Lab Nutritional Analysis of Ensiled Tree Leaves and Ensiled Chipped Leafy Branches, with Dried (non-ensiled) Comparisons, plus Average Grass Fodder Comparison, and Relation to Animal Responses.

Date Completed: 3/30/20
Amount Funded: $1,000
Project Manager: Shana Hanson
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Thanks: to Gary Anderson and Rick Kersbergen for patient instruction in lab results and animal nutrition.
Collaboration: We have completed SARE FNE18-897, within which we had produced the samples to be tested. See SARE FNE18-897 Final Report at

https://drive.google.com/file/d/1xH08aJD0RY1fXgPu1Csh4U5_h0g1QTDC/view?usp=sharing

Farm Operations: 3 Streams Farm is Certified Organic by MOFGA and includes a CSA dairy herd of Saanen goats with cashmere coats, currently 11 head, living on local trees, plants and seaweed plus salt, a pair of registered American Guinea Hogs currently due with piglets plus one daughter born last year (daughter and boar both for sale), one almost 3 yr. old Jersey heiffer/ox due to calve and be milked in April, a few muscovies and guinea fowl, fruit and nut trees, and some random wild gardens on our primarily wooded 39 acres, with another 55+/- acres of woods in Belmont, and a blueberry field with woods (17.4 acres total) just across the Lincolnville line. Pollarding of the woodland, edge and pasture trees plus accompanied browse wandering supplement our 2 acres of pasture paddock rotations. We also borrow and improve 8 more acres of pasture nearfby. We may soon head the blueberry field into an experimental silvopastural model of 3 yr. rotation with fodder trees dropping leaves to fuel the burn cycle, and goats weeding/fertilizing the 3rd yr. paddock during (2nd yr. paddock) harvest. Knowledge to address the planetary need for increased greenery and soil health is a product we value equally to sustenance.

Project Summary: Having made (in containers) and frozen samples of 9 species of tree leaf silages (beech, white birch, yellow birch, quaking aspen, big toothed aspen, red maple, red oak, white ash, and willow), most both intact (leaves, sometimes with short basal twigs) and chipped (leafy branches, 1" max. diameter), plus having saved samples of dried leaf fodders of same 9 species, most both intact and chipped, and having recorded 71% positive cattle, sheep. goat and hog responses to these fodders at 6 farms, all for SARE FNE18-897, I sent 26 samples to DairyOne for "Ration Balancer" "wet chemistry" testing of nutrient content and 5 "fermentation profiles," plus 20 additional samples for ADICP only, as DairyOne had mistaken all but those "fermentation profiled" of the original dried or ensiled samples to be "fresh forage," so had not measured ADICP. I then compared nutrition of hand-stripped versus chipped silage samples, and of ensiled versus dried samples whether hand-stripped or chipped. I compared mean nutritional measurements of our hand-stripped or chipped ensiled tree matter to average DairyOne 2004-2019 figures for grass silage, and our means for hand-stripped or chipped dried tree matter to DairyOne 2004-2019 figures for grass hay. I also juxtaposed animal response data from SARE FNE18-897 with lab nutritional data, and noted tree locations and circumstances.

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Assessment: Animal responses were recorded as "3 = immediately consumed; 2 = eventually consumed; 1 = tasted, and 0 = refused." Wet Chemistry test results measured Dry Matter, Crude Protein, Soluble Protein, Acid Detergent Fiber, and 11 minerals. Fermentation Profiles gave lactic/acetic acid ratio, and %s of probiotic, butyric, and isobutyric acids, crude protein, ammonium CPE, and ammonium nitrogen % of total nitrogen.

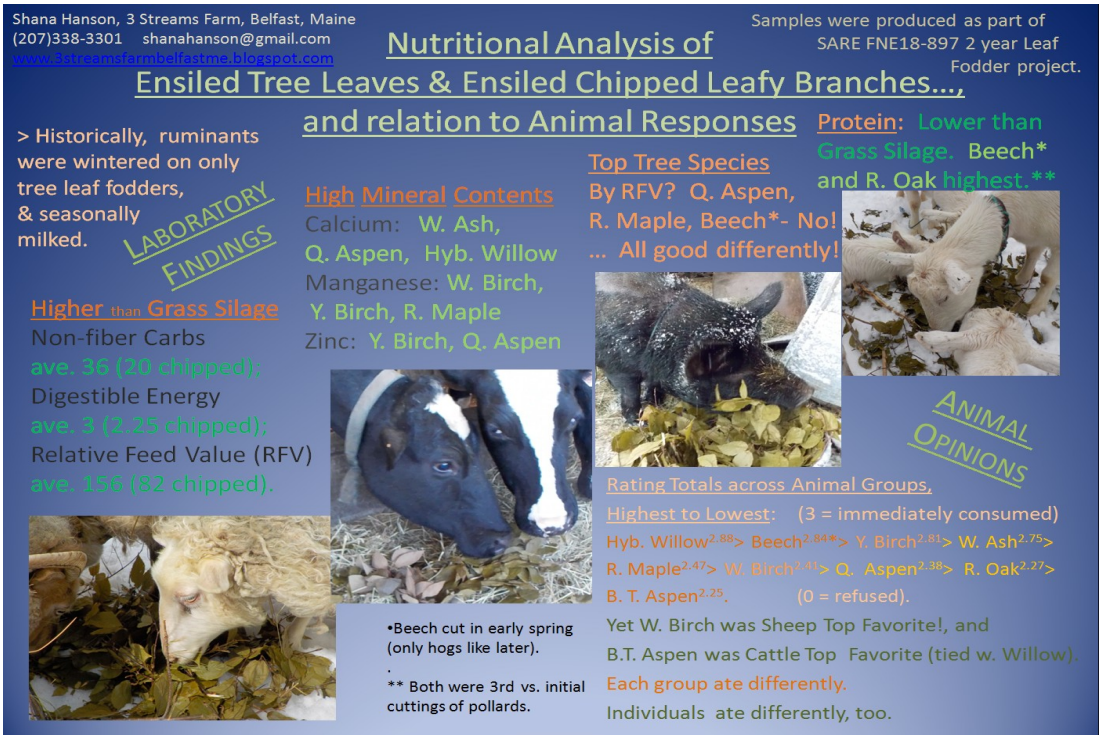
Timeline: Sent samples to lab soon after award receipt in July, 2019. I will share results through March 2021, and leave posted.

Budget: $936 for 26 Dairy One Ration Balancer "wet chemistry" tests @ $36/ea, $125 for 5 Fermentation Profiles @ $25/ea, plus $25. UPS shipping (I covered $86 beyond the grant award).

Information sharing: This report will be posted at https://**3streamsfarmbelfastme.blogspot.com**. I will send a press release summary with the link to VT, NY and ME University Extension Services (possibly other states), NOFAs and MOFGA, NEMA Agroforestry, USDA National Agroforestry Center, Silvopasture social network, Tree Hay Facebook group, USDA Climate Hub, MGFN and others.

