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Silage Making in Polythene Bags

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Abstract

India is the world's leading producer of milk. The increase was more than 12 times since independence. However, productivity is a matter of concern. The production technologies of feed and fodder need to be more versatile for sustainable milk and meat production. Nevertheless, seasonal variations in supply and demand of fodder often affect the milk production which needs to be addressed. Use of preserved feed like silage is extremely limited in India compared to rest of the world. Often the cost of infrastructure associated with forage preservation is intimidating the farming community, besides, the knowhow on ensiling. This article discusses the aspects on suitability of crops, methodologies and advances in silage making.

1. Introduction

India has vast livestock population of 525.78 million according to 20th livestock census (<https://dahd.nic.in>) and produces milk to the tune of 210 MT which accounts for 24% of world's milk production (Anonymous, 2021). The statistics indicate a promising trend in milk and meat production over the years; on the contrary, the productivity is always lagging behind. The feed and fodder constitute a major input in livestock production that controls the animal productivity. It is a fact that only 4.5% of gross agricultural land is under forages as against 14% recommended in India. Further, it is estimated that there is deficit of 11.24% green fodder besides deficiencies of dry fodder and concentrates. Round the year non-availability of green fodder is inevitably one of the strongest reasons for low productivity of our livestock. Crop residues, grazing in CPRs (common property resources), stover and little concentrates constitute their diet. The grazing in CPRs fetch sufficient forage during monsoon and early winters but later is not rewarding owing to drying up of greenery with onset of spring. The paucity of green fodder reaches its peak in summer months and often causes uproar in assemblies and state governing bodies. On the contrary, raising a crop during summer is associated with assured irrigation that is seldom guaranteed in rainfed agriculture which is predominant in India. Furthermore, under assured irrigation, cash crops and commercial crops are preferred over the fodder crops for quick cash

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incentives. Conserved and preserved fodders alone can suffice the situation. However, it is a fact that we are a novice in this regard.

2. Technologies to Overcome Fodder Deficiency through Fodder Conservation

India has to yet master the technology of fodder conservation. This reminds us of the age old proverb of 'Make hay while Sun shines' analogous to preserving the green fodder for harder fodder deficit times. The most important methods available for preserving the seasonal excess of green fodder are hay and silage making. Each method has its own advantages and limitations

2.1. Hay

Hay making is the process of turning green, perishable forage into a product by drying the forage in the sun so that it can be safely stored and easily transported without danger of spoilage, while keeping nutrient loss to a minimum. This chiefly involves reduction of moisture content. Hay making is the most common and easy method of preserving seasonal excess of green fodder and the only method of preserving farm by-products in country. Hay is a stored forage that is essentially characterized by having low moisture content (less than 15 %). All the forage crops can be made into hay.

2.2. Silage

Silage may be defined as the green succulent roughage preserved under controlled anaerobic fermentation in the absence of oxygen by compacting green chops of fodder in air and water tight entities through process commonly called ensiling. However, in terms of nutritional value silage dominates haylage.

In the ensiling process, the absence of oxygen leads to the fermentation of water soluble carbohydrates to produce organic acids which increase acidity of the material (pH about 4.0). Such anaerobic acid production (mainly lactic acid) arrests the growth of bacteria and moulds as well as inactivates putrefying organisms, i.e. acts as a preservative. Consequently, the process reduces nutrient losses and changes the nutritive value. It serves as one of the best method of fodder conservation. Unlike hay making, which has seasonal constraints and heavy nutrient losses, silage on the other hand is superior and has better acceptability, digestibility and nutritive value (Driehuis, 2013).

2.2.1. Advantages of silage preparation

1. Silage once prepared can be used for a year especially during off season
2. Overcome the need of taking a fodder crop in summer and lean periods wherein the resources are also limited to raise a crop
3. More nutritious and palatable than hay due to use of additives viz., leguminous grass, salt and jaggery or molasses.
4. When high yielding crops are ensiled, the crop utilization is extended beyond the crop growth period.
5. Unlike other food crops, a silage crop is harvested early, thus, field is vacated early for the next crop. In this way 2-3 crops can be grown in an year.
8. Silage can be made at any time regardless of the season, but rains interrupt haymaking.

2.2.2. Crops suitable for ensiling

Silage can be made from all types of forage crops e.g. , sorghum, maize, pearl millet, bajra napier hybrids and also perennial grasses (para grass, guinea grass, rye grass etc.). However, silage making should be done at the right stage of crop which varies with each crop.

