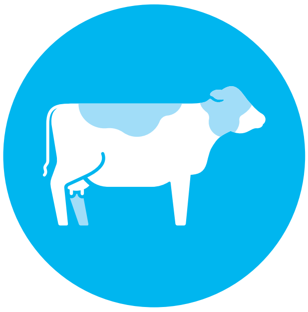
Selko® TMR

Simple steps to keep your TMR fresh

ruminants.selko.com



Total Mixed Ration (TMR) is the foundation of your dairy herd's nutrition, but improper silage storage, handling, or composition can lead to microbial growth, reducing feed quality and animal health. If not managed correctly, microbes can grow, resulting in spoilage. This spoilage reduces feed quality, lowers feed intake, and leads to production losses.

This guide will help you understand why testing your silage and TMR is important and provide you with practical steps to assess microbial risks on your farm and identify preventive actions to ensure consistent feed quality.

Why test microbial status of your TMR?

- Identify your main microbial challenge
- Prevent heating and feed spoilage
- Maintain dry matter intake and milk production
- Reduces feed leftovers

Risk factors for TMR spoilage

To effectively manage spoilage risks and being able to act on time, it is essential to recognize the specific risk factors at both the silage and at feeding time of the TMR. Key risk factors are:

- **Poor silage compaction and/or sealing:** Leads to oxygen exposure, promoting yeast and mold growth.
- **Poor silage fermentation:** If silage is not properly fermented, balance between beneficial microbes, such as lactic acid forming bacteria, and harmful microbes is suboptimal. As a result, silage conditions are more favorable for wild yeast and moulds, which leads to faster spoilage when exposed to air.
- **Improper silage face management:** Once silage is opened and included in the TMR, exposure to oxygen can reactivate microbial growth, causing microbes to grow rapidly.
- **Adding moisture to the TMR:** TMR is widely recognized as an effective strategy to reduce feed selection feeding behavior in cattle, ensuring a more uniform intake of nutrients during consumption. However, this will stimulate microbial proliferation and increase the risk of spoilage and heating of TMR.
- **Slow feed-out rate:** Taking too long to use silage or TMR can lead to deterioration as silage is longer exposed to oxygen.
- **Warm weather conditions:** Higher environmental temperatures accelerate microbial activity and spoilage of the TMR at the feeding line.
- **Dirty feed line:** A clean feeding line minimizes the growth of harmful bacteria, molds, and yeasts that contribute to spoilage and heating. Residual feed build-up in the line can ferment or decompose, contaminating fresh feed, so regular cleaning ensures only fresh, uncontaminated feed reaches the cows.

Recognizing risk indicators is the first step in preventing microbial spoilage, but to fully understand the severity of the issue, additional actions must be taken. Identifying early warning signs allows farmers to determine the extent of the problem and take preventive/corrective measures before it impacts herd health and productivity. By conducting tests on silage and TMR, dairy farmers can quantify microbial risks, assess spoilage potential, and make informed decisions to optimize feed quality.

Testing the silage for microbial risks

Before evaluating the TMR, it's crucial to test the silage, as it is a primary source of microbial contamination. Silage naturally contains microbes and when the silage is poorly fermented or exposed to oxygen harmful yeasts, molds, and bacteria can grow rapidly, which can then end up in the TMR. Identifying microbial risks in silage early allows for corrective actions to preserve feed quality and protect herd health.

Quick on-farm testing

Quick on-farm tests to assess the spoilage risk of silage and TMR include visual inspection, smell evaluation and temperature measurements.

By simply looking, feeling and smelling the silage, you can have a good idea of the quality of the silage and if there is a risk of spoilage. Fresh silage should have a pleasant, slightly sweet or fermented aroma, while musty, sour, or rancid odors indicate undesired microbial activity. Table 1 illustrates how specific color appearances and smell parameters indicate the quality of silage.