I reported preliminary results of this project at MOFGA Farmer to Farmer Conference in Nov. 2019, and offered spreadsheets and a poster summary at the 2020 Vermont Grazing and Livestock Conference. I will continue to offer this new information in consultations, and at MOFGA and NOFA events. I will present at ME Grass Farmers' Network Grazing Conference June 28. I will offer this report and my verbal summaries amongst a deeper exploration of tree leaf fodders during our Tree Fodder Seminar 2020, July 6-10.

Results:
Poster Summary for Vt. Grazing and Livestock Conference, 2/11/20:



DairyOne “Ration Balancer” Test Results for 26 Diverse Samples:

Description	Harvest Date	% Moisture	% Dry Matter	% of DM Crude Protein	% of DM Solub. Prot.	% of DM ADF	% of DM NDF	% of DM NFC	% of DM TDN	Mcal/lb. NEL	Mcal/lb. NEM	Mcal/lb. NEG	RFV
W BIRCH ENSILED HAND STRIPPED	9/25/2018	57.6	42.4	11.5	3	27.3	41.5	36.5	61	0.64	0.6	0.33	151
Y BIRCH ENSILED HAND STRIPPED	8/10/2018	59.5	40.5	12.1	4	29	41.1	36.1	59	0.62	0.57	0.31	150
W ASH ENSILED HAND STRIPPED	7/15/2018	34.7	65.3	11.2	6	27.2	39.7	38.3	59	0.62	0.56	0.31	159
R MAPLE ENSILED HAND STRIPPED	8/5/2018	54.4	45.6	8.9	7	24.8	34.4	46.2	64	0.68	0.64	0.37	188
R OAK ENSILED HAND STRIPPED	8/20/2018	53.4	46.6	15.6	9	30.9	49.5	24	58	0.58	0.54	0.29	122
Q ASPEN ENSILED HAND STRIPPED	9/25/2018	59.3	40.7	12.7	5	24.1	34.2	42.5	64	0.68	0.64	0.37	191
B. T. ASPEN ENSILED HAND STRIPPED	9/10/2018	53.2	46.8	10.7	9	29.3	41.4	37.3	61	0.64	0.6	0.33	148
WILLOW ENSILED HAND STRIPPED	7/6/2018	66.6	33.4	11.4	13	32	45.2	32.9	60	0.61	0.58	0.32	132
BEECH ENSILED HAND STRIPPED	5/26/2018	66.6	33.4	19.2	8	27.8	38.8	31.2	62	0.65	0.61	0.35	161
Averages		56.14	43.86	12.89	7.11	28.04	40.64	36.11	60.89	0.64	0.59	0.33	155.78
BEECH ENSILED SHREDDED CHIPPED	5/27/2018	61.7	38.3	12.2	16	47.8	63.1	14.3	56	0.49	0.48	0.23	76
BIG TOOTHED ASPEN ENSILED CHIPPED	9/10/2018	54.3	45.7	8.1	9	41.5	56.5	24.9	57	0.54	0.51	0.26	93
Q ASPEN ENSILED CHIPPED	9/26/2018	55.9	44.1	8.1	5	37.8	51.1	30.4	59	0.58	0.54	0.29	108
W BIRCH ENSILED CHIPPED Check dates	6/2/2018	48.2	51.8	5	9	51.1	67.3	17.2	54	0.44	0.46	0.21	68
R OAK ENSILED CHIPPED Check dates	8/4/2018	45	55	8.4	13	46	64	17.1	55	0.48	0.48	0.23	77
W ASH ENSILED CHIPPED	7/15/2018	41.6	58.4	5.6	7	46.2	67.5	16	52	0.43	0.43	0.18	73
R MAPLE ENSILED CHIPPED	6/14/2018	55.4	44.6	6.2	10	39.6	54.5	28.8	58	0.55	0.52	0.27	99
Y BIRCH ENSILED CHIPPED	6/22/2018	47.8	52.2	5	18	51.5	69.3	15.2	54	0.42	0.45	0.2	65
Averages		51.24	48.76	7.32	10.87	45.19	61.66	20.49	55.62	0.49	0.48	0.23	82..37
BEECH DRIED INTACT	5/27/2018	10.3	89.7	19.1	6	28.3	49.7	20.7	60	0.59	0.56	0.3	125
HYBRID WILLOW MOFGA DRIED INTACT	7/6/2018	10.3	89.7	15.2	3	25.1	41	33.3	62	0.64	0.6	0.34	157
Y BIRCH DRIED INTACT	6/8/2018	13	87.1	17.9	3	23	36.9	34.7	63	0.66	0.63	0.36	179
BIG TOOTHED ASPEN DRIED INTACT	2018	9.7	90.3	15.3	7	27.4	41.8	32.4	62	0.64	0.6	0.34	150
RED OAK DRIED INTACT	2018	11.2	88.8	18.1	4	25.5	46.3	25.1	60	0.61	0.57	0.32	139
W ASH DRIED INTACT	7/15/2018	10.2	89.8	11.4	7	23.5	39.3	38.9	62	0.65	0.61	0.35	167
Averages		10.78	89.23	16.17	5	25.47	42.5	30.85	61.5	0.63	0.59	0.33	152.83
W BIRCH DRIED CHIPPED	6/2/2018	8.6	91.4	6.1	13	44.4	59.2	24.2	56	0.52	0.5	0.25	85
Q ASPEN DRIED CHIPPED	9/25/2018	9.5	90.5	7.2	9	43.9	59.3	23	56	0.52	0.5	0.25	86
R MAPLE DRIED CHIPPED	6/14/2018	8.1	91.9	5.7	15	48.1	67.2	16.6	54	0.44	0.46	0.21	71
Averages		8.73	91.27	6.33	12.33	45.47	61.9	21.27	55.33	0.49	0.49	0.24	80.67

