

Effects of Delayed Wrapping of Baled Silage

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Use of baled silage allows greater flexibility of harvest when weather does not allow drying and harvesting forage as dry hay. This is especially the case in the spring/early summer when rain often occurs, and in fall when cooler temperatures don't allow adequate drying. Recommendations for chopped silage are to immediately cover with plastic after silo filling is completed in order to stop oxygen exposure and encourage anaerobic fermentation by lactic acid bacteria. Elimination of oxygen is especially important in production of baled silages because fermentation is restricted, with less production of fermentation acids. However, timely wrapping on the day of baling can be difficult if significant numbers of bales need to be wrapped, or if a mechanical breakdown occurs. So what happens to baled silage wrapped after a time delay? Research conducted by USDA-ARS and University of Wisconsin scientists at Marshfield, WI, addressed this question.

When high-moisture forages are harvested, packed tightly, and covered in plastic (whether in a silo or bale), plant respiration continues to use plant sugars, producing carbon dioxide and water until oxygen is depleted. Plant respiration also results in heat production, the process responsible for spontaneous bale heating in wet hay. When baled silage is not wrapped, plant respiration continues due to oxygen entry into the bale, resulting in increased heat production and greater internal bale temperatures. In this research, an alfalfa-grass mix was cut and baled at ~60% moisture, wrapped subsequently at 4 hours, 1, 2, or 3 days after baling, and then stored for 97 days. Bale temperature was monitored at wrapping and during storage. As expected, bale temperatures at wrapping substantially increased with time delay (Table 1) from 95°F at 4 hours post-wrapping to 147°F after 3 days. The increased respiration also led to lower water soluble carbohydrates (sugars) at wrapping and a greater buffering capacity (resistance to pH change). Both factors make anaerobic fermentation and lowering of silage pH more difficult, with less sugar available for fermentation and more resistance to pH change. This was the case when the bales were opened, with final pH similar between the bales wrapped after 4 hours or 1 day (average pH=5.7). However, pH was greater when wrapping was delayed by 2 (pH=5.78) or 3 days (pH=5.89). Total, lactic, and acetic acid content were reduced with delayed wrapping, especially with a 2- or 3-day delay. Lactic acid is the most desirable acid to quickly drop silage pH and preserve the silage. Butyric acid was elevated for the bales wrapped at 4 hours. This may be due to the generally high moisture level of the bales (59%) and greater lactic acid content, which can also be converted to butyric acid by clostridial bacteria. Baling at a slightly lower moisture (45-55%) is generally recommended for baled silages.

Nutrient quality at harvest and after storage was reduced when wrapping was delayed. Concentrations of neutral detergent fiber (NDF) and lignin were increased, while available energy measured as total digestible nutrients (TDN) was reduced as wrapping was delayed. This was most evident for bales wrapped after 2 or 3 days compared to those wrapped at 4 hours or 1 day post-baling. Crude protein did not change much; however, protein bound to NDF and Acid Detergent Fiber (ADF) increased in response to the heating that occurred before wrapping, which also decreases protein digestibility.

Based on these results, wrapping as soon as possible has the most desirable fermentation and maintains the greatest forage quality. A 24-hour delay generally had minimal effects on fermentation and nutritive quality compared to wrapping on the day of baling, and may serve as a cutoff for the maximum time delay before wrapping. Longer delays (>1 day) will likely result in significantly reduced fermentation and forage quality. Proper planning of wrapping prior to harvesting is advised, including communicating with your custom wrapper about your schedule or ensuring your wrapping equipment is well maintained and you have a sufficient plastic supply.

Table 1. Fermentation and quality of baled silages after delayed wrapping.

	At Wrapping			Post-Storage					
	Bale temp, °F	WSC, % DM	Buffer Capacity, mEq/kg DM	Max bale temp, °F	Final pH	Total acids, % DM	Lactic acid, % DM	NDF, % DM	TDN, % DM
4 hours	95	5.3	421	101	5.70	4.64	1.88	45.4	57.3
1 day	117	4.6	451	121	5.68	3.13	1.59	46.5	56.9
2 days	128	4.5	479	139	5.78	1.54	0.73	47.9	56.5
3 days	147	4.0	510	152	5.89	2.11	0.67	49.7	54.8

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