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Silage Making: An Emerging Enterprise for Dairy Sector

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Abstract
Silage allows the long-term storage of a variety of wet agro-industrial by-products. Excess forages can be conserved as hay or silage. However, ensiling generally produces better quality roughage than hay because less time is required to wilt the feed, when the forage loses nutrients, causing a reduction in feed quality. Hay making requires a longer period of rain-free days, which are often rare in the tropics during the wet season when feed excesses generally occur. The principles of silage making are the same regardless of size of operation, the major difference being in the type of storage used (Mickan 2003). However, the mechanics of silage making (labour, timing, resources) for individual small holders are completely different to those in larger communal farms, where labour and other resources can be shared or amalgamated for efficiencies of size of operation.

Introduction
Silage is the term used for the product formed when any green plant material is put in a place where it can ferment in the absence of air. When green fodders are in plenty they are conserved as silage to meet the demand of good quality fodder during lean season.
Silage is the green succulent roughage preserved more or less in its original condition, with minimum deterioration and minimum loss of nutritive constituents of fodders. The process of conserving green fodder is called as ensilage. Silo is the receptacle in which silage is made. Green, fruity silage is the most palatable and nutritious type with a DM (dry matter) of 25-35%.
During ensiling, fermentation of sugars forms acids and breaks down some of the forage proteins into simpler compounds, including ammonia.

Advantages of Silage Making:

1. Crops can be ensiled when the weather does not permit curing them into hay or dry fodder.
2. Use of silage generally makes it possible to keep more animals on a given land area.
3. Silage furnishes high-quality succulent feed for any season of the year at a low expenses
4. Satisfactory silage can be produced from weed crops that would make poor hay. The ensiling process kills many kinds of weed seeds
5. Crop from a larger area can be stored in less space as silage than as dry fodder.

Disadvantages of Silage Making

1. Silo construction is costly.
2. Loss of nutrients may be very high, if silos are not properly prepared.
3. Due to fermentation, there is 5-20% loss of dry matter.
4. If air enter silo, carotene loss is much.

Crops:
Crops rich in soluble sugars/CHO are most suitable for ensiling. eg. Maize (corn), jowar, bajra. Cultivated and natural grasses can be ensiled with addition of 3-3.5% molasses

Stage of Harvesting:
Crop should be harvested between flowering and milk stage. In general, crops with thick stems are conserved in form of silage while thin stemmed crops are conserved as hay.

Silo:

It is an air-tight structure designed for the storage and preservation of high moisture fodder as silage.

Pit silos are common. Pits are dug 2.4 to 3m depth, with variable sizes. 1 cubic meter of space is required for 400kg fodder. The size of a silo should be calculated based on the number of cows to be fed and the length of the feeding period.

Preparation:

Select crop that is to be ensiled when it has 30-35% dry matter. Crops are harvested and ensiled when ears start coming. It is always better to chop fodder first since packing is better and loss of nutrients is minimized.

Fodder should be evenly distributed throughout the pit. At the top of silo fodder should be packed 3-4 feet above ground level. It should be covered with long paddy straw or poor quality grasses on all sides and then covered with wet mud and dung to seal and prevent entry of air and water. The layer may be about 4-5 inches thick.

0.5% salt, 1% urea are added to cereals and grasses to improve palatability and nitrogen content.

Temperature rises to about 27 to 38 degrees Celsius. Fermentation starts to convert green crops into silage.

Silage would be ready in 2 months.

Fermentation:

Fermentation can occur in two ways: lactic acid fermentation and butyric acid fermentation.

When fodder contains 65% to 75% moisture and enough sugar, anaerobic lactic acid bacteria becomes active, to produce a good clean- smelling silage of high quality (pH 4).

If forage is too rich in proteinaceous substances, butyric acid fermentation will dominate. Butyric acid has a sharp, disagreeable smell and such silage is not relished by animals.

Store the plant material at a moisture content of 65%-75% excluding air to minimize loss of nutrients due to respiration, to initiate growth of lactic acid bacteria rapidly, to prevent mold formation, to prevent development of aerobic organisms.