Description	Harvest Date	% of DM Calcium	% of DM Phosphor	% of DM Magnesiu	% of DM Potassium	% of DM Sodium	PPM Iron	PPM Zinc	PPM Copper	PPM Mangan	PPM Molybden	% of DM Sulfur	HDE
W BIRCH ENSILED HAND STRIPPED	9/25/2018	1.2	0.17	0.32	0.76	0.007	69	182	7	1090	0	0.19	1.17
Y BIRCH ENSILED HAND STRIPPED	8/10/2018	1.05	0.13	0.27	0.9	0.01	62	260	7	843	0.1	0.13	
W ASH ENSILED HAND STRIPPED	7/15/2018	1.54	0.12	0.32	1.04	0.008	56	13	9	76	0.1	0.28	
R MAPLE ENSILED HAND STRIPPED	8/5/2018	0.71	0.1	0.15	0.56	0.009	39	29	7	627	0.1	0.12	1.27
R OAK ENSILED HAND STRIPPED	8/20/2018	0.78	0.15	0.19	1.11	0.01	66	34	6	337	0.2	0.17	
Q ASPEN ENSILED HAND STRIPPED	9/25/2018	1.39	0.15	0.26	0.83	0.017	50	277	8	194	0	0.22	1.26
BIG TOOTHED ASPEN ENSILED HAND STRIPP	9/10/2018	1	0.18	0.11	1.25	0.011	48	80	5	132	0.1	0.2	1.17
HYBRID WILLOW MOFGA ENSILED HAND ST	7/6/2018	1.23	0.17	0.31	1.73	0.015	37	98	6	199	0	0.28	1.12
BEECH ENSILED HAND STRIPPED	5/26/2018	0.51	0.28	0.2	1.34	0.013	218	31	13	145	0.1	0.24	
Averages		1.045556	0.16111	0.2366667	1.0577778	0.01111	71.6667	111.6	7.5556	404.7778	0.07778	0.2033	1.198
BEECH ENSILED SHREDDED CHIPPED	5/27/2018	0.6	0.17	0.13	0.71	0.01	180	28	10	132	0.2	0.14	0.88
BIG TOOTHED ASPEN ENSILED CHIPPED	9/10/2018	1.27	0.14	0.11	0.89	0.012	74	77	5	102	0.3	0.13	0.99
Q ASPEN ENSILED CHIPPED	9/26/2018	1.05	0.11	0.19	0.64	0.011	79	186	9	109	0	0.13	1.06
W BIRCH ENSILED CHIPPED 6/24? Check da	6/2/2018	0.64	0.07	0.09	0.34	0.012	291	176	4	312	0	0.06	0.86
R OAK ENSILED CHIPPED Check dates	8/4/2018	0.64	0.09	0.13	0.52	0.013	3590	55	6	372	0	0.1	0.89
W ASH ENSILED CHIPPED	7/15/2018	0.95	0.13	0.13	0.85	0.01	537	27	24	24	0.1	0.11	
R MAPLE ENSILED CHIPPED	6/14/2018	0.86	0.09	0.09	0.55	0.009	57	19	6	359	0	0.09	1.02
Y BIRCH ENSILED CHIPPED	6/22/2018	0.76	0.06	0.1	0.25	0.01	41	118	4	213	0.1	0.05	0.83
Averages		0.84625	0.1075	0.12125	0.59375	0.01088	606.125	85.75	8.5	202.875	0.0875	0.1013	0.932857
BEECH DRIED INTACT	5/27/2018	0.63	0.29	0.19	1.23	0.037	152	36	13	93	0.6	0.23	1.06
HYBRID WILLOW MOFGA DRIED INTACT	7/6/2018	1.98	0.2	0.4	2.24	0.009	80	106	9	345	0.1	0.48	1.17
Y BIRCH DRIED INTACT	6/8/2018	0.64	0.16	0.23	0.69	0.01	66	154	9	510	0	0.16	1.21
BIG TOOTHED ASPEN DRIED INTACT	2018	0.94	0.15	0.22	0.72	0.01	53	139	9	249	0	0.19	1.16
RED OAK DRIED INTACT	2018	0.87	0.18	0.14	1.21	0.011	106	46	7	588	0	0.19	1.1
W ASH DRIED INTACT	7/15/2018	1.57	0.14	0.3	1.19	0.012	70	17	12	72	0	0.24	1.21
Averages		1.105	0.18667	0.2466667	1.2133333	0.01483	87.8333	83	9.8333	309.5	0.11667	0.2483	1.151667
W BIRCH DRIED CHIPPED	6/2/2018	0.53	0.07	0.1	0.39	0.012	208	173	4	329	0	0.07	0.96
Q ASPEN DRIED CHIPPED	9/25/2018	1.11	0.11	0.2	0.62	0.008	74	174	11	97	0	0.1	0.95
R MAPLE DRIED CHIPPED	6/14/2018	0.74	0.08	0.08	0.47	0.008	595	19	5	316	0.2	0.07	0.86
Averages		0.793333	0.08667	0.1266667	0.4933333	0.00933	292.333	122	6.6667	247.3333	0.06667	0.08	0.923333

Averages for Above Samples, with DairyOne Averages for Grass Silage and Grass Hay 2004-2019:

Description	% Moisture	% Dry Matter	% of DM Crude Protein	% of DM Solub. Prot.	% of DM ADF	% of DM NDF	% of DM NFC	% of DM TDN	Mcal/lb. NEL	Mcal/lb. NEM	Mcal/lb. NEG	RFV
Average Ensiled Hand-Stripped Tree Matter	56.14	43.86	12.59	7.11	28.04	40.64	36.11	60.89	0.64	0.59	0.33	155.8
Average Ensiled Chipped Tree Matter	51.24	48.76	7.32	10.87	45.19	61.66	20.49	55.62	0.49	0.48	0.23	82.37
Average Dried Intact Tree Matter	10.78	89.23	16.17	5	25.47	42.5	30.85	61.5	0.63	0.59	0.33	152.8
Average Dried Chipped Tree Matter	8.73	91.27	6.33	12.33	45.47	61.9	21.27	55.33	0.49	0.49	0.24	80.67
Average Grass Silage	61.94	38.06	15.53	53.12	37.35	57.38	16.83	61.67	0.57	0.59	0.33	98.47
Average Grass hay	7.75	92.25	10.97	33.13	38.59	62.03	19.46	58.29	0.51	0.52	0.27	90.4

Description	% of DM Calcium	% of DM Phosphor	% of DM Magnesiu	% of DM Potassium	% of DM Sodium	PPM Iron	PPM Zinc	PPM Copper	PPM Mangan	PPM Molybden	% of DM Sulfur	HDE
Average Ensiled Hand-Stripped Tree Matter	1.05	0.16	0.24	1.06	0.01	71.67	111.56	7.56	404.78	0.078	0.2	1.2
Average Ensiled Chipped Tree Matter	0.85	0.11	0.12	0.59	0.01	606.12	85.75	8.5	202.87	0.087	0.1	0.93
Average Dried Intact Tree Matter	1.1	0.19	0.25	1.21	0.01	87.83	83	9.83	309.5	0.12	0.25	1.15
Average Dried Chipped Tree Matter	0.79	0.09	0.13	0.49	0.01	292.33	122	6.67	247.33	0.067	0.08	0.92
Average Grass Silage	0.61	0.33	0.23	2.51	0.15	688.38	38.22	9.92	102.81	1.63	0.22	0.9
Average Grass hay	0.48	0.24	0.21	1.85	0.07	201.3	31.3	8.24	85.78	1.26	0.18	0.91

Matched Pairs of Samples, with Chipped vs. Hand-stripped, & Ensiled vs. Dried Comparisons (DM basis):

