflecting a dry matter content of the grains of 1 - 2 %. In Germany, one-digit numbers on "0" define yellow-skinned grains (source: information from the Deutsches Maiskomitee e.V.).

Determine harvest time

Determining the harvest time

Choosing the **right time to harvest** maize plants is essential for further processing: Harvesting too early - and thus harvesting with too low a dry matter (DM) content - can cause losses of fermentation juice in the silo (see below for details). Harvesting too late, on the other hand, causes problems with the compaction of the harvested crop and promotes mould formation and reheating.

Set chop length

Determine chop length

The **optimum chop length** depends on the dry matter (DM) content of the chopped material:

- 40 % DM approx. 5.0 mm chop length
- 35 % DM approx. 6.0-7.0 mm Chop length
- 30 % DM approx. 7.0-8.0 mm chop length

Make sure that the maize grains are quartered or eighthed. The harder and drier the grain, the more intensively you should chop it. Insufficient grain preparation leads to poorer digestibility of the maize starch and thus to a lower feed value. This is recognisable by higher proportions of maize grain particles in the faeces.

Maximum compression

Maximum compaction

The faster you achieve a complete air seal, the better the ensiling quality. **High compression of the ensiled material reduces the residual oxygen.** This quickly creates anaerobic conditions and the fermentation process begins immediately. At the same time, high compaction prevents oxygen from penetrating quickly and widely when the silage stalk is cut. This **protects against aerobic spoilage** of the silage.

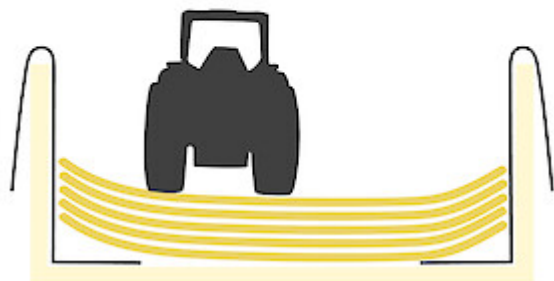
The following minimum compaction should be achieved depending on the dry matter (DM) content of the maize silage:

- 225 kg DM/m³ at 25 % DM
- 245 kg DM/m³ at 30 % DM
- 250 kg DM/m³ at 33 % DM
- 270 kg DM/m³ at 35 % DM

Storage of the maize silage in the silo



1. Layering" step: Depending on the size and weight of the compaction vehicle used, farmers should spread the layers of chopped maize between 15 and 30 cm thick and distribute them as evenly as possible in the silo.



2. Rolling" step: When rolling the maize silage, farmers must ensure that the chopped plants are evenly compacted in the silo - including the mass on the silo edge. Start rolling immediately after the first trailer is spread.

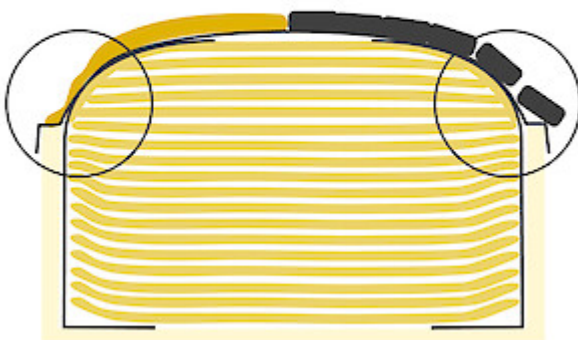
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3. Step: "Final rolling of the last layer": When rolling, make sure to drive slowly (approx. 2.5 km/h). Pressure is more important than speed when rolling. Completely pass over all layers about two to three times. After spreading the last load, it is important to compact the mass for another hour. This compresses the maize optimally.



4. Step: "Covering": A complete spreading and an even compression of the chopped maize plants are the beginning. But only a quick, airtight covering of the silo with foil and subsequent weighting (e.g. with car tyres) guarantee the lowest possible silage loss.



5. Step: "Regular check of the silo": Weather conditions and weather can influence the tightness of the silo. Therefore, regularly check the position and

tightness of the film and weighting and correct them if necessary.

For the ensiling process to be optimally successful, the ensiling chain must be coordinated in terms of product delivery and product compaction.

Ensile correctly: Avoiding energy, nutrient and DM losses

Ensiling inevitably results in losses of energy, nutrients and dry matter. A distinction is made between **unavoidable, process-dependent and avoidable losses**. In order to use the valuable feed efficiently, farmers should minimise losses.

Unavoidable losses

Unavoidable losses

Unavoidable losses - as the name suggests - cannot be completely prevented. However, farmers can try to reduce the extent and volume of **losses through residual respiration and fermentation**. To achieve this, the silo must be filled quickly, compacted and sealed airtight.

