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Popular Article

SILAGE: A Fermented Feed

Manju Bissu and Priyanka Bissu
RAJUVAS, Bikaner
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Abstract

Silage is a fermented feed in a silo pit and used fed to animal throughout the year. There are 4 phases (aerobic, anaerobic, stable, and feed-out) for silage. The most critical phases to manage to minimize nutritive losses are when the silage is going from an aerobic to an anaerobic environment and at feed-out. The first important step in achieving silage of high nutritive value is to harvest at the proper maturity and moisture level. Alfalfa should be harvested between mid-bud and one-tenth bloom, and corn should be harvested between one-half and two-thirds milk-line. The type of silo is (pile, bunker, bag, or upright) used for silage production. The objective of this article is how to make silage and maintain its nutritive value.

Keywords- Anaerobic, corn, dry matter, feed-out, silage, silo

Introduction

Silage is the end product of fermenting low dry matter forages (typically grass, alfalfa, and corn) in an anaerobic environment. Corn silage is the most energy dense forage source used in dairy cow diets in tropical environments (Bernardes and Rêgo, 2014; De Oliveira et al., 2017). It is usually stored in a silo of various designs (upright, bunker, bag, or pile), and fed to animals throughout the year. Silage making is an old agricultural practice that started more than 3,000 yr ago (Wilkinson et al., 2003). Production of high-quality silage is dependent on both controllable and uncontrollable factors. Silage management factors that are under the control of the farmer are forage species and agricultural background, stage of maturity or moisture concentration at harvest, harvesting and ensiling methods, type of storage structure, use of silage additives, feed-out methods, feed bunk management, and diet formulation (Mahanna and Chase, 2003). Uncontrollable factors are climate-related that are specific to a region can adversely affect silage production and utilization. Sorghum is an annual crop that is well adapted to environments with limited rainfall and high temperatures (Mann et al., 1983), but sorghum silage typically has a lower nutritive value than corn silage (Pino and Heinrichs, 2017).

Silage Fermentation Phases

There are 4 phases for silage production-

- **Aerobic phase** happens at the beginning of fermentation when the pH is high. During this phase, oxygen is consumed by the microbes that are present in the forage.
- **Fermentation phase** in this phase microbial population increases. The microbes consume the soluble sugars present in the forage and produce acid. The majority of the soluble sugars eventually get consumed by the microbes, and the acid concentration in the forage gets to a level that inhibits proliferation of microbes and the bacteria die.
- **Stable phase** it has minimal biological activity. The forage will remain in the stable phase until there is exposure to oxygen.
- **Feed-out phase-** The silo is opened and oxygen infiltrates through the face of the silo. This allows for growth of microorganisms that thrive in an aerobic environment (yeast, molds, acetic acid bacteria, and bacilli). These organisms are known to decrease the nutritive value of silage. The main goal when making silage is to get from the aerobic phase to the stable phase as quickly and efficiently as possible, and minimize aerobic exposure at feed-out. Therefore, many of the important silage management factors focus on reducing the time between the aerobic and stable phase, and limiting oxygen exposure at feed-out.

Factors Affecting Silage Fermentation

Time of harvesting the crop

Many factors affect the quality of forage at harvest. However, the two factors that are commonly used to determine when to harvest forages for silage are stage of maturity and DM content. The DM content of forages tends to increase as maturity advances. The quality of grass, alfalfa, and corn all tend to decline rapidly after a certain maturity level is obtained. To maximize quality, it is recommended that alfalfa be harvested at mid bud to 1/10 bloom and wilted to a DM of 30 to 35%.

Silo Type used

There are four silo types that are commonly used bunker, pile, bags, and upright silos. Higher losses of silage DM usually occur in a pile or bunker silo compared to bags and upright silos. The increase in DM loss is associated with the increased amount of surface area that has the potential to be exposed to oxygen

Silo Filling and Covering

It is an accepted fact that rapid filling of the silo at harvest time maximizes silage quality. Limiting the amount of time that the cut forage is exposed to oxygen lowers levels of

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bound protein, creates smaller increases in fiber (ADF), lowers final pH, and improves feed bunk life. Ruppel (1993) demonstrated that reducing the number of days to fill the silo from 11.3 to 5 reduced ADIN (acid detergent insoluble nitrogen also referred to as 'bound protein') by 5.28 percentage units. In a bunker silo, filling method has an effect on forage quality. Ruppel (1993) demonstrated that carbohydrate digestibility was greater when a progressive wedge method of filling was used versus full height before adding to length and full length before increasing height methods were used. Several chemical additives can reduce aerobic spoilage; some of the most effective include potassium sorbate and sodium benzoate. A study evaluated 2 potassium sorbate and sodium benzoate application rates in improving the aerobic stability of corn silage (Bernardes et al., 2015). Both additives applied at 2 g/kg effectively reduced silage spoilage compared with untreated corn silage. Because the high cost of the chemical additive can limit its application to the entire silage mass, it may be applied only to the surface of the silage, where the risk of deterioration is greatest (Da Silva et al., 2014). A plastic film to cover silage has to ful-fill 3 essential functions. The film should prevent precipitation and damage caused by rain, hail, or birds. It should be UV resistant to remain intact after prolonged exposure to sunlight. Finally, it must ensure anaerobic conditions during ensiling (Bernardes, 2016). Thus, using high-quality plastic film and ensuring close contact of the film with the silage surface are essential for the production of high-quality tropical silages (Lima et al., 2017).

Silo Feed-out

There is a great opportunity for silage quality to deteriorate during feed-out from a silo because the silage face is exposed to oxygen for long periods of time. In the presence of oxygen, yeast and mold spores that had remained dormant in the anaerobic environment can become active. Yeast and molds that are growing in the silage are the primary cause of ensiling losses at feed-out. Losses during unloading depend on the density of the silage, the ambient temperature, the aerobic stability of the silage, and feed-out rate, which determines the duration that the silage is exposed to air (Muck et al., 2003).

Four key steps to reducing DM losses and quality of silage at feed-out include:

1) Capitalize on proper harvesting and storage techniques.
2) Feed approximately 5 inches of silage per day from the silo face.
3) Do not leave loose silage on the floor of the silo.
4) Scrape silage face downward.

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Advantages Of Silage

- No need of ideal weather conditions for ensiling forage as is required for hay and grain production.
- The annual crops (corn, sorghum small grains), there is a higher yield of nutrients per acre than grain.
- Flexibility in harvest dates.

Disadvantage Of Silage

- Silage has a higher moisture content and lower nutrient density than many other feeds
- Need more sophisticated storage systems to ensure an anaerobic environment
- The moisture content and nutrient density limit feasibility of transport (produced and stored close to home)
- High initial investment in facilities and equipment.

Final Remarks

Silage is the end product of fermenting low dry matter forages (typically grass, alfalfa, and corn) in an anaerobic environment that is used through-out the year. Silage processing is easy and no need of ideal weather condition for ensiling forage. For good silage anaerobic condition should be maintained, otherwise yeast and mold are spoil the silage in aerobic condition. Low acidic PH of silage is preferable.

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