Description	Harvest Date	% Moisture	% Dry Matter	% of DM Crude Prot.	% of DM Solub. Prot.	% of DM ADF	% of DM NDF	% of DM NFC	% of DM TDN	Mcal/lb. NEL	Mcal/lb. NEM	Mcal/lb. NEG	RFV
W ASH ENSILED HAND STRIPPED	7/15/2018	34.7	65.3	11.2	6	27.2	39.7	38.3	59	0.62	0.56	0.31	159
W ASH ENSILED CHIPPED	7/15/2018	41.6	58.4	5.6	7	46.2	67.5	16	52	0.43	0.43	0.18	73
Chipped/Intact		1.198847	0.89433	0.5	1.1666667	1.69853	1.70025	0.418	0.8814	0.693548	0.76786	0.5806	0.459119
W ASH ENSILED HAND STRIPPED	7/15/2018	34.7	65.3	11.2	6	27.2	39.7	38.3	59	0.62	0.56	0.31	159
W ASH DRIED INTACT	7/15/2018	10.2	89.8	11.4	7	23.5	39.3	38.9	62	0.65	0.61	0.35	167
Ensiled/Dried		3.401961	0.72717	0.9824561	0.8571429	1.15745	1.01018	0.985	0.9516	0.953846	0.91803	0.8857	0.952096
Q ASPEN ENSILED HAND STRIPPED	9/25/2018	59.3	40.7	12.7	5	24.1	34.2	42.5	64	0.68	0.64	0.37	191
Q ASPEN ENSILED CHIPPED	9/26/2018	55.9	44.1	8.1	5	37.8	51.1	30.4	59	0.58	0.54	0.29	108
Chipped/Intact		0.942664	1.08354	0.6377953	1	1.56846	1.49415	0.715	0.9219	0.852941	0.84375	0.7838	0.565445
Q ASPEN ENSILED CHIPPED	9/26/2018	55.9	44.1	8.1	5	37.8	51.1	30.4	59	0.58	0.54	0.29	108
Q ASPEN DRIED CHIPPED	9/25/2018	9.5	90.5	7.2	9	43.9	59.3	23	56	0.52	0.5	0.25	86
Ensiled/Dried		5.884211	0.48729	1.125	0.5555556	0.86105	0.86172	1.322	1.0536	1.115385	1.08	1.16	1.255814
BEECH ENSILED HAND STRIPPED	5/26/2018	66.6	33.4	19.2	8	27.8	38.8	31.2	62	0.65	0.61	0.35	161
BEECH ENSILED SHREDDED CHIPPED	5/27/2018	61.7	38.3	12.2	16	47.8	63.1	14.3	56	0.49	0.48	0.23	76
Chipped/Intact		0.926426	1.14671	0.6354167	2	1.71942	1.62629	0.458	0.9032	0.753846	0.78689	0.6571	0.47205
BEECH ENSILED HAND STRIPPED	5/26/2018	66.6	33.4	19.2	8	27.8	38.8	31.2	62	0.65	0.61	0.35	161
BEECH DRIED INTACT	5/27/2018	10.3	89.7	19.1	6	28.3	49.7	20.7	60	0.59	0.56	0.3	125
Ensiled/Dried		6.466019	0.37235	1.0052356	1.3333333	0.98233	0.78068	1.507	1.0333	1.101695	1.08929	1.1667	1.288
B. T. ASPEN ENSILED HAND STRIPPED	9/10/2018	53.2	46.8	10.7	9	29.3	41.4	37.3	61	0.64	0.6	0.33	148
BIG TOOTHED ASPEN ENSILED CHIPPED	9/10/2018	54.3	45.7	8.1	9	41.5	56.5	24.9	57	0.54	0.51	0.26	93
Chipped/Intact		1.020677	0.9765	0.7570093	1	1.41638	1.36473	0.668	0.9344	0.84375	0.85	0.7879	0.628378
WILLOW ENSILED HAND STRIPPED	7/6/2018	66.6	33.4	11.4	13	32	45.2	32.9	60	0.61	0.58	0.32	132
HYBRID WILLOW MOFGA DRIED INTACT	7/6/2018	10.3	89.7	15.2	3	25.1	41	33.3	62	0.64	0.6	0.34	157
Ensiled/Dried		6.466019	0.37235	0.75	4.3333333	1.2749	1.10244	0.988	0.9677	0.953125	0.96667	0.9412	0.840764
W BIRCH ENSILED CHIPPED	6/2/2018	48.2	51.8	5	9	51.1	67.3	17.2	54	0.44	0.46	0.21	68
W BIRCH DRIED CHIPPED	6/2/2018	8.6	91.4	6.1	13	44.4	59.2	24.2	56	0.52	0.5	0.25	85
Ensiled/Dried		5.604651	0.56674	0.8196721	0.6923077	1.1509	1.13682	0.711	0.9643	0.846154	0.92	0.84	0.8
R MAPLE ENSILED CHIPPED	6/14/2018	55.4	44.6	6.2	10	39.6	54.5	28.8	58	0.55	0.52	0.27	99
R MAPLE DRIED CHIPPED	6/14/2018	8.1	91.9	5.7	15	48.1	67.2	16.6	54	0.44	0.46	0.21	71
Ensiled/Dried		6.839506	0.48531	1.0877193	0.6666667	0.82328	0.81101	1.735	1.0741	1.25	1.13043	1.2857	1.394366

Description	Harvest Date	% of DM Calcium	% of DM Phosphor	% of DM Magnesiu	% of DM Potassium	% of DM Sodium	PPM Iron	PPM Zinc	PPM Copper	PPM Mangan	PPM Molybden	% of DM Sulfur	HDE
W ASH ENSILED HAND STRIPPED	7/15/2018	1.54	0.12	0.32	1.04	0.008	56	13	9	76	0.1	0.28	
W ASH ENSILED CHIPPED	7/15/2018	0.95	0.13	0.13	0.85	0.01	537	27	24	24	0.1	0.11	
Chipped/Intact		0.616883	1.08333	0.40625	0.8173077	1.25	9.58929	2.077	2.6667	0.315789	1	0.3929	
W ASH ENSILED HAND STRIPPED	7/15/2018	1.54	0.12	0.32	1.04	0.008	56	13	9	76	0.1	0.28	
W ASH DRIED INTACT	7/15/2018	1.57	0.14	0.3	1.19	0.012	70	17	12	72	0	0.24	1.21
Ensiled/Dried		0.980892	0.85714	1.0666667	0.8739496	0.66667	0.8	0.765	0.75	1.055556	#DIV/0!	1.1667	
Q ASPEN ENSILED HAND STRIPPED	9/25/2018	1.09	2.41	64	3	57	33	10	9	194	0	0.22	1.26
Q ASPEN ENSILED CHIPPED	9/26/2018	1.05	0.11	0.19	0.64	0.011	79	186	9	109	0	0.13	1.06
Chipped/Intact		0.963303	0.04564	0.0029688	0.2133333	0.00019	2.39394	18.6	1	0.561856	#DIV/0!	0.5909	0.84127
Q ASPEN ENSILED CHIPPED	9/26/2018	1.05	0.11	0.19	0.64	0.011	79	186	9	109	0	0.13	1.06
Q ASPEN DRIED CHIPPED	9/25/2018	1.11	0.11	0.2	0.62	0.008	74	174	11	97	0	0.1	0.95
Ensiled/Dried		0.945946	1	0.95	1.0322581	1.375	1.06757	1.069	0.8182	1.123711	#DIV/0!	1.3	1.115789
BEECH ENSILED HAND STRIPPED	5/26/2018	0.51	0.28	0.2	1.34	0.013	218	31	13	145	0.1	0.24	
BEECH ENSILED SHREDDED CHIPPED	5/27/2018	0.6	0.17	0.13	0.71	0.01	180	28	10	132	0.2	0.14	0.88
Chipped/Intact		1.176471	0.60714	0.65	0.5298507	0.76923	0.82569	0.903	0.7692	0.910345	2	0.5833	
BEECH ENSILED HAND STRIPPED	5/26/2018	0.51	0.28	0.2	1.34	0.013	218	31	13	145	0.1	0.24	
BEECH DRIED INTACT	5/27/2018	0.63	0.29	0.19	1.23	0.037	152	36	13	93	0.6	0.23	1.06
Ensiled/Dried		0.809524	0.96552	1.0526316	1.0894309	0.35135	1.44079	0.861	1	1.55914	0.16667	1.0435	
BIG TOOTHED ASPEN ENSILED HAND STRIPF	9/10/2018	1	0.18	0.11	1.25	0.011	48	80	5	132	0.1	0.2	1.17
BIG TOOTHED ASPEN ENSILED CHIPPED	9/10/2018	1.27	0.14	0.11	0.89	0.012	74	77	5	102	0.3	0.13	0.99
Chipped/Intact		1.27	0.77778	1	0.712	1.09091	1.54167	0.963	1	0.772727	3	0.65	0.846154
HYBRID WILLOW MOFGA ENSILED HAND ST	7/6/2018	1.23	0.17	0.31	1.73	0.015	37	98	6	199	0	0.28	1.12
HYBRID WILLOW MOFGA DRIED INTACT	7/6/2018	1.98	0.2	0.4	2.24	0.009	80	106	9	345	0.1	0.48	1.17
Ensiled/Dried		0.621212	0.85	0.775	0.7723214	1.66667	0.4625	0.925	0.6667	0.576812	0	0.5833	0.957265
W BIRCH ENSILED CHIPPED 6/24? Check da	6/2/2018	0.64	0.07	0.09	0.34	0.012	291	176	4	312	0	0.06	0.86
W BIRCH DRIED CHIPPED	6/2/2018	0.53	0.07	0.1	0.39	0.012	208	173	4	329	0	0.07	0.96
Ensiled/Dried		1.207547	1	0.9	0.8717949	1	1.39904	1.017	1	0.948328	1	0.8571	0.895833
R MAPLE ENSILED CHIPPED	6/14/2018	0.86	0.09	0.09	0.55	0.009	57	19	6	359	0	0.09	1.02
R MAPLE DRIED CHIPPED	6/14/2018	0.74	0.08	0.08	0.47	0.008	595	19	5	316	0.2	0.07	0.86
Ensiled/Dried		1.16216	1.125	1.125	1.1702128	1.125	0.0958	1	1.2	1.13608	0	1.286	1.18605

