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Group (B, C, E, D, A)

Silage

Contents

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What is silage?

Forage which has been grown while still green and nutritious can be conserved through a natural 'pickling' process. Lactic acid is produced when the sugars in the forage plants are fermented by bacteria in a sealed container ('silo') with no air. Forage conserved this way is known as 'ensiled forage' or 'silage' and will keep for up to three years without deteriorating. Silage is very palatable to livestock and can be fed at any time.

Why silage not hay?

Forages can be made into hay to conserve the nutrients, especially protein, before they decline in the plant. However, it is often too wet to dry the successfully and special machinery, has to be used to assist the forage to dry quickly. Forage crops such as maize, are too thick-stemmed to dry successfully as hay.

Silage is considered the better way to conserve forage crops. A forage crop can be cut early and only has to have 30% dry matter to be ensiled successfully. There is no need to dry out the plant material any more than that, so wet weather is not such a constraint as it is with making hay.

Silage is a fermented feed resulting from the storage of high moisture crops under anaerobic conditions in a structure called as silo. In brief, Silage is a high moisture fodder that farmers use to feed their domestic animals, especially during the dry season. Made up of grass, corn, maize, and others, silages are made by chopping the crops into small pieces and then storing them.

The silage is then fermented to provide feed for livestock. The fermentation process of silage is done in multiple phases and takes around 3 weeks to be completed. The process of fermentation is done to improve dry matter intake and create a more digestible feed.

Six phases of silage fermentation and storage.

Age of Silage	Phase I	Phase II	Phase III	Phase IV	Phase V	Phase VI
	0-2 days	2-3 days	3-4 days	4-21 days	21 days-	
Activity	Cell respiration; production of CO_2, heat and water	Production of acetic acid and lactic acid ethanol	Lactic acid formation	Lactic acid formation	Material storage	Aerobic decomposition on re-exposure to oxygen
Temperature Change	20.6-32.2 ℃	32.2-28.9 ℃	28.9 ℃	28.9 ℃	28.9 ℃	28.9 ℃
pH Change	6.5-6.0	6.0-5.0	5.0-4.0	4.0	4.0	4.0-7.0
Produced		Acetic acid and lactic acid bacteria	Lactic acid bacteria	Lactic acid bacteria		Mold and yeast activity

* Temperature dependent on ambient. Ensiling temperature generally is 15 higher than ambient.
Adapted from McCullough.

The Reason Why

It is cut just before they are fully mature is that all forms of preserved grass, such as hay and silage, will have lower amounts of nutrients than fresh pasture, so everything must be done to make the end of product be as nutritious as possible.

Fermentation process:

i. During Silage preparation, the grass is allowed to wilt in the field for a few hours to reduce the moisture content to around 60-75% as this is the optimum level.
ii. During the fermentation process, the cut grass is chopped into even smaller pieces (0.5 inches) and then compressed to eject the oxygen more efficiently.
iii. This is important because the microorganisms especially, lactic acid bacteria, grow best under anaerobic (oxygen-free) conditions.
iv. Seal the compressed grass with plastic to keep oxygen out.
v. After the fermentation process is done and once all of the oxygen is used up, lactic acid bacteria start to multiply. These are the bacteria that are needed to make the silage. They play a key role in turning the plant sugars into lactic acid causing the pH to drop (mixture becomes more acidic). Once the pH is around 4-5, the sugars stop breaking down and the grass is preserved until the silage is opened and exposed to oxygen.
vi. Lactic acid bacteria and clostridia bacteria grow without oxygen. Plant proteases are enzymes which solubilize plant proteins and browning is a chemical reaction resulting from high

temperatures. Good ensiling creates an oxygen-free environment to stimulate lactic acid bacteria growth and prevent growth of molds and many yeasts.

vii. If the pH isn't low enough, a different kind of bacteria will start fermenting the silage, producing by-products (like ammonia) that taste bad to cows and sheep. Thus, the latter situation needs to be avoided at all costs.

viii. This 1- 4-week period sees growth of lactic acid bacteria and the lowering of pH.

Advantages

1. Silage has more nutrients preserved per acre because there is less field loss.
2. Less affected by weather damage because the forage does not lie in the field drying.
3. The ensiling process has become more mechanized and is therefore less labor intensive than haymaking.

Disadvantages

1. Extensive losses in storage if the silage is mismanaged.
2. Spoilage losses also can be substantial if the silage is not fed out quickly enough.
3. The storage facilities for silage are distinct and not as multi-purposeful as barns so initial investment in equipment can be high.
4. hay is very transportable, silage is full of water, making it heavy and difficult to move from place to place.