
MISSISSIPPI STATE UNIVERSITY EXTENSION
Center for Forage Management and Environmental Stewardship

# Hay Inoculants and Preservatives

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Balege and hay production have started in the southern USA and this time of the year, one of the major obstacles in the hay-making process is wet conditions, high humidity, and cooler temperatures that impact the curing process. Sometimes the hay is still a bit wet but a storm is coming and you want to get it baled and stored before the rain. To be able to counteract some of these environmental conditions, producers will need to depend on different types of preservatives or inoculants to minimize hay losses due to higher moisture content.

Before we start discussing these products, it is important to keep in mind that moisture in hay for storage will depend on bale size. This means that small square bales can be stored at moisture levels between 18 and 20% while large round bales should be stored at 15 to 18% moisture. On the other hand, baleage should be wrapped at moisture levels between 40 and 60% (ideally 50%) to allow for proper fermentation.

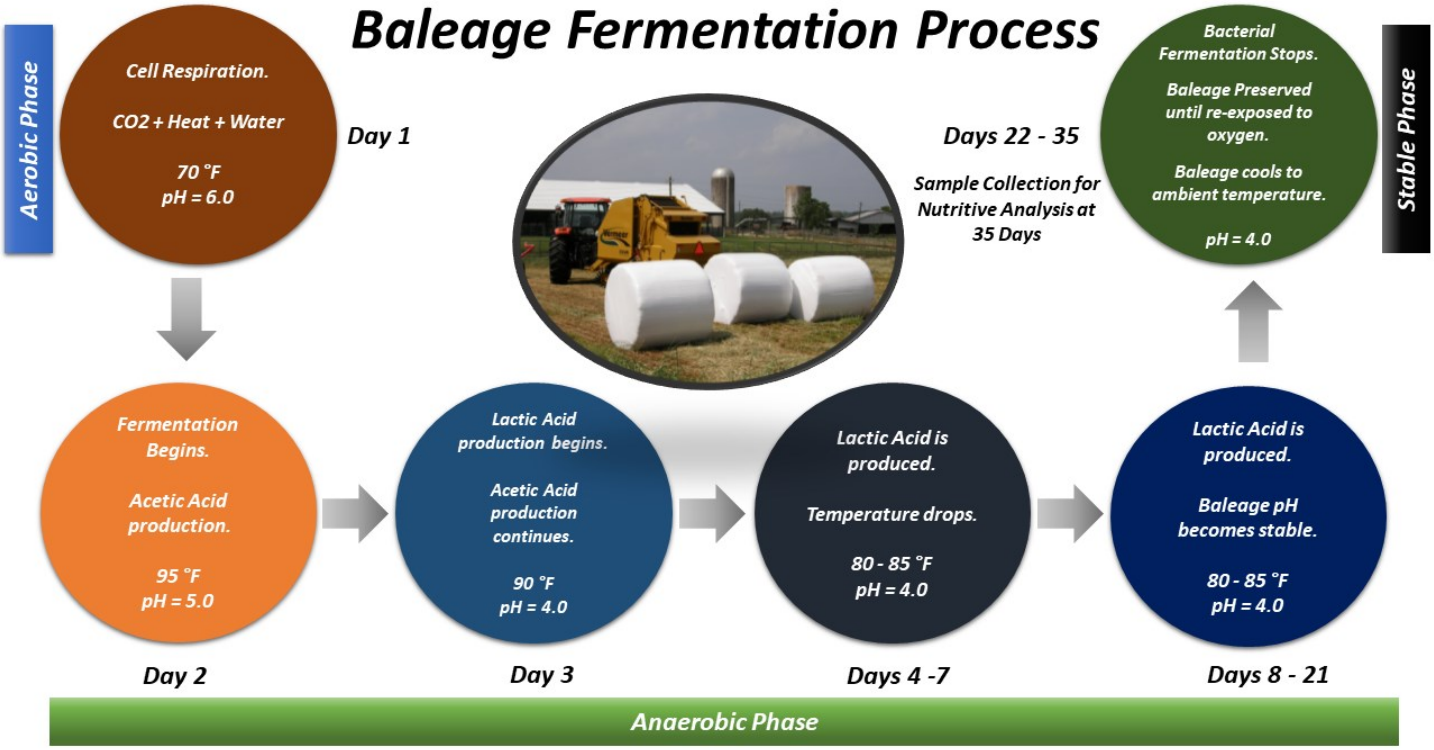
***Inoculants –*** These products are designed to aid in the fast fermentation of baleage, reduce dry matter losses, and improve anaerobic stability. They contain ingredients like bacteria, yeast, and enzymes or a combination of them that reduce the growth of micro-organisms that cause hay to mold and spoil. They cannot be stored for a long time. There are two types of bacterial inoculants, homofermentative and heterofermentative. These inoculants should applied uniformly as the forage is baled (preferably to the windrow) and before any possibility of rain. It is important to understand that hay ensiled with low nutritive value will continue to have low nutritive value after the fermentation process (Junk in, junk out!). Bacterial inoculants respond best in forage crops with high sugar levels and they are not recommended for use in hay that is very mature with low sugar levels. There are two types of inoculants, homofermentative and heterofermentative. The homofermentative types include bacteria such as *Lactobacillus plantarum,* the *Pediococcus* species, and *Enterococcus faecium* and they only produce one product, lactic acid. The heterofermentative types include *Lactobacillus buchneri* and they produce different products including lactic and acetic acids and ethanol. A third type being marketed includes a combination of homofermenters along with *Lactobacillus buchneri*. Lactic acid is a weak spoilage inhibitor while acetic acid is a good spoilage inhibitor. Ethanol is a poor spoilage inhibitor. This means that the choice of inoculant should depend on the targeted goal. If the goal is to preserve nutritive value, then use a homo-fermenter inoculant that increases lactic acid production. If the goal is to reduce bale heating, then use a heterofermenter inoculant that increases acetic acid production.

