NUTRITIVE VALUE OF ENSILATED LEAVES FROM SELECTED MAINE TREE AND SHRUB SPECIES FOR FORAGE PRODUCTION.

By Jaime Garzon, Assistant Extension Professor and Forage Educator, University of Maine Cooperative Extension

Note:

The results in this bulletin are exclusively descriptive, as there was no experimental design to validate the responses statistically. Therefore, conclusions, predictions, or deductions based on the results shown should be avoided.

Introduction

Climate variability refers to the natural changes the weather experiences on different time and space scales. These fluctuations in average climatic conditions, such as temperature, precipitation, winds, etc., occur regularly and cyclically. On the other hand, climate change has intensified the fluctuations observed decades ago. In Maine, this is observed with an increase in air temperature and a greater incidence of extreme events, such as very hot or very cold days in the year.

These effects directly impact the performance of Maine's pastures. Warmer days reduce the productivity of pastures, commonly established with cool-season forages, increasing the summer slump effect. A greater number of droughts or floods also negatively impact pasture yield, jeopardizing the main food source for Maine livestock.

Maine also has a large acreage established with woods. Many of the state's agricultural operations have forested areas, and their operators have observed that cattle, sheep, and goats sometimes consume tree leaves without any sign of intoxication.

Therefore, the objective of this project is to evaluate the nutritive value of fresh, and silage leaves from 28 tree species, all established in Maine, to bridge an informational gap that is slowing livestock farmers from productively using on-site woody perennial forages when weather challenges interfere with their grass-forage harvests.

Methodology and variables evaluated

Twenty-eight tree/shrub species were initially selected based on empirical observation of animal intake and availability at Maine operations. Foliage samples were taken between June and October 2022-2024, considering the species that were available at the time. Samples were taken primarily at four locations:

1. Maine Organic Farmers and Gardeners Association. Unity (ME).
   44° 35’ 23.3” N; 69° 17.25’ 25.7” W.
2. Y Knot Farm. Belmont (ME).
   44° 24’ 24.25” N; 69° 06’ 7.3” W.
3. Faithful Venture Farm. Searsmont (ME).
   44° 24’ 53.5” N; 69° 13’ 1.7” W.

4. Laufer's Homestead. Montville (ME).
44° 27.09' N; 69° 18' 56.3" W.

Harvest was performed using a chain-flail leaf-separator prototype. Cutting with hand-held power-tools, and stripping leaves with this machine prototype (created by current technical advisor Karl Hallen) was 90% quicker than traditional hand-stripping, producing 2,500+ gallons of tree/shrub leaf silage in 1,000 linear feet of field edges (Figure 1).

Figure 1. Chain-flail leaf-separator prototype in operation.

After each harvest, a proportion of the fresh material was sent to the Dairy One® forage lab, while the remainder was stored in plastic barrels with enough compaction to ensure anaerobic fermentation (Figure 2). Fermentation time varied from one to four months. After that, a subsample was taken for further analysis.

Figure 2. Packaging, fermentation, and final product in tree/shrub leaf silage.

Crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), water-soluble carbohydrates (WSC), total digestible nutrients (TDN), and relative feed value (RFV) were determined by NIR analyses in the DairyOne® lab.

Results

The project started with the evaluation of 28 tree species. However, nine species showed incomplete and very variable results, and box elder caused animal death, so this bulletin focused on the results of the remaining 18 species (Table 1).

The ensiling process showed a reduction in the mean values of CP, WSC, and TDN with an increase in ADF and NDF. These changes are explained by the fermentation process itself, where microorganisms take soluble carbohydrates as an energy source and transform protein sources with it. It is important to note that a good quality forage is expected to have 15-25% crude protein, 15-30% ADF, 40-60% NDF, 7-10% WSC, and 60-70% TDN. Thus, the mean nutritive value of all materials after the ensiling process fits within these ranges.

Moreover, fresh leaves showed greater CP, WSC, and TDN values. Nonetheless, tree leaves may contain antinutritional components such as alkaloids, tannins, or cyanogenic acids. These compounds are usually degraded by anaerobic silage fermentation, so it is more advisable to supply ensiled foliage instead of fresh for animals to consume. In turn, this would increase palatability and animal preference, decreasing the risk of poisoning. An exception must also be made for monogastric animals such as poultry or pigs, as these species are more sensitive to poisoning due to their lack of rumen. Feeding ensiled foliage to these animals is not recommended until further studies have been conducted.

Finally, basswood and black locust were the species that maintained a higher concentration of CP after the fermentation process, with 3.6 – 5.3% WSC and 61% TDN.