Table 1. Visual and sensory check of silage to determine quality

Color	
Very dark olive green	**Weather damaged and/or very wet silage with a poor fermentation.** Usually occurs with high legume content or immature grass that may have been fertilised with a high rate of nitrogen. Sour or putrid aroma
Dark olive green/brown	**Normal colour for wilted legumes, which usually produce a darker-coloured silage than grasses.**
Light green to green/brown	**Normal colour range for grass, cereal and maize silages**
Pale green/straw yellow	**Normal colour range for wilted grass silages.**
Light amber brown	**Typical colour for more mature grasses and cereals** Sometimes seen with low DM silages, and weather-damaged grass silages. Bottom layer of wet silage can be yellow with fruity or sour aroma
Brown	**Some heating has occurred during storage or due to aerobic spoilage during feed out**
Dark brown	**More extensive heating. Due to inadequate compaction, delayed sealing or poor air exclusion. Usually accompanied by significant proportion of waste (mouldy) silage.**

Smell	
Mild, pleasantly acidic, sour milk or natural yoghurt smell	**Normal lactic acid fermentation - desirable**
Very little smell, but slightly sweet aroma	**Heavily wilted silage with little fermentation, especially from crops with low sugar content. Stronger aroma as DM content falls.**
Sweet, fruity alcoholic aroma	**Yeasts have played an active role in the fermentation. Ethanol levels high. These silages are often unstable during feed out.**
Sour vinegar smell	**Poor fermentation dominated by bacteria producing acetic acid. Common with low DM, low-sugar forages, intake likely to be depressed**
Rancid butter, putrid aroma	**Poor fermentation dominated by clostridia bacteria that produce high levels of butyric acid. Silage wet and sometimes slimy. Rub silage between fingers, warm the hand for a few seconds and then smell. The presence of butyric acid is easily detected.**
Strong tabacco or caramel smell with flavour of burnt sugar	**Heat-damaged silage, dark brown in colour. Palatable to stock but nutritive value is very low**
Musty or mouldy aroma with only mild fermentation aroma	**Mouldy silage due to poor compaction and sealing. Also evident in aerobically spoiled silage, which can be warm and have a compost aroma. Intake likely to be low; some silages may be rejected**

Silage assessment using tools

By regularly checking silage temperatures and pH, you can identify potential issues before they become major problems and ensure your silage is being stored and preserved properly.

Sampling

Make use of specialized silage thermometer probes of varying lengths (long: 50-80cm and short: 10-15cm) or use a long thermometer probe (50-80cm) combined with a thermo-camera. The probes are usually long metal rods designed to withstand the moist, sometimes acidic environment of silage.Insert the probe thermometers at different locations within the silage clamp (Figure 2).

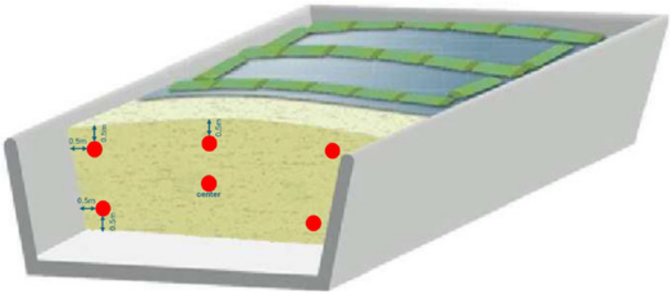


Figure 2. Clamp samples should be taken from the center as well as from various points along the edges, approximately 0.5m from the sides

At each sampling point, insert the two probes (short and long) within 5-7 cm of each other. Sampling points should be taken from the silage face that has been exposed for at least 12-24 hours after shaving to ensure accurate results and avoid false negatives. At the same time, longer than 48 hours before sampling should be avoided, as it may lead to false positive results due to excessive exposure and potential secondary fermentation at the face clamp.

