LITCHFIELD ANALYTICAL SERVICES

P.O. Box 457
535 Marshall Street
Litchfield, MI 49252
Phone: (517)-542-2915 Fax: (517)-542-2014
email: litchlab@qcnet.net web page: www.litchlab.com

Feeds Forages Mycotoxins Soils Plant Tissues Manure Fertilizers Lime Water

Forage Fermentation Analysis

The quality of silage and high-moisture grains is dependent on management decisions and practices implemented before, during, and after ensiling. Quality is not only determined by the stage of maturity at harvest but also by the moisture, harvesting methods, ensiling methods, type of storage structure, feed-out methods, and the use of additives.

Traditional forage evaluation methods may provide information about nutrient content for ration balancing purposes, but do not normally evaluate quality as it has been impacted by these management issues. A "Forage Fermentation Analysis" provides information for evaluating silage management and may provide insight into issues of animal acceptance, palatability, and nutritional quality.

Moisture

Proper moisture at harvest is critical to allow for compaction of the silage mass and air exclusion and to provide sufficient moisture for strong lactic acid fermentation. Too high a moisture content may lead to prolonged fermentation, excessive protein breakdown, and too high an acid level. Too low a moisture level may lead to an unstable forage mass, and yeast and mold problems. Moisture level has the greatest impact of any variable on the extent of fermentation.

pH

pH is a key criteria to evaluate silage fermentation. Generally, the lower the pH, the better preserved and more stable is the silage. Haylage should reach a final pH of around 4.5 and corn silage near 4.0. The pH of the forage alone is not a good indicator of the quality of the silage or the type of fermentation that occurred. Forages ensiled at moisture levels greater than 70% may develop large populations of clostridia bacteria which produce butyric acid rather than lactic acid. This may result in a sour silage with a pH of 5.0 or above.

Titratable Acidity

Titratable acidity is a measure of the amount of base (NaOH) necessary to neutralize to a pH of 6.5 (rumen pH level). A high number indicates a more extensive fermentation, more acid production, and more stable silage for storage and during feed-out. Too high a level is a concern due to extensive conversion of organic matter to acids (reduced energy) and the challenges of keeping the rumen pH from dropping too low.

ADIN or Heat-Damaged Protein

During the initial ensiling process, freshly cut plant material and aerobic bacteria continue to respire within the silo structure. The oxygen utilized in the respiration process is contained within and between the forage particles at the time of ensiling. Respiration is undesirable because the aerobic bacteria consume soluble carbohydrates that might otherwise be available for the beneficial acetic and lactic acid bacteria or the animal consuming the forage. Under ideal crop and storage conditions, respiration will last only a few hours. With improper management, it can continue for several weeks.

While respiration consumes oxygen to create the desired anaerobic conditions, it produces water and heat in the silage mass. Excessive heat build-up resulting from extended respiration can greatly reduce the digestibility of nutrients such as proteins. ADIN (Acid Detergent Insoluble Nitrogen) above 10% are an indication of excessive heating during fermentation and a significant loss of protein and energy availability in the forage.

Ammonia

During respiration, proteins are broken-down to amino acids and then to ammonia and amines. Up to 50% of the total plant protein may be broken down during this process. The extent of protein breakdown (proteolysis) is dependent on the rate of pH decline in the silage. The acid environment of the silage eventually reduces the activity of the enzymes that break proteins down. High ammonia is an indication of a poor or extended fermentation leading to protein breakdown. High ammonia forages may present significant feeding problems. High ammonia levels imply the presence of amines and amides (protein breakdown products) which are toxic.

Acetic Acid

Once aerobic bacteria deplete the oxygen, the development of anaerobic bacteria begins. The first bacteria to develop under anaerobic conditions ferment soluble carbohydrates and produce acetic acid as an end product. Acetic acid production is desirable because it initiates the pH drop necessary to create an environment for complete fermentation and is utilized by ruminants. As the pH of the ensiled mass falls below 5.0, acetic acid producing bacteria decline in numbers because this pH level inhibits their growth. The activity of the acetic acid producing bacteria lasts no longer than 24 to 72 hours. Higher acetic acid levels imply a slow or prolonged aerobic phase and an excessive loss of energy. Bunk stability will be good due to the anti-mycotic activity of acetic acid. Reduced dry matter intake may result when acetic acid levels exceed 5 - 6%.

Lactic Acid & Lactic Acid as a % of Total VFA

Lactic acid is the primary fermentation acid resulting from a good fermentation. The faster that fermentation proceeds, the less dry matter and energy loss and the higher the lactic acid / total VFA (Volatile Fatty Acids) ratio. For efficient preservation, lactic acid should comprise greater than 70% of the total VFA produced. When silage is consumed, lactic acid is utilized by cattle as an energy source.

Propionic, Butyric, and Isobutyric Acids

Propionic acid should be present only in small quantities in a normal fermentation (< 1%). Butyric and isobutyric acids are an indication of spoiled silage and will lead to significant reductions in dry matter intake and animal performance. Excessive harvest moisture and/or lack of adequate sugars result in a clostridial fermentation and the production of butyric acid. Butyric acid should be present only in trace amounts in properly fermented silage.

Total VFA

Total VFA (Volatile Fatty Acids) will generally increase with increasing moisture levels. At 50% moisture, total VFA in a forage may be 3% while at moisture levels above 70%, total VFA may exceed 15% of the forage on a dry matter basis. Higher total VFA levels result from fermentations that convert greater amounts of rumen fermentable carbohydrate to rumen non-fermentable acids. This results in reduced energy and may present nutritional challenges.

Total VFA as a Percentage of NFC

Volitile Fatty Acids (VFA) are the non-rumen fermentable component of NFC (Non-Forage Carbohydrates). It is of value for nutrional programming to know the amount of rumen fermentable versus rumen non-fermentable material. While it is not valid to compare VFA as a percentage of NFC in this context, the total VFA value may be used to infer the degree to which the NFC is rumen non-fermentable.

Ethanol

Ethanol is an indication of yeast activity. Yeast converts sugars to alcohol and can metabolize lactic acid which will raise pH and lead to an unstable silage.

Mold and Yeast

Molds degrade forage energy and lead to reduced dry matter intake. Some molds may produce toxins under certain circumstance. Yeast is fast growing and is responsible for much of the “heating” of forages and high moisture grains at feed-out.

Ash

High ash levels may be due to soil contamination during harvest or storage. Soil contamination may inoculate the silage with yeasts, molds, and other organisms that could inhibit fermentation and impact silage stability. High levels of iron are usually due to soil contamination but could come from other sources such as the storage structure.

Particle Size

Particle size values are generated using the Penn State Forage Particle Separator. Materials chopped too coarse may lead to poor fermentation due to lack of air exclusion in the silage mass. Too fine a chop may not provide enough roughage value to stimulate cud chewing and saliva production leading to poor rumen buffering.

Relative Feed Value (RFV)

This is a key measure of hay-crop nutritional quality. It is based on a formula using Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF). High relative feed value indicates forage quality that will provide higher levels of starch and sugar as a substrate for good fermentation. High RFV is necessary for economic animal production.

Advantages of Using Litchfield Analytical Services

We utilize the most modern laboratory methods available. Our staff is trained and experienced in testing grains and feeds, which will ensure you accurate and consistent results. Routine sample analysis will be completed within 72 hours of receipt of sample. Results can be reported by email or fax upon customer request.

Compare our turn-around time, the quality of the tests that you receive, and our very competitive rates. We are sure that you will want to place your feed analysis work in our experienced hands.