% of Hand-stripped (Intact) Silage Nutrient Levels & Ratings in Chipped Silage (DM basis):

Species Harvest Date	Dry Matter	Crude Protein	Soluble Protein	Acid Detergent Fiber	Neutral Detergent Fiber	Non-Fiber Carbohydrat	Total Digestible Nutrients	Net Energy Lactation	Net Energy Maintenanc	Net Energy Gain	Relative Feed Value
White Ash 7/15/18	89	50	117	170	170	42	88	69	77	58	46
Q. Aspen 9/25/18	108	64	100	157	149	71	92	85	84	78	57
Am. Beech 5/26/18	115	64	200	172	163	46	90	75	79	66	47
B.T.Aspen 9/10/18	98	76	100	142	136	67	93	85	85	79	63
Aves.	102.5%	63.5%	129.25%	150.25%	154.5%	60.75%	90.75%	78.5%	81.25%	70.25%	53.25%

Description	Calcium	Phosphoru	Magnesium	Potassium	Sodium	Iron	Zinc	Copper	Manganese	Molybdenu	Sulphur
White Ash 7/15/18	62	108	41	82	125	959	208	267	32	100	39
Q. Aspen 9/25/18	96	5	0.3	21	0.02	239	1,860	100	56	100	58
Am. Beech 5/26/18	118	61	65	53	77	83	90	77	91	200	58
B.T.Aspen 9/10/18	127	78	100	71	109	154	96	100	77	300	65
Aves.	100.75%	61.87%	51.57%	56.75%	77.75%	358.75%	563.25%	136%	64%	175%	55.25%

% of Dried Fodder Nutrient Levels & Ratings in Ensiled Fodders (DM basis):

Description	Dry Matter	Crude Prot	Solub Prot	AD Fiber	ND Fiber	Non-F Carb	TD Nutrient	NE Lactati	NE Mainten	NE Gain	Rel Feed V
White Ash 7/15/18 Int	72	98	86	116	101	98	95	95	92	89	95
Q. Aspen 9/25/18 Ch	49	112	56	86	86	132	105	112	108	116	126
Am. Beech 5/26/18 Int	37	100	133	98	78	151	103	110	109	117	129
Hyb. Willow 7/6/18 Int	37	75	433	127	110	99	97	95	97	94	84
W. Birch 6/2/18 Ch	57	82	69	115	114	71	96	85	92	84	80
R. Maple 6/14/18 Ch	49	108	67	82	81	173	107	125	113	129	139
Aves.	50.17%	95.83%	140.63%	104%	95%	120.67%	100.5%	103.67%	101.83%	104.83%	108.83%

Description	Calcium	Phosphoru	Magnesium	Potassium	Sodium	Iron	Zinc	Copper	Manganese	Molybdenu	Sulphur
White Ash 7/15/18 Int	98	86	107	87	67	80	76	75	106	0.1/0	1
Q. Aspen 9/25/18 Ch	95	1oo	95	103	137	107	107	82	112	0/0	130
Am. Beech 5/26/18 Int	81	97	105	109	35	144	86	100	156	167	104
Hyb. Willow 7/6/18 Int	62	85	77	77	167	46	92	67	58	0	58
W. Birch 6/2/18 Ch	121	100	90	87	100	140	101	100	95	100	86
R. Maple 6/14/18 Ch	116	112	112	117	112	10	100	120	114	0	129
Aves.	95.5	96%	97.67%	96.67%	103%	87.83%	93.67%	90.67%	106.83%	122.00%	84.67%

5 Samples (included above), Additional DairyOne "Fermentation Profiles," plus ADICP & Adjusted CP

Description	Harvest Date	% Moisture	% DM	% Crude Prot.	% Avail. Prot.	% ADICP	Adj. Crude Prot.	% Solub. Prot.	Ph	% Ammonia (CPE)
Y BIRCH ENSILED HAND STRIPPED	8/10/2018	59.5	40.5	12.1	8.3	3.8	9.3	4	5.1	0.05
W ASH ENSILED HAND STRIPPED	7/15/2018	34.7	65.3	11.2	6.5	4.7	7.5	6	5.6	0.06
R OAK ENSILED HAND STRIPPED	8/20/2018	53.4	46.6	15.6	12.7	3	13.7	9	5.4	0.12
BEECH ENSILED HAND STRIPPED	5/26/2018	66.6	33.4	19.2	16.5	2.7	17.5	8	3.7	0.06
W ASH ENSILED CHIPPED	7/15/2018	41.6	58.4	5.6	2.6	3	3.6	7	5.5	0.02
Averages		51.16	48.84	12.74	9.32	3.44	10.32	6.8	5.06	0.062