Typically, lower temperatures are measuerd when using the short probe compared to when using the long probe as residual heat dissipates slower at the core of the clamp. Exceptions include silages harvested during cold weather but exposed to warm ambient conditions during feed-out. Instead of a short temperature probe a thermal camera can be used in conjunction with the long probe thermometer. The thermal camera provides a thermal map of the framed scene, allowing for instant visualization of temperature distribution and rapid identification of heated areas, such as hotspots on the silage face. Additionally, monitoring pH can be an effective method for assessing the quality and stability of silage. The pH serves as a key indicator of fermentation success, aerobic stability, and microbial activity. Proper pH control is essential, as fluctuations can lead to feed spoilage, reduced digestibility, and potential health risks for livestock.

Common methods to measure the pH:

1. It is common practice for dairy farmers to get their silage tested for pH, as well as for other nutritional parameters like dry matter, crude protein, fiber content, starch and fermentation byproducts (lactic acid, acetic acid, etc.). Many farmers work with feed suppliers, (independent) nutritionists or specialized laboratories. **Trouw Nutrition can also offer the silage testing services.**
2. Direct probe insertion. This method requests a specific pH probe suitable for semi-solid materials which can read pH in samples with at least 30-40% moisture. It provides quick results without extra sample preparation, but but a proper pH meter can be relatively expensive.
3. Sample preparation method. This approach uses a standard digital pH meter, a weight scale, and distilled water. Prepare a sample by mixing 10g of silage or TMR with 90ml of distilled water in a cup. Insert the pH sensor probe into the mixture to obtain a reading. This method is more accessible and cost-effective but requires additional preparation time.

Interpretation guidelines

Stable clamp

- The long probe registers higher temperatures than the short probe / thermal camera, indicating no significant aerobic spoilage.
- Properly fermented silage should have a pH of:
  - 3.8 - 4.2 for corn silage
  - 4.3 - 5.2 for grass silage with a DM of 30 – 50%
  - 4.8 - 5.5 for grass silage with a DM >50%, depending on the DM%

Unstable clamp

- Medium Aerobic spoilage - The long probe registers 3-5°C lower temperatures than the short probe / thermal camera.
- Significant Aerobic spoilage - The long probe registers >5°C lower temperatures than the short probe / thermal camera.
- pH > 4.2 for corn silage
- pH > 5.5 for grass silage with a DM of 30-50%. For grass silages with a higher DM content, it depends on the DM levels.

Regardless of the cause of excessive heat in the silage, it's probably too late to address the issue now. Focus on managing the problem for the time being by proper TMR management and spoilage prevention during feeding and then plan steps to prevent it in the next season.

TMR assessment using tools

To test the temperature of a TMR, you'll want to use a short probe thermometer that is designed to handle the consistency and conditions of TMR. A digital thermometer with a probe is ideal for this task. Ensure the probe is long enough (10-15cm) to reach the center of the TMR mix and is designed to handle moist or dense feed materials. Additionally, an infrared thermal camera can be used to evaluate temperature variations across the feed bunk.

Sampling

Take temperature readings from at least five different locations along the feed bunk to ensure a representative assessment. At each sampling point, begin by measuring the superficial temperature by inserting the probe into the TMR at a shallow depth of 3–5 cm. Hold it steady for 30–50 seconds to allow the reading to stabilize before recording the measurement. Next, push the probe deeper, reaching 10–15 cm, and again wait for the temperature to stabilize before recording the measurement. Sometimes this method is challenging due to regular push of the feed as well as insufficient feed depth at the bunk which dissipate the temperature. One option is to isolate a sample of fresh TMR into a 5-10kg bucket and measure the temperature after 6-12-24h with the short probe thermometer or with a temperature data logger.

If available, use an infrared thermal camera to assess temperature variations across the feed bunk (Figure 3). Start by measuring the temperature of the TMR in its undisturbed state to capture the superficial temperature accurately. This initial measurement helps identify any heating occurring on the outer layer due to environmental exposure. Next, thoroughly mix the TMR to expose the inner part, ensuring that deeper layers are brought to the surface. Once mixed, take a second temperature measurement to assess any differences between the outer and inner layers.

