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Forage Conservation Methods: Quality Feed for Cattle

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Introduction

India being a tropical monsoon-bound country with unimodal rainy season, surplus green herbage is available at the flush growth periods during *kharif* as well as *rabi* (in irrigated areas). It is desirable that these are preserved /conserved with minimum loss of nutrients. These can be conserved either as hay or silage or artificial dehydration for feeding to livestock during lean periods when the availability of fresh forage is meagre or negligible (mid-October to mid-December and mid-April to June). Ensilage has many advantages over the other methods of forage conservation. There is high-energy output in high-temperature dehydration. Hay making is difficult during monsoon season because of unscheduled rainfall and little availability of sunlight in addition to loss of nutrients due to leaching. Crops can be well conserved as silage, but it requires precautions as lack of understanding of the factors associated with the ensiling technique may produce silage of bad quality, leading to poor animal performance or even wastage of fodder.

Silage

Silage is the material produced by controlled fermentation of crops under anaerobic conditions. This process is known as ensilage and the container used for the purpose is known as silo. The fermentation process is governed by microorganisms present in fresh herbage or by additives to maintain anaerobic condition. When herbage is placed in an airtight container, naturally occurring bacteria ferment the carbohydrates (sugar) present in the herbage to produce mainly the lactic acid. The aim is to achieve a sufficient concentration of lactic acid to prevent other type of bacterial activity, *i.e.,* clostridia activity. The main requirements are the exclusion of air to maintain anaerobic conditions and to discourage clostridial fermentation which leads to production of carbon dioxide, ammonia, amines, butyric acid, etc.

Methods of controlling fermentation:

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There are several ways in which the clostridial type fermentation can be checked. One of the commonly used practices is to increase the dry matter of the herbage. In ensiled crops containing 30% or more dry matter, crop ensile satisfactorily. The promotion of lactic acid fermentation is important pathway for controlling clostridial growth. Another method of controlling fermentation is by addition of preservatives and additives. Carbohydrates in the forages may be naturally occurring or may be added as a separate ingredient such as molasses obtained as sugar industry by-products, which acts as a fermentable substrate.

Additives for effective ensiling of nutrients:

Various types of additives can be used to improve or inhibit the fermentation or supplement nutrients needed by ruminants to be fed as silage. Propionic acid, formaldehyde, etc. have been used to increase the rate of lactic acid fermentation and produce stable silage. Carbohydrate sources such as molasses, whey, yeast and other energy-rich ingredients have also been used as additives to increase the fermentation and feeding value of silage. Urea @ 0.5-1.0% have been found to increase crude protein content and also the lactic acid content of silage made from cereal fodders.

Microbial activity:

As anaerobic conditions are achieved in silo, the species of *Escherichia, Bacillus, Clostridium, Leuconostoc, Lactobacillus* and *Pediococcus*
develop. Lactic acid bacteria (*Streptococcus, Leuconostoc, Lactobacillus* and *Pediococcus*) are the important organisms for the preservation of silage of good quality.

Silos:

The different types of silos generally used are: (i) pit silo, (ii) tower silo, (iii) trench cum bunker, (iv) trenches, and (v) drum and PVC silo. The silo must provide a solid surface to permit consolidation of the ensiled material and elimination of air. It must protect the silage from water. In India, pit silo is the most common.

Techniques of Silage Making:

- **Dry matter:** Dry matter should be above 30%. Crops of high moisture should be ensiled with the addition of preservatives and additives. In poor weather, wilting should be avoided, and additive should be used for good fermentation.