Description		LACTIC ACID	ACETIC ACID	LACTIC/ACETIC	PROPIONIC ACID	% Butyric	% Iso Butyr.
Y BIRCH ENSILED HAND STRIPPED	8/10/2018	0	0.25	0	0.13	0.1	0.05
W ASH ENSILED HAND STRIPPED	7/15/2018	0.03	0.05	0.52	0	0	0
R OAK ENSILED HAND STRIPPED	8/20/2018	0.04	0.09	0.4	0	0	0
BEECH ENSILED HAND STRIPPED	5/26/2018	0.07	0.13	0.53	0	0	0
W ASH ENSILED CHIPPED	7/15/2018	0.03	0.02	1.25	0	0	0
Averages		0.034	0.108	0.54	0.026	0.02	0.01

Description		% Total Acids	Amm-N	% of Total N
Y BIRCH ENSILED HAND STRIPPED	8/10/2018	0.53	0	
W ASH ENSILED HAND STRIPPED	7/15/2018	0.08	1	
R OAK ENSILED HAND STRIPPED	8/20/2018	0.13	1	
BEECH ENSILED HAND STRIPPED	5/26/2018	0.21	0	
W ASH ENSILED CHIPPED	7/15/2018	0.05	0	
Averages		0.2	0.4	

20 Additional Samples sent to replace missed ADICP measurements (missed asking for Adjusted CP):

Description	Harvest Date	% Moisture	% Dry Matter	% ADICP
W ASH ENSILED INTACT	9/25/2018	66.9	33.1	3.5
W ASH ENSILED INTACT	10/2/2018	72.8	27.2	6.7
W BIRCH ENSILED INTACT	10/20/2018	62.1	37.9	4.3
WILLOW ENSILED INTACT	7/8/2019	66.4	33.6	7.6
R OAKS RD SIDE ENSILED INTACT	7/30/2018	55.3	44.7	2.1
Q ASPEN ENSILED INTACT	9/5/2018	51.5	48.5	5.3
R MAPLE ENSILED INTACT	8/5/2018	51.1	48.9	2.6
W ASH ENSILED INTACT	8/30/2018	54.2	45.8	7.1
Averages		60.0375	39.9625	4.9
R MAPLE ENSILED CHIPPED	6/14/2018	51.6	48.4	1
Y BIRCH ENSILED CHIPPED	6/22/2018	49.1	50.9	3.6
R OAK ENSILED CHIPPED	8/4/2018	51.8	48.2	4.2
Averages		50.83	49.17	2.93
DRIED BEECH INTACT	5/26/2018	12.4	87.6	4.7
DRIED W BIRCH INTACT	6/16/2018	13.2	86.8	2
DRIED WILLOW INTACT	7/6/2018	13.9	86.1	5.4
DRIED Q ASPEN INTACT	2018	11.5	88.5	5.1
Averages		12.75	87.25	4.3

Description	Harvest Date	% Moisture	% Dry Matter	ADICP
DRIED BEECH SHREDDED	5/27/2018	11	89.1	2.2
DRIED Y BIRCH CHIPPED	6/22/2018	8.2	91.8	2.2
DRIED W ASH CHIPPED	7/15/2018	6	94	1.9
DRIED R OAK CHIPPED	8/31/2018	11.1	88.9	2.7
DRIED B T ASPEN CHIPPED	9/12/2018	5.7	94.3	3.7
Averages		8.4	91.62	2.54

Discussion:

COMPARISON TO GRASS SILAGE AND HAY:

Protein:
On average our ensiled or dried tree leaf fodders had comparable Crude Protein to grass silage or hay, but 1/3 to 1/5 as much Soluble Protein and 3 to 4 times higher Acid Detergent Insoluble Crude Protein (ADICP), so less Available Protein and lower Adjusted Crude Protein than ensiled or dried grass fodders.

Strangely, in the only goats' milk test I have run (data for a cheesemaker to present about cheesemaking with tree leaf-based milk, during Tree Fodder Seminar 2017), proteins were higher than in average goats' milk. The goats had eaten oak, maple, and pasture that day.

Traditionally, animals were over-wintered solely on tree leaf fodders, but were probably not being milked nor fattened in winter. Protein in our samples was sufficient for maintenance diets.

Our protein figures varied. Our beech samples were consistently highest, probably due to the early cut date and due to being the envigorated growth of a previously pruned tree in full sun outside the Demo Area. Oak samples were next highest in protein; the 8/20/18 oak samples were envigorated growth from a previously pruned stand in full sun, but the 8/4/18 oak samples were from the shady 20 yr. growth in the Demo Plot.

Fiber:
Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) in our hand-stripped samples were significantly lower than in average grass-based fodders – a pleasant surprise! Our chipped fodders had somewhat higher ADF and NDF than grass-based fodders.

Non-fiber Carbohydrates:
Our hand-stripped silages on average had over twice as much Non-fiber Carbohydratres (NFC) as average grass silage, and our dried hand-stripped samples had 1 ½ times as much NFC as average grass hay.

Our chipped fodders were on average slightly higher in NFC than grass-based fodders, another pleasant surprise!

Total Digestible Nutrients:
Our samples were on average comparable to grass-based fodders as to Total Digestible Nutrients (TDN).

Net Energy:
Our Net Energy figures (NELactation, NEMaintenance, and NEGain) for hand-stripped fodders averaged about 1/5 higher than those of average grass-based fodders. Our NE figures for chipped silages averaged 1/5 lower than average grass silage, but those of our dried chipped samples were comparable to NE figures for average grass hay.

Relative Feed Value:
Hand-stripped samples received Relative Feed Value (RFV) ratings on average of over 1 ½ times the rating average for grass-based fodder.

Minerals:
Summary: Our fodders were generally higher than grass fodders in calcium, zinc and manganese, but were lower in phosphorus, potassium, sodium and molybdenum. Other minerals were within range of levels in grass-based fodders. Our findings were fairly consistent with those of Austad et al. (2003), who tested similar fodders in Norway, EU (much more thoroughly than did we). Minerals varied widely by tree species, so offering diverse or mixed fodders is beneficial.

Calcium:
Our samples were high in Calcium. Willow, ash, and aspens were highest. None of our samples had as low Calcium as the grass-based fodder averages. Our early-cut beech samples were lowest and just a bit higher than grass-based fodder averages; Garmo (1999) found Calcium levels to rise with the growing season.

Phosphorus:
Beech stood out as high in Phosphorus (P), with similar amount or more than in grass-based fodders. Generally our samples averaged lower in P than grass-based averages. Livestock generally need more phosphorus than is available in most leaf or grass forages. Sheep and goats can eat up to 20% rapeseed a.k.a. "canola" (they do not need that much!), which has 1.1 to 1.3% P with 25 to 30% digestibilty (Maison, T., 2013), much higher than the .65 to .69% in soy meal. My hogs say that hogs may have more limited tollerance for rape. Dave Oullette at Lake Shore Farms, St. David, ME sifts rape out of his oats as "weed seeds;" we sifted here one year, so I have 3 barrels full. Due to this study, I am changing my "no grain for goats" rule to feed this supplement.