Comparing these readings can help determine if there are any heating issues within the feed, which could indicate microbial activity, spoilage, or fermentation inconsistencies.

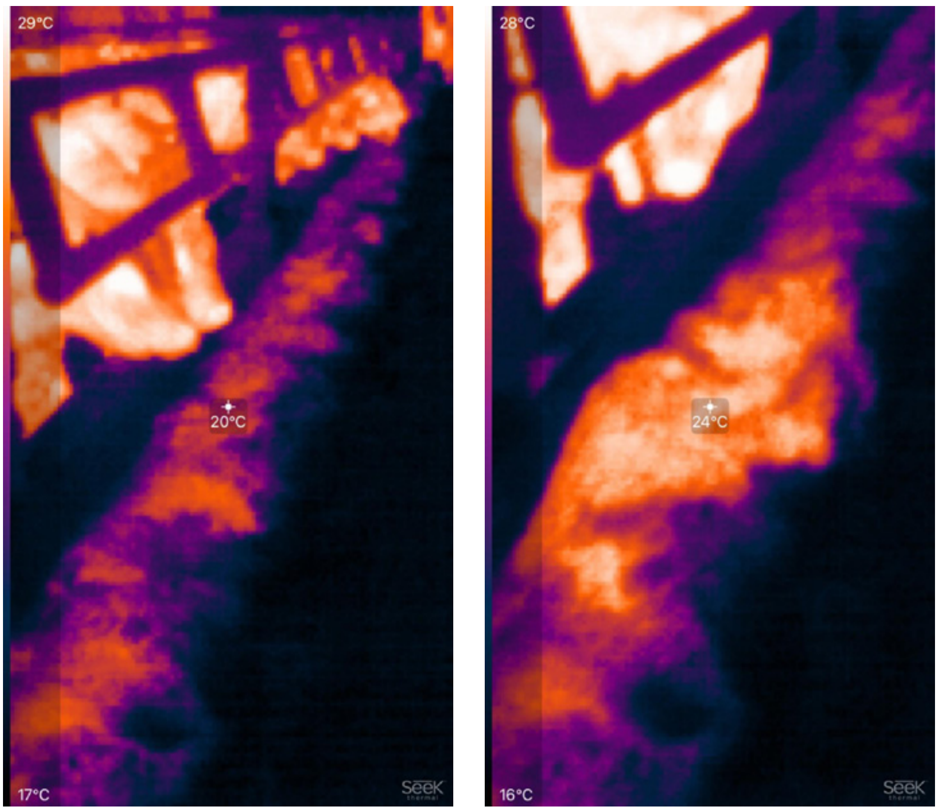


Figure 3. Infrared thermal images of the outer layer (left) and the core of a pile of TMR (right) showing a temperature difference of 4°C, 3 hours after the TMR preparation.

Interpretation guidelines

Stable TMR

- Temperature difference between the outer layer and internal is **< 5°C**. This indicates minimal microbial activity and good aerobic stability

Unstable TMR

- The internal temperature is **> 5°C higher** than the outer layer temperature. This suggests ongoing microbial fermentation, leading to heating, nutrient loss, and potential spoilage.

Lab testing for accuracy

A more accurate way of testing the spoilage risk of silage and TMR is via lab testing. For farmers already conducting tests before feeding, some of the values can already give an indication of the spoilage risk of the TMR. While lab testing takes more time, it provides more reliable results and a clearer diagnosis of potential issues. Lab testing evaluates the fermentation profile of silage, measuring both beneficial compounds, such as lactic acid, and harmful ones, like butyric acid. Ensuring proper fermentation is essential for preserving silage quality and maintaining its safety for consumption (see Table 2).

