

INTERRELATIONSHIPS OF TOTAL LOSSES AND CHEMICAL CHANGES IN PRESERVATION OF SILAGES

Howard Voelker, Dairy Department
South Dakota State College, Brookings

The purpose of this research was to determine the chemical changes which occur between ensiling and feeding oat and alfalfa forages and to determine such changes in relationship to total weight losses of these silages.

During the past four years more than 500 samples were collected for analyses. Usually samples were collected every three or four truck-loads as the trucks were unloaded when the silos were filled. The samples were placed in plastic bags and delivered to the Station Biochemistry Laboratory for conventional analyses. During the feeding of silages, samples were usually taken once each week from the silos to obtain representative samples as the silages were fed. Also, samples of spoiled silages from the top of the silos, etc. were obtained.

The samples were frozen soon after collection and stored. Then they were analyzed for ether extract, crude fiber, crude protein (N x 6.25), ash and nitrogen-free extract by A.O.A.C. methods or slight variations of them. Carotene determinations were made on some of the samples (slight modification of A.O.A.C.). Some of the samples were composited, where many samples were available on fairly uniform forages. The weights of silage into the silos were determined by weighing truck-loads of forage on a large scale. The consumption of edible silage was determined by weighing the silage into feed bunks and recording weights of weighed spoilage and feed refusals. Losses were determined as the difference in weight between forage weighed into the silos and edible silages.

RESULTS

The changes that took place in the silage composition between ensiling and feeding are shown in Table I. It is apparent that there was a very slight change in ether extract values of good silage between ensiling and feeding. Crude fiber increased, percentagewise, by about 3% on the average. The protein percent decreased about 1% upon storage. Percentagewise, ash values increased 1.5%. The ash values appeared to increase the most where the total losses were highest and changed very little where total losses were low. The average of the average percentages of nitrogen-free extract showed a decrease of 3.27%.

By comparison of the chemical analyses of Table I and Table IA with Table II it is clear that in spoiled silage some of the changes

TABLE I
CHANGES IN CHEMICAL COMPOSITION OF SILAGES IN SEVERAL TYPES OF SILOS BETWEEN
ENSILING AND FEEDING

Kind and Date	Silo	As ensiled (dry basis)			Ash			N.F.E.			As fed (dry basis)			Ash			N.F.E.		
		Ether Extract %	Crude Fiber %	Protein %	%	%	%	%	%	%	Ether Extract %	Crude Fiber %	Protein %	%	%	%	%	%	%
Alfalfa sodium bisulfite 57-58	Bunker	3.12	29.95	16.28	9.02	41.63	3.20	33.37	16.09	12.94	34.40								
Alfalfa 1958	Plastic & bales	2.57	23.28	21.13	8.93	44.09	3.24	26.04	21.15	10.94	38.65								
Oat 57-58	Upright	3.80	28.20	12.10	9.50	46.40	3.70	31.30	11.10	10.00	43.90								
Oat 57-58	Bunker	3.80	28.90	12.90	8.60	45.80	3.40	30.00	12.00	11.20	43.40								
Oat 58-59	Upright	3.64	30.06	11.63	10.25	44.42	3.89	30.65	9.79	10.81	44.86								
Oat 58-59	Bunker	4.13	26.72	10.65	8.83	49.67	3.01	29.58	12.51	10.98	43.92								
Alfalfa S. 1958	Harve- store	3.23	20.40	23.91	11.08	41.38	4.24	21.95	21.26	9.88	42.67								
Alfalfa W. 1959	Harve- store	2.54	23.66	22.63	8.36	42.81	2.18	28.72	18.17	7.93	43.00								
Alfalfa 1955-56	Bunker	3.23	25.08	18.01	8.61	44.31	2.26	31.49	16.86	12.38	37.01								
All silages	Averages	3.34	26.25	16.58	9.24	44.59	3.24	29.23	15.43	10.78	41.32								
Change ensiling to feeding		-10%	+2.98	-1.15	+1.54	-3.27													