Color:

When temperature in the silo is moderate, silage tends to be yellowish or brownish green and sometimes even golden in color. This is due to action of organic acids on chlorophyll and its conversion into brown, magnesium free pigment, Phaeophytin. Silage is dark brown or black when temperature in silo the is high.

The four phases of silage making

Once the fresh material has been harvested, chopped, compacted and well sealed, the ensiling process then begins and undergoes four phases.

Phase 1 Aerobic phase

Any oxygen trapped between the forage particles is eliminated as a result of the respiration (‘breathing’) of the plant material and the aerobic (with air) activities of yeasts and bacteria. The plant enzymes are also active during this phase, provided the pH is still within the normal range for fresh material (pH 6.0–6.5). This phase may take a few hours only, provided the forage is well compacted and sealed as soon as possible after harvest.

Practical aspects of the aerobic phase:

- fill the storage site quickly (1–2 days)
- chop the material as short as possible (1–3 cm)
- compact the storage container as well as possible, as fingers should not be able to be inserted into the compacted forage
- seal the storage container air tight
- weight the top of the stack to maintain an airtight seal between the cover and compacted forage
- seal as soon as possible after harvesting is completed.

Phase 2 Fermentation phase

This stage begins once the oxygen is gone and the storage becomes anaerobic. Depending on the properties of the ensiled crop and the ensiling conditions, this phase may last several days to weeks. A successful fermentation will see the number of lactic acid- producing bacteria dominate, reducing the pH to 3.5 to 4.5. The lower pH level may be achieved in unwilted material whereas the higher levels are from wilted forages.

Practical aspects of the fermentation phase:

- mix molasses (at 3–5% on wet basis), a substrate source for the bacteria, to encourage lactic acid fermentation
- If possible, wilt forage to preferably about 30% Dry Matter (DM).

Phase 3 Stable phase

Once the pH level has dropped, and air and water is not permitted to enter the storage site, most microorganisms of phase 2 slowly decrease in numbers, resulting in a silage which is relatively stable. However, some acid tolerant microorganisms survive this period in an almost inactive state, along with others such as Clostridia and bacilli which survive as spores.

How to conduct the stable phase:

- Maintain an airtight seal around the silage
- Repair holes as soon as they are noticed.

Phase 4 Feed out phase or aerobic spoilage phase

This phase begins when holes are made in the storage site by mice, birdsor other agents or it becomes uncovered for feeding out. The aerobic spoilage phase occurs in two stages. Deterioration begins through degradation of the preserving organic acids by yeasts and occasionally acetic acid bacteria. This results in a rise in the pH and then the second stage of spoilage begins. This is associated with increasing temperature in the silage and activity by spoilage microorganisms such as bacilli, moulds and enterobacteria.

The rate of spoilage is highly dependent on the numbers and activity of the spoilage organisms in the silage and may be in the range of 1.5% to 4.5% DM loss/d.

Practical aspects of the aerobic spoilage phase:

- maintain an airtight seal
- feed out to ensure about 20 to 30 cm removal from the entire silage face each day
- if the silage gets hot, feed it out at a faster rate
- if silage heating occurs, consider a smaller stack face next harvest.

Quality:

Very good silage has acidic taste and smell, is free from butyric acid, mold, sliminess, has pH in 3.5-4.2 range, has 1%-2% lactic acid and ammoniacal nitrogen less than 10% of total nitrogen.

Good silage has acidic taste and smell, has traces of butyric acid, has pH in 4.2-4.5 range and has ammoniacal nitrogen about 10-15% of total nitrogen.

Fair silage has ensiled material with some butyric acid, slight proteolysis, some molds, pH 4.8 and above and 20% ammoniacal nitrogen.

Checklist for making good silage:

- Avoid bad weather at the time of harvest
- Assess the quantity of crop to be harvested
- Check the condition of silo.
- Check growth stage of the crop
- Addition of molasses, salt, etc.
- Proper filling of silo
- Covering and sealing of silo

Conclusion:

Conservation of green fodders under anaerobic conditions in the green form is called ensiling and the conserved green fodder is called silage. Making silage by optimally using green fodder during winter is profitable for dairy farmers.

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