Forage News
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Utilizing Baleage as an Alternative Way to Maintaining Forage Quality

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Grazing fresh forage year round at the optimal stage of maturity would supply the highest quality and most palatable form of feed in any livestock operation. Because of fluctuations in seasonal growth and plant maturity, biomass production of annual ryegrass and other cool-season forages in the spring is very rapid, making it necessary to harvest and store forages to maximize both quality and productivity. However, producing hay in the spring is a difficult task because of the high moisture content in the forages and cooler temperatures that extend the drying time. Forage producers are increasingly turning to baled silage as it provides advantages including high quality, flexibility in handling and feeding systems, limited capital expenditures and low losses during production and storage.

Table 1. Advantages and disadvantages of baleage production.

Advantages	Disadvantages
Decreased curing time from cutting to bailing.	Increased harvest cost per bale versus conventional cured hay.
Less rain-free weather is needed, giving a greater ability to harvest the forage at ideal maturity.	Tube and bale-wrapping equipment requires additional capital expenditures.
Potential for more timely harvests of large quantities of forage and lower field losses.	Disposal of used plastic wrap could be an issue. Bags are not usually reusable. Plastic should not be burned, as it produces toxic fumes.
Complete mechanization in harvesting and feeding (therefore lowering labor costs).	Higher spoilage potential as compared to traditional silage methods.
Consistent forage quality on a daily basis when properly stored.	Higher risk of forage spoilage if integrity of wrap is compromised.
More nutrients preserved for feeding and possible nitrate reduction.	Birds and rodents can puncture plastic and holes must be covered.
Requires one-half to one-third the drying time of hay – only 13 to 20 hours, as opposed to 40 or more for dry hay.	Limited transportation due to cost of moving high-moisture bales.
Decreases feed loss because of better palatability over dry hay.	Bale weights increase dramatically as moisture increases causing issues with handling equipment, particularly for smaller equipment such as front-end loaders, so bale size must be adjusted accordingly.
Allows for a producer-controlled cutting schedule – first cut at the optimum time with subsequent cuts when quality is highest.	Storage life is shorter than that of chopped silage or dry hay.

Baleage, also known as round bale silage or haylage, is a somewhat newer method of preserving forage. Baleage is simply forage that is baled at higher moisture content than dry hay and then stored in sealed plastic wrap. Because of the high moisture level and air-tight environment, the forage ferments and is preserved by acid production during fermentation. This method has certain advantages and disadvantages over other forage harvesting and preservation systems (**Table 1**).

Forage Species for Baleage – Baleage is the most sensitive of the ensiled forages to moisture variation. Just a few percentage points up or down can ruin your forage stored in this manner. When cutting forages for baleage, annual grasses such as sudangrass, sorghum-sudan hybrids, millets, and annual ryegrass should be cut for baleage at the boot to early head stage. Other small grains such as oats, wheat, and barley should be cut at the boot to early dough stage. Ensiling forage as baleage can be a management strategy for high-nitrate grasses such as Johnsongrass. Some studies suggest up to a 50% reduction in nitrate content of the ensiled forages due to the de-nitrification process. Legumes do not contain high amounts of water-soluble carbohydrates (WSC) and are difficult to ensile. A legume/grass mixture has higher sugar content and ferments better. Small grains and ryegrass are easily ensiled because of their high WSC levels. Consider cutting them early is you want to increase protein levels. Bermudagrass is difficult to ensile because of low sugar concentration (usually less than 4% fermentable sugars), high buffering capacity (more lactic acid needed to lower pH), and fermentation of some substrates (malic and oxaloacetic acids) to weak acids (acetic) that buffer near pH 5. Keep in mind that poor quality forage that is ensiled as baleage is still poor quality forage. **Table 2** provides baleage quality information for forages commonly grown in Mississippi.

Table 2. Quality analysis of different forages ensiled for baleage.

	Forage Quality[1]		
Forage Crop	**DM**	**CP**	**NDF**
	---------- % ----------		
Bahiagrass	50.2	12.9	68.9
Bermudagrass	44.9	13.0	73.2
Annual Ryegrass	40.1	19.2	61.4

[1] DM = Dry Matter; CP = Crude Protein; NDF = Neutral Detergent Fiber.
Source: McCormick, 2006. Bale Silage Production Issues. LSU AgCenter.