The enzyme-based preservatives are different than bacterial inoculants since their main purpose is to promote the breakdown of plant cell wall compounds such as cellulose and starch and make these nutrients available to lactic-producing bacteria inoculants during the fermentation process. The common types of enzymes used include cellulase, amylase, and protease. Compared to inoculants, these enzymes can be stored for long periods; however, they are not recommended for use on dry hay. These preservatives will not directly prevent mold. Because these preservatives can break down fibers, their greatest effect can be on mature forage crops with higher fiber and moisture content.

***Hay Preservatives/Additives –*** These products are designed to prevent heating and subsequent dry matter losses of hay baled at moisture levels greater than 18% to reduce heating and inhibit the growth of aerobic microbes. Hay preservatives should not be confused with hay desiccants, which are drying products applied at cutting to increase the forage drying rate. Organic acids such as propionic, lactic, and acetic acids are the most used hay preservatives. Propionic acid could be very caustic and the use of an ammonium propionate, a “buffered, pH balanced, or neutralized” propionic acid, is often recommended. Some buffered mixtures of these products might also be available. A propionic/acetic mixture can help with mold and bacterial growth since propionic acid is highly effective at controlling mold growth and acetic acid is effective against bacterial growth. The rates of application will vary depending on the moisture content of the bale and the bale size. Square bales containing 20 to 25% moisture could be treated with 0.5 to 1.0 % solution of propionic acid while bales containing 25 to 30% may require a 1.0 to 1.5% solution of the acid. Large bales will require higher application rates. Hay preservatives have been shown to have an inconsistent impact at moisture content exceeding 30%. Although the use of propionic acid as well as the buffered version is not harmful to livestock, propionic acid is corrosive and causes damage to equipment and humans if not handled properly. Acid-treated hay still will heat some and be-

come discolored, but most of the nutritive value will remain unchanged. Another approach to determining the actual rate of acid (pounds of product per ton of dry matter) is to obtain the moisture percentage of the hay in the windrow and subtract it from 10. For example, hay baled at 30% moisture requires 20 pounds of acid per ton of dry matter. When choosing a product, keep in mind the cost per pound of acid and the concentration of the active ingredient.

***Hay Drying Agents –*** Drying agents should be applied at the time of cutting the hay. Two commonly used drying agents include potassium carbonate and sodium carbonate. The purpose of drying agents is to modify the waxy layer on the surface of the stems and leaves. Breaking these layers will increase moisture loss and increase the wilting rate during harvest and as a consequence reduce the waiting period for baling. These agents seem to be more effective in legumes than grasses because of morphological differences. The cost per treated ton of hay could range from $5 to $10.




These additives, inoculants, or preservatives do have their place within the hay production systems, but it is important to understand the proper time to consider the use of such products. Hay inoculants and preservatives do not increase the nutritive value of hay, but rather are designed to help maintain the nutritional aspect and reduce spoilage. An effective inoculant helps to drive fermentation in the right direction, preventing undesirable microbes from degrading valuable protein and energy resources from the ensiled forage. Effective application of hay preservatives relies heavily upon using the proper rate (dependent on moisture content and size of bale) and quality of forage. Not all inoculants are created equal, consult with the product manufacturer to determine the storage requirements for the product you choose to apply and the recommended application rates.

## *Upcoming Events*

*For upcoming forage related events visit:* ***http://forages.pss.msstate.edu/events.html***

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