Process-dependent losses

Process-dependent losses

Process-dependent losses are caused by the ensiling of **ensiled material that has been harvested too wet**. These include, for example, leachate losses. Valuable nutrients are lost with the seepage juice. Process-dependent losses can be avoided by an optimal harvest time.

Avoidable losses

Avoidable losses

Avoidable quality losses can be prevented by proper handling of the ensiled material. **Aerobic spoilage** is the most common problem in the production of maize silage. This occurs when atmospheric oxygen gets into the silage when the silo is opened. The yeasts, which are inhibited by the oxygen withdrawal but have not died, subsequently become active again. They break down the fermentation acids formed into CO_2 and water under **rapid heating**. But aerobic acetic acid bacteria can also trigger aerobic spoilage in maize silage. The bacteria use the alcohol present in maize silage as an **energy source** and convert it to acetic acid. Once the alcohol is used up, the acetic acid is degraded to CO_2 and water. This leads to an increase in the pH value and consequently to a proliferation of undesirable microorganisms in the silage.

Energy losses of maize silage

Cause of loss	Evaluation	Energy losses
Residual respiration	Unavoidable	1 – 2 %
Fermentation	Unavoidable	4 – 10 %
Silage leachate	depending on process	0 – 8 %
Field losses	process-dependent	1 – 5 %
Faulty fermentation	Avoidable	0 – 10 %
Aerobic spoilage (in silo)	Preventable	0 – 10 %
Reheating	Avoidable	0 – 10 %

Tdry matter losses = 1.5 x energy losses (source: Zimmer, 1969; Praxishandbuch Futter- und Substratkonservierung DLG 2011).

Practical tip: What you can do to prevent reheating

If the aerobic stability of the silage is too low and there is a risk of reheating on the feed table, you can **add propionic acid or potassium sorbate when mixing the ration in the feed mixer**. It can also be useful to treat the cutting surface with propionic acid. However, this does not penetrate deeply into the silage, which is why the treatment must be repeated daily.

In principle, it helps to **mix rations** more frequently and present them fresh. If reheating already starts in the silo, it helps to **feed** faster. This should already be taken into account in the dimensions of the silo and always be adapted to the herd size. The feed rate should be at least 1.5 metres per week in winter and ideally even 2.5 metres per week in the summer months. **Mouldy feeding areas** must not be fed under any circumstances. Always remove the corresponding spots generously.



Farmer and deuka advisor stand in front of maize silo and discuss the optimal ration design based on high quality maize silage (© Deutsche Tiernahrung Cremer).

To reduce ensiling losses, avoid reheating and improve feed intake, farmers can use **ensiling agents** in the production of maize silage. Different products are recommended depending on the intended use. An overview of common silage additives including their proven effectiveness can be found [here](#).

Assessing the quality

There are different ways to **determine the quality of a silage**. The methods differ in their informative value and handling. For a quick assessment of silage quality, the sensory test directly on the silage stand according to the **DLG key** is suitable.

Sensory characteristics of high-quality maize silage

Odour	• Smells pleasantly acidic (aromatic, bread-like) • Has no perceptible acetic acid odour, does not smell of alcohol, butyric acid, yeast or mould • Is free of foreign odours
Colour	• Has - depending on the variety - a golden-yellow colour (compact types) to yellow-olive colour ("stay green" types)
Mould	• No mould is visible
Structure	• The plant parts are not microbially decomposed or attacked
Contamination	• No contamination is visible

In addition, farmers can check how well the silage has been compacted by testing the silo with a **thumb or biros**. The harder the thumb or biros can be pressed into the cut surface of the silo, the higher the compaction. A concrete calculation of the compaction is possible by means of a **silo borer** and the subsequent **determination of the bore volume** and the dry matter (DM) content.

LUFA analysis: Exact assessment of the feed value

For an **exact assessment of the feed value** of the silage - and thus a precise feeding of the herd - a **laboratory analysis** (e.g. at LUFA Nord-West / LKS Lichtenwalde) is indispensable. The sample sent in should represent the silo as well as possible. A mixed sample from different places and layers of the silo provides the most accurate result. In addition to the dry matter, the **nutrient content** is also determined in the laboratory. In addition, the **quantity and trace elements** as well as the fermentation acids can also be analysed. The more parameters are analysed, the more accurate the ration calculation. The cattle's needs are optimally covered without creating deficiency situations or luxury consumption.