Magnesium:
Hand-stripped samples were similar to grass-based aves. in Magnesium content; chipped samples were lower.

Potassium and Sodium:
Our samples were significantly lower in both Potassium and Sodium than grass-based fodders. Our Potassium levels meet nutritional requirements, but Sodium does not (so we harvest seaweed, plus provide a salt block).

Iron:
Iron content varied greatly, and I wonder about the ensiled chipped Red Oak 8/4/18 figure of 3590 ppm, from a Demo Plot tree and so much higher than our other samples, most from that site. Average Iron content nevertheless remained lower than figures for grass-based fodders.
Our Iron levels are nutritionally more than sufficient.

Zinc:
Our Zinc figures were 2 to 3 times the Zinc averages for grass-based fodders. Samples from both Birch species, both Aspens, and Willow were much higher in Zinc than were our other samples; Red Maple and White Ash had much less Zinc than average grass-based fodders.

Copper:
Copper figures were within range of grass-based figures. Beech, White Ash, and then Quaking Aspen were highest. Chipped ensiled 7/15/18 ash had 24 ppm – almost twice the level in the next highest sample – is this a mistake? High levels of Copper can be toxic to sheep – and ash was less a top species choice for the sheep in SARE FNE18-897 than it was for cattle, goats and hogs.

Manganese:
Our samples were high in Manganese. Average Manganese content in hand-stripped samples was about 4 times the average grass-based figures, and average of chipped samples was about twice the grass-based amounts. White and Yellow Birches, Red Oak, and Red Maple were particularly sky-high in Manganese.

Molybdenum:
Our Molybdenum figures were a small fraction of those of grass-based fodders. Deficiencies have not been reported, so supplementation is not needed.

Sulphur:
Sulphur figures were within range of grass-based figures.

Horse Digestible Energy:
Horse Digestible Energy (HDE) was in range of that of grass-based fodders.

FERMENTATION PROFILES:
Acidity Querry:
5 Fermentation Profiles found extremely low amounts of the five acids measured, yet Ph ranged from 5.6 down to 3.7. Spring-packed Beech had the lowest Ph, probably due to having longest to ferment, yet was reported to have only .21% Total Acids, as was average for our 5 samples.

Do traditional hand-stripped, and modern chipped tree leaf silages produce different acids than does grass silage? Whatever these acids are, the livestock (and the noses and sometimes mouths of humans) approve.

Ammonia, CPE % & Amm-N % of Total Nitrogen:
These figures were also extremely low in our samples.

Reflections on Shelf-life, Palatability and Mold in our Silages:
I now (2/29/20) still have silages harvested in summer 2018, which seem to have increased in acidity. A few buckets (ones without plastic bags stuffed for the top layer) have slight white fibrous mold (which the animals accept) at top edge air leaks.

I have been feeding out these remaining old silages as an ultimate treat, to my heiffer (soon to be cow) after ox practice, and to my hogs right next to her (so they won't be tempted to jump the fence to share).

Tree matter keeps more easily than grass in general; one can dry fresh branches under a tarp without molding. More information is needed as to what happens chemically in this pleasant aromatic fermentation of tree matter.

CHIPPED SILAGE vs. HAND-STRIPPED (also noted as "Intact") **SILAGE:**

Hand-stripped leaves remained intact, and only short base twigs were included. Chipped leafy branches included branch wood up to1 inch.

4 pairs of matched (same harvest from same tree) chipped and hand-stripped samples included White Ash, Quaking Aspen, Am. Beech, and Big Toothed Aspen. Dry matter was 2% higher in chipped vs. intact; Soluble Protein was 29% higher in chipped, probably due to faster fermentation. Fiber was of course much higher, by 50 (ADF) and 54% (NDF) in chipped, due to inclusion of branch wood.

Non-fiber Carbohydrates (NFC – nutritious cell contents) in chipped silage were 61% of those in intact silage, on average. Net Energy figures were on average 70 to 80% of that of intact silages. Relative Feed Value (RFV) of chipped silage was on average 53% of that of intact silages.

Calcium levels on average were similar in chipped and hand-stripped samples.

Phosphorus, Magnesium, Potassium, Manganese and Sulphur were all significantly lower in chipped versus hand-stripped fodders, by 36 to 48%. Sodium was lower by 22%.

Iron, Zinc, Copper and Molybdenum were significantly higher on average in chipped versus hand-stripped fodders, so must be more present in wood or bark than in leaves. Copper was only 36% higher, but Zinc in average chipped fodder was more than 5 times as much as in hand-stripped.

See chart on pp. 8-9 for ranges of variance; I am a farmer who took a statistics course over 20 years ago. I am using the term "significant" loosely.

ENSILED vs. DRIED:

Ensiled fodders on average had about 50% of the Dry Matter of dried fodders, in our matched (same harvest from same tree) pairs of samples. The only other significant difference measured was that ensiled samples had 41% more Soluble Protein than matched dried samples.

Traditional sources tell us that cattle and hogs were fed ensiled tree leaves, which were believed to be more easily digested than dried leaves.

See chart on p. 9 for ranges of variance; I am a farmer who took a statistics course over 20 years ago. I am using the term "significant" loosely.

RELATION OF LAB RESULTS TO LIVESTOCK RESPONSE DATA:

Rankings of Livestock Responses, Calcium Levels, RFV and NFC
(Top six ratings in each data category are underlined, for an informal visual scan of correlation.)

Livestock Responses averaged for each tested sample across aves. for each livestock species.
* 3 = Immediately Consumed; 2 = Eventually Consumed; 1 = Tasted; 0 = Refused.

Livestock Responses * see note and rating scale above	**Calcium** %DM	**RFV**	**NFC** %DM
1st, 3. W. Ash Dried Intact (2nd cutting of Edge Pollard)	2nd, 1.57	4th, 167	3rd, 38.9
1st, 3. B. T. Aspen Ensiled Hand-stripped (Edge trees by pond, some topped previously?)	11th, 1.0	11th, 148	5th, 37.3
3rd, 2.93 Yellow Birch Ensiled Hand-stripped (D)	9th-10th, 1.05	10th, 150	7th, 36.1
4th, 2.88 Hyb. Willow Ens. Hand-str. (Full sun at MOFGA)	6th, 1.23	13th. 132	10th, 32.9
4th, 2.88 Am. Beech Dried Intact (3rd pruning, House yard)	23rd-24th, 0.51	14th, 125	20th, 20.7
6th, 2.86 Hyb. Willow Dried Intact (Full sun at MOFGA)	1st, 1.98	7th, 157	9th, 33.3
7th, 2.84 Red Oak Ensiled Hand-stripped (3rd pruning, Rd. front by pond)	16th, 0.78	15th, 122	18th, 24.
8th, 2.63 White Ash Ens. Hand-str. (2nd cutting, Edge Pollard)	3rd, 1.54	6th, 159	4th, 38.5
8th, 2.63 Am. Beech Ensiled Hand-stripped (3rd pruning, House yard)	23rd-24th, 0.51	5th, 161	12th, 31.2
10th, 2.52 Red maple Ensiled Hand-stripped (D)	19th, 0.71	2nd, 188	1st, 46.2
11th, 2.50 Big-toothed Aspen Ensiled Chipped (Edge trees by pond, some topped previously?)	5th, 1.27	18th, 93	16th, 24.9
12th, 2.40 Quaking Aspen Ensiled Hand-stripped (D)	4th, 1.39	1st, 191	2nd, 42.5
13th, 2.30 Am. Beech Ensiled Chipped (3rd pruning, House yard)	25th, 0.5	22nd, 76	26th, 14.3
14th, 2.25 Quaking Aspen Ensiled Chipped (D)	9th-10th, 1.05	16th, 108	13th, 30.4
15th, 2.21 Yellow Birch Dried Intact (D)	20th-22nd, 0.64	3rd, 179	8th, 34.7
16th, 2.19 White Birch Ensiled Hand-stripped (D)	7th, 1.2	8th, 151	6th, 36.5
17th, 2. Big-toothed Aspen Dried Intact (D)	13th, 0.94	9th, 150	11th, 32.4
18th, 1.75 Red Oak Ensiled Chipped (D)	20th- 22nd, 0.64	21st, 77	22nd, 17.1
19th, 1.67 Red maple Dried Chipped (D)	18th, 0.74	24th, 71	23rd, 16.6
White Birch Ensiled Chipped (D)	17th, 0.64	25th, 68	251st, 17.2
20th, 1.6 Red Oak Dried Intact	13th, 0.87	12th, 139	15h, 25.1