Sorghum: Higher silage yields and better quality can be obtained if sorghum is harvested and ensiled at early dough stage. Making silage from crop prior to flowering stage poses a threat of cyanide.

Maize: Maize, unlike sorghum, does not pose any threat of anti-nutritional factors, hence can be cut and made into silage at any stage of crop. However, highest tonnage could only be achieved when harvested at milky stage to dough stage.

Bajra: It is always ideal to ensile the bajra crop at the early dough stage. When making silage with perennial grass varieties, the first cut can be used as green fodder and the second cut can be used as silage.

Perennial grasses : Bajra napier, guinea grass, para grass, rhodes grass, anjan grass, rye etc. can also be made into silage. Harvesting perennial grasses just at the sight of panicle initiation assures good quality non-fibrous silage.

Pulses: Pulse crops are high in moisture. Owing to their high protein content, they are not suitable crops for silage preparation in tropical conditions, as high protein putrefies the silage. However, during preparation of silage from grass and cereal fodders, addition of 5% of leguminous fodders always increases the protein content

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of silage.

2.2.3. Silage making/Ensiling

There are several methods and techniques in making silage. Earlier, making silage required huge investment in infrastructure viz., masonry, brick silos or towers. However, in present conditions there are many simple and economic alternate technologies which do not require much investment. The most versatile, flexible and economical way of silage making is in polythene bags of more than 100 micron thickness. These are available in different sizes starting from 50 kg capacity up to 500 kg and even more. Farmers can customize their own sizes based on their requirements.

2.2.4. The process of ensiling in a polythene bag

- The select crop has to be harvested at right stage. Care has to be taken to cut at 4 inches height from ground to avoid contact with soil which otherwise spoils the silage.
- Chopping of fodder crop (1 to 2 inches pieces) has to be done with help of a chaff cutter, immediately after harvest to minimize the losses.
- Ideal moisture content for initiating ensiling process is 65%. For this we need to conduct a test called 'Grab Test' as described by FAO (Figure 1). Take a handful of chopped fodder. Squeeze it into a ball for 20 to 30 seconds



Figure 1: Grab test to check the right moisture content for ensiling

and then release. If palm feels a bit moist afterwards and the ball slowly falls apart, then the fodder is ready for silage. If the moisture content in the ball drips in form of droplets from fist, it indicates that moisture is high and it needs to be further dried before ensiling.

- Now the bottom of the bag should be first covered with dried paddy straw so as to absorb any excess moisture of silage.
 - The cut fodder could be mixed evenly with salt and molasses/jaggery at rate of 0.5 and 1%, respectively. Salt content improves the palatability and nutritive value of silage, while molasses hastens fermentation by increasing the sugars. If not, silage can be made with or without adding salt or jaggery (Venkataramanan et al., 2010).
 - Legume can also be added @ 5% to improve protein content of silage
 - The well mixed chopped pieces of fodder must now be evenly filled into the bag pressing at every step to exclude air
 - The 50 to 100 kg capacity silage bags can be easily filled. However, care should be taken in excluding all the air while filling up the bag.
 - Compression is most important step in ensiling. This can be done by stamping with clean feet or pressing with an iron mallet. Airtight conditions assure better quality silage as ensiling requires anaerobic conditions
 - The top of the bag must be covered with little paddy straw again and later sealed by tightly closing the bag to prevent entry of air and water.
 - After closing the silage bag, move it to a high, clean and dry place in the field.
 - Once the bag is sealed perfectly the temperatures inside rise slowly 34 to 38 °C. Fermentation starts to convert green crops into silage.
 - After closing the silage bag, it takes at least 45 to 60 days to make the silage.
- ### 2.2.5. What happens during ensiling
- Immediately after packing off bag, the temperature starts increasing due to respiration process inside the bag.
 - Once all the oxygen present is exhausted, anaerobic conditions prevail and this encourages the lactic acid bacteria to dominate as they thrive under anaerobic conditions.
 - Lactic acid bacteria produce lactic acid which reduces the pH of silage to 4.00 or less, thus maintaining the

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quality of silage.

- Mould growth is prevented at such low pH conditions
- When protein content of fodder is high rather than lactic acid fermentation, butyric acid fermentation dominates resulting in silage with a sharp, disagreeable smell which is not relished by animals.
- Once silage is ready, sweet sour smell can be felt from a distance which is due to lactic acid and ethanol produced during fermentation.