Table 2: Parameters commonly tested in silages

Parameter tested	Length of the observation period
Dry matter (DM)	DM percentage will have a big effect on feed intake.
Ammonia-N (N)	Should be between 5-10% of total nitrogen. A level of 10% or above suggests fermentation has been poor, resulting in protein breakdown. A common cause is a high level of residual fertiliser.
Total fermentation acids (TFA)	TFA is an indicator of the level of acidification and should be 8-12% of DM.
Lactic acid	After a good lactic acid fermentation >80% of the total fermentation acids will be lactic acid, resulting in a lactic acid content of 7-10% of DM.
Butyric acid	If butyric acid is present, secondary fermentation has taken place. This results in poor quality silage with a bad smell and a reduced palatability. A perfect silage should contain no butyric acid, but a maximum of 0.5% of DM is acceptable.

Table 3. Microbial parameters and their acceptance level to determine aerobic stability

	Silage and TMR aerobic stability		
KPIs	Yeast CFU/g	Molds CFU/g	Entero CFU/g
Excellent	<100,000	<10,000	<300
Moderate risk	100,000 - 1,000,000	10,000- 100,000	300 - 1000
High risk	>1,000,000	>100,000	>1000

Lab tests can detect mycotoxins, molds, bacteria and yeasts that might be present in silage or TMR. These microorganisms can thrive in improperly stored or improperly mixed feed and can lead to poor animal health and lower milk production (see table 3).


DeLaval

Protecting TMR Quality with Selko TMR

While proper silage and TMR management are crucial for preventing spoilage, additional strategies can further enhance feed stability and quality. **Selko TMR** is a specialized feed additive designed to protect TMR from microbial deterioration, reducing the risk of heating, pH increases and spoilage. By inhibiting the growth of yeasts and molds, Selko TMR helps maintain the nutritional integrity of the feed, ensuring consistent dry matter intake and supporting optimal milk production. Its scientifically formulated blend of preservatives and acidifiers extends the aerobic stability of TMR, even in challenging conditions such as warm weather or slow feed-out rates. Integrating Selko TMR into your feeding program can help safeguard feed quality, minimize waste, and improve overall herd performance.

Conclusion

Aerobic stability testing may seem complex, but simple on-farm assessments can reveal a lot about your TMR's quality. By identifying and addressing spoilage risks, you can reduce feed waste, maintain cow performance, and improve your farm's profitability. As a **preventative approach**, incorporating **Selko TMR** into your feeding strategy can further enhance feed stability by inhibiting yeast and mold growth, reducing heating, and preserving the nutritional value of TMR. This proactive solution helps safeguard feed quality, ensuring consistent dry matter intake and supporting optimal herd performance.

For more information on testing procedures or professional lab services, contact your Trouw Nutrition representative today!

References

Relun A, Dorso L, Douart A, Chartier C, Guatteo R, Mazuet C, Popoff MR, Assié S. **A large outbreak of bovine botulism possibly linked to a massive contamination of grass silage by type D/C Clostridium botulinum spores on a farm with dairy and poultry operations.** Epidemiol Infect. 2017 Dec;145(16):3477-3485. doi: 10.1017/S0950268817002382. Epub 2017 Nov 2. PMID: 29094676; PMCID: PMC9148736.

Selko

For more information
about the science
behind Selko visit:

ruminants.selko.com

Selko is the Feed Additives brand of Nutreco. In an era defined by global trends that include increased regulation, pressure to reduce antibiotics, climate change, raw material shortage, and scarcity of land use, the demand is rising rapidly for sustainable and safe feed-to-food production. Selko products and services help to achieve this.

Selko specializes in research-proven feed additives that help reduce harmful microorganisms and mycotoxins at various stages in the feed-to-food chain, leading to improved quality at the feed mill and farm level.

We offer a wide range of solutions related to health and mineral optimization. All aiming to support animal health and help reach your animals' full production potential. This way, we help you get the best results for you, your animals and your customers.

REF#:194|SELKO|SELKO TMR|EN|1.0|26-03-25|CEN|2025-0049NL