21st, 1.53 White Ash Ensiled Chipped (2nd cutting, Edge Pollard)	12th, 0.95	23rd, 73	24th, 16.
22nd, 1.36 Red maple Ensiled Chipped	15th, 0.86	17th, 99	14th, 28.8
23rd, 1.29 Yellow Birch Ensiled Chipped (D)	17th, 0.76	26th, 65	25th, 15.2
24th, 0.75 Quaking Aspen Dried Chipped (D)	8th, 1.11	19th, 86	19th, 23.

(D = samples from Demo Plot trees in dense woodland.)

Why did livestock choose what they chose?
Some loose correlation is shown above between animal choices and calcium levels, Relative Feed Value figures, and Non-Fiber Carbohydrates. Such ordering of other data in the lab tests seems on visual review to be unlikely to yield strong correlations.

A stronger correlation exists between animal choice order and visually noted foliar health due to prior access to sunlight, enriched soil sites, and past pruning of the tree sampled leading to young vigorous growth. See small notes in parentheses next to each sample name above. Demo Plot samples, marked with (D) above, were from approximately 20 yr. old growth on trees in a tall dense woodland.

Historically, Europeans harvested young (3 to 8 yr. old) previously pollarded growth on all species, plus in lesser quantity used foliage from felled trees.

In our SARE Demo Plot woodland, the trees are now in almost full sun due to canopy harvest, and the next harvest (planned to be in 4 to 5 years) will likely receive consistently high animal ratings, and possibly higher lab test figures as well.

VALIDITY:

We had funding for less than one test of each bucket, bag, or bale of distinct material type, most from one tree each on one harvest day each. Therefore NONE of our data is conclusive, but more a taste or glimpse of possible feed value or lack thereof, for this diverse range of winter-stored tree leaf fodders. Our averages for dried chipped fodders are especially limited, as we only tested 3 species-differentiated samples.

Fermentation Profiles clearly missed testing actual chemical constituents of tree leaf silages.

CONCLUSION:

Dried and ensiled tree leaf fodders are tasty to livestock and are likely to provide sufficient nutrition for winter maintenance, with supplementation for phosphorus and sodium. Protien and protein digestibility limit use for lactation or growth; a mixed diet including tree leaf fodders along with a protein source may then be beneficial.

Livestock groups and individuals within groups select differing preferences, with some loose correlations to lab data. Minerals vary greatly per species; we hope that the varied selections by animals and animal groups reflect their differing needs. Unmeasured antifeedant plant chemicals vary per species, season, weather and tree health. Tree “happiness” is my intuitive factor related to low antifeedants and high foliar health which my animals seem to value; perhaps a simple brix test might be enlightening, or there may be energetic factors beyond current lab testing. Trees in full sun and young growth from pollards are rated higher by animals than older canopy growth from a dense previously unpruned woodland.

Chipped fodders had about 60 to 80% of the nutrition of similar hand-stripped fodders (which include more leaf and less wood), yet some of these were especially high in certain minerals (iron in bark or wood might be desired by some; the copper could be problematic for sheep). Such chipped fodders are convenient to pack and transport, and may be beneficially fed as part of a more diverse diet. Sheep and goats are able to select choice pieces and leave the woody bits for bedding, especially if chipped or shredded coursely (Austad et al, 2003; also our experience in SARE FNE18-897).

Climate disruption is most closely related to loss of top soil and unprecedented destruction of climate-regulating plant and foliar land cover. Tree-driven water cycles and evapotranspiration are of prime importance; the unprecedented atmospheric carbon accounts for only 5 to 8% of climate disruption (Bane, 2019; Eisenstein, 2018; Hanes, 2019; Jehne, 2019). Tree-based fodder production involves cultivation of more layers of perennial greenery on the farm, and/or use of tree wastes from community sources; both can relieve pressure to produce crops from tilled land.

Both trees and pasture offer greater climate benefits when vegetative growth is stimulated by well-timed pruning or grazing. The stakes are high; further study and practical trials are in order to surmount labor barriers and solidify modern use of tree leaf fodders.

NEXT STEPS:

We hope to experiment with winnowed separation of leafier vs. woodier portions of chipped leafy branches, as the material blows out of various chipper/shredders, this summer, 2020, for silage more dense in nutrients. Collaborators are invited!

Because the DairyOne Fermentation Profiles tested only acids not present in our tree leaf silages, Sue Ishaq at UME Orono (ruminant gut microbe expert) has taken samples (3 each type this time, for more validity) from our July 8, 2019 willow silage (again from MOFGA) and Sept. 25, 2018 Demo Plot w. ash silage (now older but remaining tasty to livestock), to explore in the University labs. We look forward to finding reasons for animal enthusiasm!

Effects on parasite loads are suspected, noted in traditional literature, should be tested, and could prove particularly valuable for organically raised sheep. Historically, European sheep were fed only dried tree leaves in winter (no grass hay), to reduce parasite loads (Slotte, 2000; Read, 2003; Machatschek, 2002).

More thorough sampling, of higher numbers of trees of each species, higher number of tests per sample batch, and of sets of trees in specific types of locations (based upon sunlight access and soil qualities) and at various harvest dates would be worthwhile to produce more conclusive results.

Tests of 24 or 48 hr. digestibility would be of interest. Austad et al (2003) did report on invitro digestibility of chipped leafy branches vs. foliage (dried and ensiled); a closer look is in order to see if a comparison can be made to grass fodders (once my Norwegian friend/translator sails home).

A full translation of Austad et al. (2003) into English from Norwegian would be valuable, as these biologists looked into the health of the sheep as well as more stringent testing of the leaf silages and dried fodders. (If someone obtains author permission to do this, I can lend my bound copy sent by Ingvild.)

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