This is an ongoing research project, so new results are expected to be included in this bulletin in the near future.

Acknowledgments

The University of Maine Cooperative Extension thanks Shana Hanson for providing the data and photos that comprise this bulletin's results.

Funding

This project was funded by Northeast Sustainable Agriculture Research and Education (NE-SARE) through FNE22-013 and FNE24-083 Farmer Grant awards. NE-SARE is funded by the National Institute of Food and Agriculture (NIFA).

Other sources:

- Hanson S. (2025) A closer look to guide farm use of tree/shrub silages: Per-species & ensilement analyses for safe, nutritious rationing, plus replicable trial results. Project FNE24-083. Northeast Sustainable Agriculture Research and Education. https://projects.sare.org/project-reports/fne24-083/.
- Hanson S. Hallen K. (2024). Efficient leaf-dense tree/shrub silage production from field edges: Climate-resilient winter forage supplement for cattle, sheep, and goats. Project FNE22-13. Northeast Sustainable Agriculture Research and Education. https://projects.sare.org/project-reports/fne22-013/.

- Chin J. (2022). The potential use of tree leaf silage for livestock nutrition, including willow, drumstick, mulberry, and acacia species. Thesis. University of Maine. https://digitalcommons.library.umaine.edu/honors/719/.
- Gabriel S. (2021). Quantifying nutritional value and best practices for woody fodder management in ruminant grazing systems. Project FNE19-30. Northeast Sustainable Agriculture Research and Education. https://projects.sare.org/project-reports/fne19-930/.

Table 1. Nutritional value of fresh and ensiled leaves from 19 tree and shrub species in Maine.

TREE AND SHRUB SPECIES	FRESH						SILAGE					
	CP (%)	ADF (%)	NDF (%)	WSC (%)	TDN (%)	RFV	CP (%)	ADF (%)	NDF (%)	WSC (%)	TDN (%)	RFV
American beech	12.3	31.0	52.6	7.7	64.0	115	12.7	35.8	55.6	2.9	59.0	102
American elm	11.1	23.1	53.4	8.3	58.0	124	12.1	23.7	54.0	4.3	54.0	121
Arrowwood	12.0	31.4	43.0	9.4	68.0	139	12.8	36.2	49.7	5.1	60.0	114
Basswood	19.4	24.0	42.6	9.5	65.0	163	19.8	24.8	45.3	3.6	61.0	143
Big toothed aspen	9.8	27.1	38.8	14.0	72.0	176	10.8	28.3	39.6	8.7	61.0	157
Black cherry	17.0	25.6	34.9	9.1	67.5	174	13.5	22.2	30.0	8.8	64.2	232
Black locust	17.1	25.5	36.9	10.0	67.0	203	17.3	26.6	37.3	5.3	61.0	170
Gray birch	14.1	30.7	43.0	6.8	72.0	146	11.6	31.9	44.4	8.2	63.0	133
Green ash	15.4	26.9	43.3	8.3	66.0	134	12.8	28.4	40.9	8.3	59.8	165
Honeysuckle	11.1	29.9	45.0	13.6	65.0	173	11.2	25.8	36.6	12.0	64.6	156
Leatherwood	9.5	27.0	36.5	16.5	72.0	205	8.7	32.4	43.2	13.9	66.0	137
Norway maple	12.0	23.6	41.0	9.3	68.0	281	12.8	24.0	42.8	4.8	65.0	153
Red maple	10.9	16.8	25.1	18.0	79.0	97	10.0	23.5	33.3	14.5	68.8	220
Red oak	15.6	27.3	40.4	6.6	61.0	126	14.3	29.0	46.3	4.1	60.3	134
Rock maple	11.0	18.7	32.5	20.1	69.0	209	9.5	22.9	34.1	14.3	66.0	194
Smooth buckthorn	14.3	20.3	32.5	15.3	70.0	308	15.4	25.9	38.9	6.5	67.0	164
White ash	9.9	25.1	37.1	7.6	66.0	145	11.1	26.8	39.2	8.4	59.3	161
Winterberry	11.7	27.6	43.4	9.6	69.0	-	12.6	31.4	49.2	4.0	62.0	122
AVERAGE	**13.1**	**25.5**	**39.7**	**10.9**	**67.8**	**170**	**12.9**	**27.5**	**41.7**	**7.5**	**62.7**	**157**
Standard deviation	2.7	3.9	6.7	4.0	4.4	54	2.7	4.2	7.0	3.7	3.8	35

CP: Crude protein; ADF: Acid detergent fiber; NDF: Neutral detergent fiber; WSC: Water soluble carbohydrates; TDN: Total digestible nutrients; RFV: Relative feed value