Fast, cost-effective and convenient: The LUFA analysis tool

Would you like to precisely analyse the quality of your maize silage? Then order an analysis of your silage sample with our LUFA analysis tool. Benefit from our joint project with the Agricultural Research Institute(LUFA). You can find more information, all discounts and the appropriate investigation forms [here](#).



Only an exact analysis (e.g. at LUFA Nord-West or LKS Lichtenwalde) makes optimal and precise feeding possible (© Deutsche Tiernahrung Cremer).

The right dry matter content: Decisive for feeding?

Regular **examination of the dry matter (DM) content of the silage** is important for optimal cattle supply.

Only in this way can farmers ensure the intake of the appropriate amount of feed by their cattle and thus the right amount of **nutrients** for high performance. In order to achieve a high feed intake with a low selection of the ration, the DM content of the total ration should not exceed 40 %.

The DM content of the silage can fluctuate due to weather influences (e.g. drying out of the cut surface due to sunshine or precipitation). This changes the weight of the silage and the amount of **nutrients** absorbed by the cows.

Key figures for high-quality maize silage

Parameters (unit per kg DM)	Maize silage
Dry matter (g)	300 – 370 ¹⁾
Crude ash (g)	< 40
Crude protein (g)	< 90
NDFom (g)	350 – 400
ADFom (g)	210 – 250

Thickness (g)	> 300
NEL (MJ)	> 6,6
ME (MJ)	> 11
nXP (g)	> 132
RNB (g)	- 8 to - 9
pH value	< 4,2 (4,0 – 5,0) ²⁾
Lactic acid (g)	> 50
Acetic and propionic acid (g)	20 – 30
Butyric acid (g)	< 3
Pure protein (% of XP)	> 50
Ammonia (% of total nitrogen)	< 8

1) Depending on the grain content, 2) Depending on the dry matter content of the silage

Abbreviations NDFom = neutral detergent fibre after ash removal, ADFom = acid detergent fibre after ash removal, NEL = net energy lactation, ME = convertible energy, nXP = usable crude protein at duodenum, RNB = ruminal nitrogen balance

Source: Praxishandbuch Futter- u. Substratkonservierung, DLG-Verlag, 2011, Gruber Table for feeding dairy cows, breeding cattle, sheep, goats 2020 LfL-Information

Compensating for poor silage quality? This is how it works!

Compensation through tailor-made feed

If maize silage has too low a starch content and thus too low an energy content, this can be **compensated for with high-energy concentrates**. Depending on whether other basic feeds are used in addition to maize silage, the use of a different energy supplement is recommended. Energy supplements are distinguished by different proportions of rumen-degradable and rumen-stable starch (recognisable by the ratio of grain maize with a high proportion of rumen-stable starch to rapidly fermentable cereals such as wheat, barley, rye or triticale as well as the proportion of digestible crude fibre from dried sugar beet pulp or cereal by-products).

An exclusive **substitution of maize silage starch by grain maize is not sensible**. The reason for this is the significantly higher starch resistance of grain maize. If the fibre digestibility of maize silage is reduced (e.g. due to a late harvest), an energy supplement with a high proportion of digestible crude fibre, dried sugar beet pulp or cereal by-products can be used to compensate.

- **Bull fattening feed**

(<https://www.deuka.de/en/farm-animals/beef/beef-cattle/beef-cattle-feed/bull-fattening-feed/>)

- **Calf concentrate** (<https://www.deuka.de/en/farm-animals/beef/kaelber/kaelberfutter/kaelberkraftfutter/>)

Conclusion - Maize silage: How can high quality be ensured?

- Basic feed such as maize silage forms an important basis for high performance of cows and bulls. For this, the silage should be of high quality.
- Decisive for the quality of maize silage are the stage of ripeness, chop length, comminution of the grains, compaction as well as a quick, complete and airtight covering of the silo.
- In order for maize silage to have a high content of energy, nutrients and dry matter, farmers have to avoid losses through optimal ensiling. Above all, aerobic spoilage due to reheating must be prevented.
- Only a laboratory analysis (e.g. using our LUFA analysis tool) forms the basis for precise feeding.
- If the quality of the maize silage is insufficient and the ration therefore has a starch or energy deficit, farmers should feed a suitable energy supplement.

Further information

- **Brochure "Coarse feed evaluation"** of the German Agricultural Society (DLG). This provides information on the assessment of the fermentation quality of green fodder silage on the basis of chemical tests.
- **Leaflet "Consideration of the coarse forage performance of dairy cows" (No. 443)** of the German Agricultural Society (DLG).
- Website of the **"Agricultural Inspection and Research Institute (LUFA) North-West**.
- Website of the **Saxon State Control Association (LKS)** and the **LKS Lichtenwalde**.

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