Principles of Making Baleage – Ensiling forages as baleage requires 40 to 60% moisture (with a targeted average of 50%) rather than 18 to 20% moisture. This is an intermediate level between hay and silage production. Making baleage with too much moisture reduces the feed quality of the forage and reduces the amount of dry matter stored per bag, greatly increasing storage cost. On the other hand, making baleage with inadequate moisture reduces fermentation and increases mold production, greatly increasing storage losses. The reduction of moisture content for baleage could be accomplished by mowing, windrowing, and bailing between 4 and 24 hours after cutting. Considerably longer wilting periods might be necessary depending on the forage moisture and conditions.

It is important to decrease bale size since baleage weighs more than dry hay due to moisture content. The most common sizes are 4' x 4' or 4' x 5' bales. These bales weigh 900 to 1300 lbs depending on density and moisture concentration. They are usually best for handling and

feeding. Larger bales that utilize relatively less plastic can be made, but they are discouraged because of handling difficulties (**Fig. 1**).

The preservation of baleage quality is maintained by ensuring that an optimum fermentation occurs during the ensiling process. This is achieved when lactic acid is produced. Lactic acid is the most efficient fermentation acid and will drop the pH of a forage crop faster than any other. The faster the fermentation process is completed, the more stable the silage will be. In addition, fast fermentation means more nutrients are retained within the silage.

In conventional ensiling, the fermentation process will normally produce silage with a final pH range of 4.0 to 4.5 (**Table 3**). In baleage, producers should expect a final pH in the 4.7 to 5.8 range. The higher pH values associated with baleage are related to a slower fermentation process. Harvesting forages with a long fiber usually results in a slow release of the plant nutrients necessary for the growth of acid-producing bacteria. This generally results in less fermentation in the baleage than in chopped silage.

Figure 1. Baleage production: individual wrapping and bale tube ensiling.

Forage moisture can also influence the level of fermentation. Maintaining moisture levels will ensure proper fermentation and result in lower pH values. It is generally advisable to start

baling at the higher moisture content since the material dries as the day progresses. By using a high density baler, and the quick tubing or wrapping of the bales, it will maintain the moisture levels. The compaction provided by the high density bales will limit the amount of oxygen present and create an anaerobic environment which will limit mold growth. Also, sealing the bales within a few hours of bailing will prevent secondary air movement into the bales. Wrapping or tubing should occur ideally within five hours of baling. Delaying the operation beyond 10 hours may result in a slower fermentation process and, therefore, a slower drop in silage pH.

Table 3. pH levels of baleage compared with chopped silage across fermentation times.

	pH	
Fermentation (days)	**Baleage**	**Chopped silage**
0	5.7	5.7
1	5.8	5.1
3	5.7	4.9
9	5.5	4.6
60	5.1	4.4

Source: Anonymous. 2008. Baled Silage Production. Growing Opportunities Centre.

Baleage contains high moisture levels and most producers wonder if a forage preservative is needed. Forage crops baled in the 40 to 60% moisture range should store adequately without the need for preservatives. Some studies have suggested that the application of inoculants can help in the production of lactic acid and lead to lower pH values as compared to untreated baleage. If some of the products are considered, the most common products are either mold inhibitors (acid based) or microbial inoculants (fermentation stimulants). Producers should check with product distributors to ensure that they have been tested and approved for use on baleage systems. It is important to ensure that the application equipment is properly adjusted so that the recommended rates are properly applied. When calibrating the equipment, take into consideration forage moisture content and baling rates (tons/hour).

One common question that producers battle with is what kind of plastic to use. A suggested minimum for plastic wrapping or tubing is 4 ml. If the bales are to be carried over from one feeding season to the next, it is advisable to use a plastic with a higher rating such as 8 ml. Plastic film must have a 50% stretch factor, be resistant to ultra violet light, have good tear strength and be able to adhere well. White is used for high sunlight areas and black for lower sunlight areas.

Producers should use a 50% overlap of the plastic to ensure a sealed environment. If bales are not tight and the plastic not stretched and sealed, oxygen may continue to enter the system in which case respiration continues to occur and heat continues to be produced. If the temperature rises above 112 ºF heat damage occurs and protein is denatured, and the damaged protein is unavailable to the animal.

