Fermentation Analysis

Fermentation analysis primarily serves as a monitoring tool for good silo filling management practices. Data from a fermentation analysis can tell us whether an excellent, average, or poor fermentation occurred. The fermentation a crop goes through in most cases can be influenced by both managerial factors and those that occur naturally.

Fermentation factors that occur due to nature include moisture content, buffering capacity, and the sugar content of the crop. However, silage problems are often due to ensiling crops with less than idea ensiling management practices. This includes situations where crops are ensiled with improper moisture, maturity, packing, sealing, and feedout management.

While these reports cannot be used to balance the dietary needs of an animal, they can be used to determine whether a silage has poor nutritive value or low feed intake. Fermentation analysis is a valuable tool that can be used in conjunction with a nutritive analysis of the silage.

Interpreting a Fermentation Analysis

% Moisture: This is the difference between the as fed weight and the total dry matter (DM) weight after the drying process has been completed. Proper moisture at harvest is important for such fermentation factors as air exclusion, compaction of the silage mass, and to provide sufficient moisture to promote lactic acid fermentation.

- Ensiling at higher than normal moisture may lead to prolonged fermentation, excessive protein breakdown, and energy loss.
    - High moisture levels can allows Secondary Clostridial fermentation to occur, which can lead to undesired high levels of butyric and ammonia nitrogen.
- Ensiling at lower than normal moisture may lead to aerobically unstable silage with yeast, mold, and Bacillus problems.
    - Low moisture silages often have high levels of heat-damaged protein

pH: While pH alone is not a totally accurate monitor of silage fermentation, it is a very important criteria. Generally the lower the pH, the better preserved and more stable is the silage. Determination of silage acid levels that contribute to lowering pH is needed for further forage analysis.

Lactic Acid: Lactic acid is the strongest of all silage acids and its presence will drop pH more effectively than the other volatile fatty acids. Generally, the presence of high lactic acid levels indicates efficient fermentation and minimal dry matter losses. Ideal silage will usually (but not always) have 3 times more lactic acid than what comprises volatile fatty acids. Depending upon the crop, levels will range from greater than 1-3%.

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Volatile Fatty Acids: These acids evaporate quite easily when introduced to air and are what give silages their characteristic smell. Lactic acid in contrast has a bland odor and does not volatilize upon exposure to air. Lactic acid creates efficient fermentation because it is stronger than the volatile acids. The volatile fatty acids provide aerobic stability properties.

i. *Acetic Acid:* Provides silages with their characteristic vinegar odor and taste and is usually the predominant acid produced during fermentation for maintaining aerobic stability. Usually found at less than 3% in silages. Anything over 3% suggests inefficient heterofermentative fermentation.

ii. *Propionic Acid:* Produces a sharp sweet smell and taste and is usually lower levels of this acid are produced during fermentation for maintaining aerobic stability. Usually found at less than 1.0% in normal silages.

i. Most silage contains very low concentrations of propionic acid (<0.2 to 0.3%) unless the silage is very wet (<25% DM). In silages with more typical concentrations of DM (35 to 45% DM), concentrations of propionic acid is undetectable.

iii. *Butyric Acid:* Produces a rancid butter smell and taste. Appropriate levels of butyric acid (<0.5% of DM) indicates again that the silage has gone through a normal fermentation. However, butyric acid (>0.5% DM) indicates that the silage has undergone a clostridial fermentation, this is one of the poorest fermentations. These silages usually hold low nutritive value and have higher ADF and NDF levels because many of the soluble nutrients have degraded.

Ammonia: High concentrations of ammonia (>12 to 15% of CP) are a result of excessive protein breakdown in the silo due to a slower than normal drop in pH or clostridial action. In general, wetter silages have higher concentrations of ammonia than ones do that are not. Extremely wet silage (<30% DM) have even higher levels of ammonia concentrations and pose potential problems. Also please note that silage packed to loosely and or filled too slowly will tend to have higher than normal ammonia levels.

In theory, high amounts of ammonia by itself should not have negative impact on animals if the total nitrogen dietary fractions are balanced. If they are not negative impact may be felt causing loss in milk production and an animal's reproductive performance.

Table 1: Fermentation End Products of Common Legume and Grass Silages (Dry Matter Basis)

End Product	Legume Silage (30-40%)	Legume Silage (45-55%)	Grass Silage (30-35%)
pH	4.3 – 4.7	4.7 – 5.0	4.3 – 4.7
Lactic Acid %	7 – 8	2 - 4	6 - 10
Acetic acid %	2 – 3	0.5 – 2.0	1 - 3
Propionic Acid %	<0.5	<0.1	<0.1
Butyric Acid %	<0.5	0	0.5 – 1
Ethanol %	0.2 – 1.0	0.5	0.5 - 1
Ammonia – N (% of CP)	10 – 15	<12	8 - 12

Table 2: Fermentation End Products in Corn Silage and High Moisture Corn (Dry Matter Basis)

End Product	Corn Silage (30-40%)	HM Corn (70-75%)
pH	3.7 – 4.2	4.0 – 4.5
Lactic Acid %	4 - 7	0.5 – 2.0
Acetic acid %	1 -3	<0.5
Propionic Acid %	<0.1	<0.1
Butyric Acid %	0	0
Ethanol %	1 - 3	0.2 – 2.0
Ammonia – N (% of CP)	5 - 7	<10

Resource:

Seglar, B: Fermentation Analysis and Silage Quality Testing. Proceedings of The Minnesota Dairy Health Conference, University of Minnesota. 119-136. 2003.