



Silage Fermentation Analysis

Fermentation is a valuable means of preserving wet feedstuffs if the process is done correctly. Improper fermentation, however, can result in large losses of valuable feed and/or reduced production from animals consuming the fermented feedstuffs.

It is important to understand how to analyze the fermentation of a feedstuff in order to determine its acceptability for use in livestock diets. Also, identifying particular fermentation problems can help producers avoid future mistakes that cost them valuable feedstuffs.

The goal of the fermentation process is to quickly convert soluble carbohydrates into desirable organic acids, particularly lactic acid. As the organic acids accumulate in the fermenting feedstuff, they acidify the feedstuff and prevent growth of molds and yeast that cause spoilage.

The requirements for good fermentation include:

- **Removal of oxygen** by packing the material. Absence of oxygen will favor the activity of anaerobic bacteria that produce organic acids rather than supporting aerobic bacteria that promote spoilage.
- **The right moisture content.** The correct moisture content will depend on the crop and the storage structure. In general, corn silage should have 60-70% moisture, high moisture corn 26-32%, haylage 40-50%, and small grain silage 50-65%.
- **An adequate supply of fermentable carbohydrate.** Soluble carbohydrates from sugars and starch are needed by lactic acid bacteria to produce lactic acid. This is not a problem with properly processed high

moisture corn or corn silage. Alfalfa and small grain silages need to be harvested before maturity in order to have sufficient soluble carbohydrates.

- **A large population of lactic acid producing bacteria.** In order to have the correct fermentation products, the right lactic acid producing bacteria species must dominate the microbial population. This can be ensured by adding a high quality silage inoculant.

Initial appraisal of silage can be conducted on the farm by sight, smell, and touch.

Sight:

- The ensiled material should look similar to or slightly darker in color than the material before ensiling. A very dark color or a brown color indicates that excessive heating caused material to caramelize. This reduces digestibility of the protein.
- Appearance of molds indicates that there was insufficient lactic acid production.
- Yeast is more difficult to see, but it can be detected visually if there is a large amount. Yeast on the surface of the ensiled material indicates that not enough material is removed daily to maintain freshness. Yeast found beneath the surface indicates presence of oxygen due to inadequate packing.

Odor – The following odors are indications of improper fermentation:

- **Putrid or rancid odor** – this indicates the presence of butyric acid from *Clostridium*

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bacteria. Livestock will not eat this material readily, and fresh dairy cows are more likely to experience ketosis when consuming silage containing butyric acid. This occurs in haylages that are ensiled too wet and do not reach a pH below 5 because of insufficient lactic acid production.

- **Yeasty bread, alcohol, or fruity odors** – these indicate yeast growth.
- **Vinegar odor** – indicates high levels of acetic acid. This can discourage intake by livestock and is due to the wrong bacteria dominating the fermentation.
- **Burnt odor** – this indicates excessive heating occurred.

Touch:

- After initial fermentation, silage should not be hot. Temperatures >20°F above the ambient temperature when material was ensiled indicates poor fermentation and excessive dry matter losses. An inexpensive compost thermometer can be used to

accurately measure internal silo temperatures.

The **pH** of properly fermented silage should be <5.0 for haylages/small grain silages and <4.0 for corn silage. The pH can either be measured on the farm with a simple hand-held pH meter or when the sample is sent to the laboratory for analysis.

To obtain organic acid content and composition, silage samples should be sent overnight in a chilled container to a qualified laboratory. Table 1 shows what items a laboratory fermentation analysis should include and what the targeted levels of these parameters are for good quality silage.

TABLE 1. Fermentation Analysis – Target Levels

Item	Haylage	Corn Silage	HMC
pH	<5.0	<4.0	<4.5
Ammonia N, % of CP	<12.0	<7.0	<10.0
Lactic Acid, % of DM	2-6	5-10	1-2
Acetic Acid, % of DM	<2.5	<3.0	<0.5
Lactic/Acetic ratio	>2:1	>3:1	>3:1
Butyric Acid, % of DM	<0.25	<0.1	< 0.1
Ethanol, % of DM	<1.0	<3.0	< 2.0