Costs Associated with Baleage Production – Costs are determined by the number of bales produced (**Table 4**). This is influenced by crop yield, wilting, and baling. Using mechanically harvested forage remains a very expensive commodity nowadays. An increase in equipment needs for baleage should be considered carefully since plastic costs can range from $0.60 to $3.50 per bale and individual bale wrappers can range in price from $4,000 to $30,000.00. Costs associated with extra labor to wrap forage needs to be considered in some situations.

Although part of the added cost for grasses can be offset by reducing field and storage losses, the added costs could range from $3.50 to $8.50/bale or $11.00 to $27.00/ton of dry forage. Determine if the livestock operation is better served by investing in fencing and grazing systems to decrease hay and silage needs.

Table 4. Cost of owning and operating the bale wrapper assuming 1,000 bales are wrapped each year.

	Cost/Bale ($)	
	100 bales/hr	**40 bales/hr**
Variable Cost		
Plastic wrap	2.43	2.43
Fuel and lubrication	0.11	0.11
Labor	0.71	1.78
Tractor	0.17	0.44
Total variable cost	3.42	4.76
Total fixed cost	2.67	2.96
Total cost	6.09	7.72

Note: Cost is for the wrapping system only. It does not include costs associated with mowing, baling, storing, and feeding the baleage.

Source: Rudsrom, M. 2009. The Dollars and Cents of Bale Wrapping Haylage. Univ. of Minnesota Coop. Ext. Serv.

Handling and Storing Baleage – Remember that the harvested forage will be stored in plastic wrap to maintain an air-free environment (anaerobic conditions) and ensure proper fermentation. It is important to maintain the stored baleage properly, clearing any stubble or sharp objects that could potentially puncture the plastic wrap. Laying a piece of plastic on the ground prior to placing the bales on its surface might be a good idea. Spraying the perimeter where the bales will be placed could also help to reduce weeds that could serve as habitats for rodents and insects that could potentially chew through the plastic wrap or bag and increase storage losses.

While storing baleage, keep in mind that finding a shady area with a north facing slope might be preferred. This will minimize temperature fluctuations that could degrade both the baleage and the plastic. These conditions are the opposite of what is usually recommended for hay production. It is important to inspect the bagged bales regularly to ensure that no holes are found. If holes are found, patch them as soon as possible because wind can cause the loose plastic to bellow out. This situation provides an air exchange that usually spoils most of the outer layer in the bale.

Baleage can be stored from one season to the next. The key is to prevent air movement into the sealed bales. Big bales can be stored for up to 18 months without any noticeable deterioration in quality, but because of the risk of damage to the wrapping, it is advisable not to keep bales from one year to the next.

Proper Feeding and Baleage Utilization – There is not much science to feeding baleage. One important point is that baleage should not be fed until the ensiling process is virtually complete. This usually takes 15 to 30 days if the bales were wrapped within 5 hours of bailing. This process could take longer is if the bales were not wrapped within that 5 hour window.

The feeding process is very similar to the conventional hay feeding system. One thing that producers should be aware of is that because of the high investment in wrapping bales, it is essential to use feeding rings to reduce feeding losses. Some studies suggest up to 50% loss when feeding large round bales of baleage to cattle when a ring feeder is not utilized. This loss can be reduced to 10 to 20% when using a ring. Another strategy is to determine the number of animals in your herd and their daily consumption and to provide enough baleage to be consumed within one or two days. This ensures that if multiple bales were ensiled in a plastic tube, they could be removed individually and resealed without significant spoilages for up to two weeks. Baleage can also be used for feeding horses, and it lowers respiratory problems often associated with dry hay.

Summary – "Beat the weather and capture forage quality by preserving round bales as baleage." Baleage shows promise as a forage preservation system in Mississippi where hay is usually not cut in time because of weather conditions. Baleage takes advantage of existing hay equipment for most steps in the production and feeding parts. This will offer lower capital investment and flexibility in feeding. The baleage process allows harvesting when the forage has its highest quality without waiting on the weather. This increases dry matter yield/acre in this high moisture feed because of lower leaf loss and decreased transpiration, as well as less sugar burn off that occurs during drying. A wide range of forage crops could be used in this process, and it can utilize the existing haying equipment rather than investing or paying for silage harvesting.

While baleage is growing in popularity across the state, do not jump on the bandwagon just because your neighbor is doing it. Every operation is different. In order to successfully contribute to your operation, baleage must (1) decrease field losses, (2) decrease storage losses or (3) improve animal performance.