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- **Stage of growth:** Crops should be cut at a proper stage of maturity as it is the most important factor for controlling the silage quality. The appropriate stage of growth for cutting different fodder crops for silage making is given below:
    - Sorghum - Flowering to dough stage
    - Maize - Milk to dough stage
    - Oat - 50% flowering to dough stage
    - Grasses - Early flowering stage
- **Chopping:** Crop should be chopped before ensiling. For good silage, the shorter the chop length, the better is the quality. Chopped silage is more palatable to livestock and has little chance of secondary fermentation.
- **Filling of silo:** Silo should be filled rapidly and should not be left open. It should be sealed as soon as possible. Packing is important to create anaerobic conditions. It should be thoroughly pressed so that no air pocket is left in the silo, otherwise chances of mould formation will be there which will spoil the silage. After filling, silo should be covered with polythene sheet followed by that of a layer of soil, etc.
- **Removal of silage:** After 45 days of ensilage, the silage can be removed for feeding to animals. Care should be taken in removing the silage from silo. It should not be allowed to deteriorate after the silo is opened for feeding. Covers should be kept firmly in place as long as possible, and the minimum face should be exposed at one time. The sugars, proteins and lactic acid present in the silage are subject to attack by mould growth and oxidation as some air is allowed to fermentation and causes loss of feeding value and intake by the animals.
- **Silage quality:** Silage quality is determined mainly by the odour, physical
- state, pH, ammonical nitrogen, volatile acids and lactic acid. For desirable fermentation, the forage should be rich in water soluble sugar (more than 5% on dry-matter basis). A good-quality silage should have the following characteristics: (i) pH 4.5-5.0, (ii) ammonical nitrogen of total N – less than 10% of total N, (iii) butyric acid- less than 0.2%, (iv) lactic acid -3 to 12%, and (v) volatile acids, alcohol should below.

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Fig. No. 1. Polybag Silage Production

Fig. No. 2. Silage Making Procedure

Hay making

Conservation of high-quality forages by drying is termed as hay making. The principle of hay making is to preserve nutritional value of forages through drying it to a level at which the activity of microbial decomposers is inhibited. In India, sunlight is available in abundance, which enables farmers to dry the green forage in open sunlight and thus making hay more economical. The hay making leads to reduction of moisture content to 10-20%, which inhibits the enzyme activity in the plant to be conserved. Thin stemmed cereal crops like sorghum, oat, guinea grass, range grasses, ange legumes particularly *Sylosanthes, Siratro,* lablab bean, and all the cultivated legume fodders like berseem, lucerne, and cowpea are suitable for hay making. Leguminous forages have high buffering action and high nitrogen content, and hence are more suitable to be conveniently conserved as hay. Hay making is relatively more convenient and easier for Indian farmers. It can be done by sun drying. During inclement weather, hay making may be done by drying under shade or artificial drying through solar energy. Harvested forage particularly thick stemmed should be chopped and spread over the ground for sun curing and the layers should be changed every day to prevent any sort of fermentation or bacterial growth. After it is well dried (dry-matter content at the time of storing should be around 85-90%), this can be stored for feeding during the lean periods. Thin stemmed crops including legumes can be dried without chopping while thick stemmed fodders like sorghum, maize and *bajra* (pearl millet) require chopping or crushing before they are allowed to dry.

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Factors affecting the quality of hay:

The following factors affecting the quality of hay are important and should be given due consideration: (i) plant species, (ii) stage of harvest, (iii) leaf: stem ratio, (iv) chemical composition, (v) physical form, and (vi) deterioration during storage.

Bailing and densification:

The transport of dry grass occupies voluminous space and takes lot of time to transport resulting into higher costs. Bailing and densification of dry grass helps in reducing the volume and could be transported economically and efficiently. By using these techniques, the hay could be transported from excess producing areas to deficit areas especially during the calamities of drought. Wheat straw (*bhusa)* could be added with 20% molasses and then densified, and bales can be prepared to increase the digestibility of feed intake. Densified block of wheat straw, molasses and urea could be developed through high density bailing machine. The average density of wheat straw and stubble block obtained thus would be 398 kg/m3 and 355.0 kg/m3, respectively. Moisture level of admixture was maintained at 20% for densification. The optimum ratio of physical composition of straw block is 78:20:2 (wheat straw: molasses: urea).

