Pickled Hay: How to Make Silage

Objective

Students will learn about silage used for feeding livestock and make their own silage from fresh cut grass.

Background

Silage is preserved pasture. It is high-moisture feed for livestock that is made from crops fermented without air and can be stored over winter. It is pasturre grass that has been pickled. Making silage is an important way for farmers to feed cows and sheep during times when pasture isn't good, such as the dry season.

To make silage, the grasses are cut and then fermented to keep as much of the nutrients (such as sugars and proteins) as possible. The fermentation is carried out by microscopic organisms living in the grass.

The process must be carried out under acidic conditions (around pH 4-5) in order to keep nutrients and provide a form of food that cows and sheep will like to eat. Fermentation at higher pH results in silage that has a bad taste, and lower amounts of sugars and proteins.

First, the pasture must be cut when the grasses contain their highest nutrient levels. This is usually just before they are fully mature. This is important because 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 product as nutritious as possible.

After the grass is cut it is left to wilt in the field for a few hours to reduce the moisture content to around 60-75%. This moisture level will allow for optimum fermentation. If the grass is left out longer, it may get too dry, or it may get rained on - and both these will reduce proper fermentation. Also, the longer the grass is left uncut, the higher the loss of nutrients.

The cut grass is chopped into even smaller pieces and then compacted to remove as much oxygen as possible. (This is important because the microorganisms needed to carry out the fermentation like living in oxygen-free environments). If the silage is to be stored in a large pit, tractors and other machinery are usually driven over the grass pile until it is firm. If the silage is stored as bales, the baling machines will compact the grass as they work.

The next step is to seal the compacted grass with plastic to keep oxygen out. Mounds of silage are covered with huge polythene (plastic) sheets and weighted down (usually with old tyres) to ensure maximum compacting; bales are covered with a plastic wrapping.

While oxygen remains, plant enzymes and other bacteria and microorganisms react with the plant sugars and proteins to make energy, reducing the amounts of these nutrients in the grass.

Once all of the oxygen is used up, lactic acid bacteria start to multiply. These are bacteria that are needed to make the silage, and they turn the plant sugars into lactic acid. This causes the pH to drop (the mixture because more acidic). Once the pH is around 4-5, the sugars stop breaking down and the

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grass is preserved until the silage is opened and exposed to oxygen.

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.

Materials

- A large plastic drain pipe, approximately 40-50 cm in length and 15 cm in diameter
- Plastic sheeting and duct tape
- A 14-15 cm disk with a rubber seal so that it that fits snugly into the drain pipe
- Weights
- Lots of freshly cut grass

Procedures

Students will make their own silage, as follows:

1. Seal one end of the drain pipe with the plastic sheeting and duct tape. Make sure that it is well-sealed to keep all air out.
2. Weigh the cut grass and record the weight before placing it in the pipe.
3. Fill the pipe with cut grass, pressing down on the top to push out as much air as possible.
4. Place the disk as a lid on top of the grass and compress the grass more to squeeze out any remaining air. Important: the lid must fit very snugly to keep air out of the pipe.
5. Use weights on top of the disk lid to compact the grass. The lid should drop slightly as the grass ferments.
6. Fermentation could be finished anywhere from 2 weeks to about 45 days.
7. Weigh the fermented grass and compare with the beginning weight.

Note: The optimum moisture content of your fresh grass is 60-70 percent. You can test this by taking a clump of grass and tightly squeezing it into a small ball in your hand, then letting your hand open up. Ideally, no water will come out of the ball when you squeeze, and when you open your hand the ball will slowly fall apart. If water comes out when you are squeezing the grass, the grass is too wet (the moisture content will be over 75 percent) and it must be allowed to dry a bit more. If the ball falls apart immediately when you open your hand, it is too dry and some water should be added. Good fermentation has taken place if the silage smells fresh and fruity, and is yellow-brown or green. Silage is bad if it smells rotten or has any black, slimy parts.

Variations: Students will change variables in their experiment to compare good silage with bad silage. Possible changes may include:

- Grass/pasture type
- Amount of grass in the pipe
- Moisture content (What happens if the grass is too wet? Too dry?)
- Time of fermentation before opening the pipe
- Leaving the pipe top open to the air (This will allow fungal and other bacterial growth, resulting in compost rather than silage).

Source: "Science Learning Hub," University of Waikoto, New Zealand