2.2.6. Advantages of silage preparation in polythene bags

- Polyethylene silage bags are an excellent economic alternative to traditional silage storage methods such as pits and tower silos which needs high investment in terms of infrastructure.
- These bags can be stored at any location on farm.
- When silage is made in a bag, all the lactic acid produced during fermentation to remain in the bag itself, while in case of silage made in pit, it reaches the bottom of the pit and is wasted.
- Making silage in bags makes silage handling very easy unlike traditional methods. The bag can be easily carried to the shed without use of additional manpower.
- Each silage bag can be fully utilized due to the ideal volume of the silage bag.

2.2.7. Precautions to be taken in making silage in polythene bags

- Care should be taken to avoid contamination with soil and dirt while making silage.
- Harvesting the crop at the right stage and filling the bag with chaffed green fodder at 65% moisture and filling bag under airtight conditions are the keys to good silage making.
- Silage packing should done quickly and uniformly.

2.2.8. Handling of silage bags

- Bags may be damaged by dogs, cats, birds, rats and other animals. Therefore, the bags should be checked daily and holes should be closed if possible. If the damage is high, the silage should be repacked in a good bag as soon as possible.
- It is best to write the number and date on the silage bag for easy identification of the material placed in it.
- The silage prepared as above can be used up to 6 months without spoilage due to any fungi and could be extended even up to 1 year.

- While using, silage bag once opened, must be used on same day.
- After emptying, the bags should be washed carefully, dried and stored in dry place and can be reused number of times

2.3. Characteristics of well-made silage

- A sweet and sour smell of silage is an indication that the fermentation process has gone well.
- The pH of good silage is below 4.0.
- Color of silage can be from dark leafy green to light brown or golden brown. The color of silage depends on the fodder used to make it and the temperature generated inside. Dark or black color indicates spoilage.
- No mold should be found in silage.
- Well-made silage is soft, non-fibrous and not too wet
- Silage with above qualities do not spoil up to one year and is also relished by cattle



Figure 2: Chopping of green fodder to 1-2 inch pieces with chaff cutter

2.4. Feeding silage to livestock

Well made silage can be fed up to 15 kg per adult cattle unit (ACU). Sheep and goat can be fed up to 1.0 to 1.5 kg per well grown adult. The sweet sour odour due to fermentation makes it more palatable while acidic nature of silage helps in good digestion.

2.5. Silage bags availability

There are several private firms who are manufacturing these silage bags. These are available in different capacities from 50 kg, 100 kg and 500kg and above. Farmers can also buy conventional thick polythene bags of >100 micron thickness and customize them according to their needs. The thicker the bag longer is the life and so is the quality of silage.

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Figure 3: Drying chopped fodder to ideal moisture content



Figure 6: Labeling silage bag for convenience



Figure 4: Filling up the silage bag with simultaneous compression



Figure 7: Variety of silage bags



Figure 8: Opened silage bag

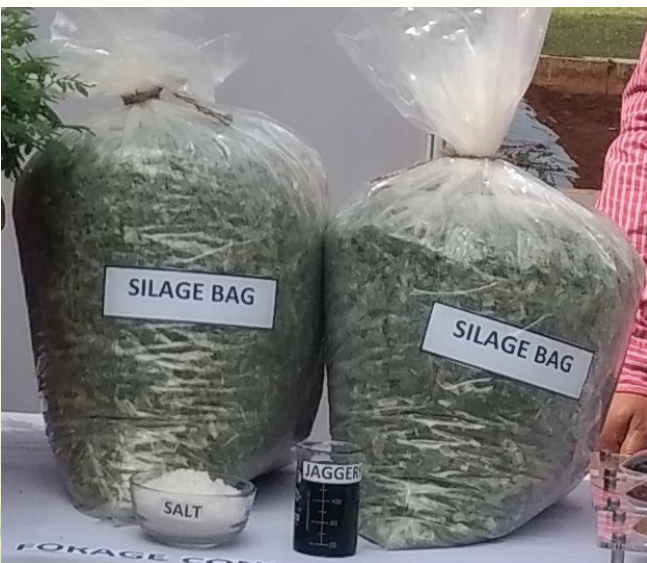


Figure 5: Closed silage bags



Figure 9: Cattle feeding on silage

3. Conclusion

Silage making in polythene bags is an ideal alternative to ensiling in silos and trenches which come with added expenditure on the farmers. It is essentially useful for the small and marginal livestock farmers as this ensures conservation of resources viz., land, water and infrastructure.

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