

the frequently reported brownish fumes in and near silos. High amounts of NO can be expected when nitrate-rich, rapidly fermenting material is ensiled. Upon inhalation, NO_x gases are oxidized in the lung to mixture of nitrous and nitric acids. These strongly oxidizing acids damage lung tissue and can cause chemical pneumonia. In addition, reactions with haemoglobin (nitrosylhaemoglobin and methaemoglobin) occur, causing impaired oxygen transfer. Animals are also affected.

Hay Making

The forage crop is cut before it is fully ripe and dried for storage as hay. Hay is more nutritious and palatable than straw. It is leafy, pliable, green and free from mould, and has a pleasant characteristic smell and aroma. The hay should not have more than 12-14% of moisture so that it can be safely stored without risk of fermentation and combustion.

Hay is the product obtained by cutting and curing the entire herbage of fine stemmed grasses or legumes so that the moisture content of the product is not more than 12-14%.

Crops Suitable for Hay Making

All thin-stemmed grasses and legumes can be conveniently and quickly dried unlike thick-stemmed fodders, which take more time for drying. e.g. grasses (Cyanodon, Cenchrus, Marvel, etc.), M.P. chari (*Sorghum bicolor*), oats, legumes (Stylosanthes, siratro, sunhemp, cowpea, berseem, lucerne, horse gram, pillipesara). In case of spear grass, the sharp pointed 'spears' or awns on the inflorescences make the hay unpalatable. Thin napier grass, sudan grass and Johnson grass can make fairly good quality hay only if they are cut at early flowering stage, before the heads set seed.

However, if the thick-stemmed fodders are required to be dried quickly they should necessarily be chopped into small pieces or crushed by passing the material in between rollers.

Stage of Harvesting the Crop for Hay Making

The nutritive value of the fodder goes down as the plant matures. At a very early stage the protein and energy contents of the fodder are very high but the dry matter yield of the fodder per unit area is very low. At the later stage when the crop is in full bloom the protein value goes down and the digestibility of nutrients is also reduced. The best time for cutting a crop for hay

making is when it is $\frac{1}{3}$ to $\frac{1}{2}$ in blossom; in case of cereals the grain is in the milk stage while in legumes tender pod formation stage is optimum.

Kinds of Hay

1. Legume hay

Good legume hay has many characteristics that make it of special value in feeding of animals. It has got a higher percentage of digestible nutrients. It has got more of digestible protein because of the high protein content. Furthermore, the protein of legumes is of superior quality as compared to that from other plants. Well cured legume hays are higher in vitamin content. They are particularly rich in carotene and may contain vitamin D. They are also rich source of vitamin E. The legume hays are particularly rich in calcium and are generally palatable.

2. Non-legume hay

Non-legume hays are made from grasses and cereals. They are, as a rule, less palatable and contain less protein, minerals and vitamins than the legume hays but rich in carbohydrates. Non-legume hays have the advantage over legume hays because their outturn per hectare is more than that of legume hays and the former can be grown easily. Hays made from crops like oats, barley, etc., compare very favourably with the other grass hays.

3. Mixed hay

Hay prepared from mixed crops of legumes and non-legumes is known as mixed hay. The chemical composition of such a kind of hay will depend on the proportion of the different species grown as a mixed crop. Such a crop is generally cut earlier because of the variation in the seeding time of the mixed crops. If harvested early, the cereals are generally richer in proteins.

Different Methods of Hay Making

There are three methods of hay making. They are field curing, barn drying, and artificial drying.

1. Field curing

As the name indicates, cut plants are cured in the field itself to make hay. The various steps in this process are:

- i. **Cutting the crop:** Any type of power or hand cutting may be used. It is highly desirable to cut in the same direction. The crop is left there itself in the swath to dry partially.

- ii. **Swath curing:** Hay is dried much more rapidly in the swath than in the windrow. Therefore, maximum advantage of swath curing may be taken to speed up the operations. But after a certain degree of curing there will be shattering and bleaching of leaves reducing the nutritive value of hay considerably. The forage should be left to cure in the swath until it is wilted sufficiently but before there is danger of shattering and loss of carotene due to bleaching action of sun. No definite time can be assigned to swath curing but at this time the moisture is roughly 40%.
- iii. **Raking:** After wilting forage to about 40% moisture in the swath, it is rolled into small loose fluffy cylindrical bundles known as windrow. It is better to do raking in the morning as dew makes the hay a little more tough and prevent shattering.
- iv. **Cocking:** This is the process of making bigger heaps after hay has been cured partially in windrows. Cocks are even protected with hay caps where rain is expected. If there is labour shortage this step may be discarded. Under such circumstances, hay is completely cured in the windrow. However, cocking is advisable as it will give better hay with more carotene content.
- v. **Baling and storing:** Pick-up baling directly from windrow is the most automated system where the baler attached to tractor picks up hay in the form of windrows and bale it. Where such machines are not available hay may be stored as loose bundles in hay stacks.

2. Mow curing (barn drying)

This refers to the practice of curing partially dried hay inside the barns in mows. Heated or unheated air is blown on to the mows until the moisture is reduced to 20-25%. Swath curing is completed in the field itself and when the moisture is 35-40%, it is taken into the barns and placed on the mows. It takes 7-14 days on the mows with unheated air to cure the hay fully. With heated air it takes less time. Generally, the hay produced in this manner will be greener and leafier and of a higher quality than field cured hay.

3. Dehydration or artificial drying

This is the process of chopping freshly cut or wilted fodder and drying it in artificial driers. This is limited to large commercial operations where alfalfa meal or alfalfa leaf meal for use chiefly as a vitamin supplement for poultry and swine are produced. Such hay is consistently of superior quality.