Production of complete feed blocks

Complete feed blocks could also be prepared by densifying machine. Nutritive value of forage is enhanced through mixing with molasses and blending with leguminous fodder, concentrate mixture, minerals and vitamin additives. The composition of complete feed blocks included wheat straw (40%), molasses (20%) dry leaves of berseem (20%), concentrate mixture (19%) and mineral mixture and vitamin additives (1%).

Preservation in the form of leaf meal

Preparation of leaf meal out of top feeds and leguminous forages as an animal feed stuff because of high concentration of protein of high biological value and other nutrients such as carotene and minerals. There exists a big deficit of concentrate in the country to the tune of 60% and this deficit can be partially bridged by replacing the concentrate feeds by leaf meals. Leaf meal production technology is simple as well as profitable enterprise for the farmers. Crude protein content (% DM basis) in leaf meals of important forage crops are as follows – *Leucaena leucocephala* (18-21%), *Sesbania sesban* (18%), lucerne (20-21%), *Stylosanthes* sp. (12-18%), *Ziziphus nummularia* (13-16%). The leaf meal of leguminous forages are also

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known to have rich content of essential amino acids such as lysine, leucine, isoleucine, threonine, methionine, cysteine, valine, histidine, and arginine.

A lot of scope exists in establishing a production, processing, and marketing chain for its popularization in different parts of the country. One lucerne leaf meal production plant started in 1977 at Udmalpet near Coimbatore produces more than 15 tonnes of leaf meal per month. The set-up consists of a chaff cutter feeding sun dried lucerne to a powdering mill for grinding and collection of sieved leaf meal. Farmers around Palladam (Tamil Nadu) have organized through a co-operative to grow and supply lucerne to the leaf meal plant. The arrangement assures regular cash income for small holder farmers through a well-developed production, processing and marketing chain. Furthermore, utilization of such meals has grain-saving effects.

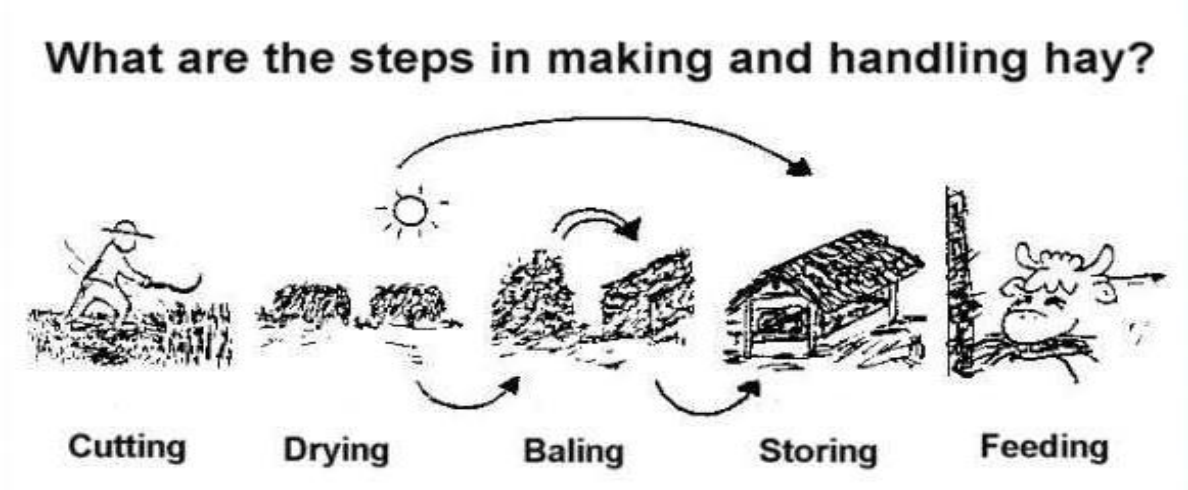

Fig. No. 3. Steps in Making & Handling of Hay