TABLE IA
CHANGES IN MOISTURE AND CAROTENE AND WEIGHT LOSSES
BETWEEN ENSILING AND FEEDING SILAGES

Kind and Date	Silo	As Ensiled		As Fed		Total Loss (%)
		H ₂ O (%)	Carotene (Mcg/g)	H ₂ O (%)	Carotene (Mcg/g)	
Alfalfa sodium bisulfite 1957-58	Bunker	70.00	140	71.70	61	32.5
Alfalfa 1958	Plastic & bales	56.12	63	60.41	18	.....
Oat 1957-58	Upright	69.7	124	72.2	117	29.6
Oat 1957-58	Bunker	67.3	133	67.5	33	37.1
Oat 1958-59	Upright	71.4	35	69.1	30	14.6 35.4
Oat 1958-59	Bunker	59.4	50	64.0	23	30.9 33.8
Alfalfa S. 1958	Harvestore	52.81	246	51.5	115	1.7
Alfalfa W. 1959	Harvestore	40.3	68	42.5	29	6.7
Alfalfa 1955-56	Bunker	62.86	33	64.2	19	.....
Average of averages		61.11	99	62.59	49	.....

TABLE II
CHEMICAL ANALYSES OF SPOILED OR INEDIBLE SILAGES

Kind of Silage	Silo	Year	Moisture %	Ether Extract %	Crude Fiber %	Crude Protein %	Ash %	N.F.E.		Carotene Mcg./g.
								%	%	
Alfalfa sodium bisulfite Change from ensiling	Bunker	1957-58	76.85	1.41	27.91	20.96	22.21	27.51	.....	.....
			6.85	-1.71	-2.04	4.68	13.19	-14.12	.....	.....
Alfalfa Change from ensiling	Bale and Plastic	1958-59	63.9	2.68	27.01	20.39	16.29	33.63	.....	.....
			7.77	.11	3.73	-0.74	7.36	-10.46	.....	.....
Oat Change from ensiling	Upright	1957-58	77.9	2.30	29.70	14.00	14.70	39.3	27	.....
			8.2	-1.50	1.50	1.90	5.20	-7.2	-97	.....
Oat Change from ensiling	Bunker	1957-58	73.4	2.30	29.80	15.40	16.30	36.20	3	.....
			6.1	-1.50	.90	2.50	7.70	-9.70	-130	.....
Oat Change from ensiling	Upright	1958-59	78.90	3.27	35.79	8.27	13.15	39.50	.....	.....
			7.41	-.37	5.73	-3.36	2.90	-4.92	.....	.....
Oat Change from ensiling	Bunker	1958-59	71.02	2.98	32.02	14.17	12.05	38.78	37	.....
			11.55	-1.15	5.30	3.52	3.22	-10.89	-13	.....
Alfalfa Change from ensiling	Bunker	1955-56	72.60	1.41	39.85	19.95	15.62	23.17	4	.....
			9.70	-1.28	14.21	-2.05	5.81	-21.24	-19	.....
Alfalfa 10% corn Change from ensiling	Bunker	1955-56	66.30	1.82	30.73	17.45	13.46	36.54	4	.....
			1.80	-1.72	5.50	1.18	6.53	-7.83	-13	.....
Overall averages	Avg. of % change		+7.42	-1.14	+4.35	+66	+6.49	-10.79	-54	.....

in chemical composition have progressed to a greater degree. The moisture content of spoiled silage increased much more than in good silage. Ether extract values in the majority of silages decreased in spoiled silage. Crude fiber, on the other hand, increased percentagewise, considerably more in the spoiled than in the edible silage. Crude protein values in spoiled silage are difficult to interpret. Apparently some other factors are involved, such as non-protein nitrogen. In the spoiled silage it is very clear that percentagewise, ash values increased a great deal, if one compares spoiled and ensiled forage. The nitrogen-free extract values decreased to a greater extent in spoiled than in edible silage. Carotene, likewise was unstable and readily lost, and lost to the greatest extent in the spoiled silage.

In summary, it appears that there are extreme differences in chemical changes that occur in alfalfa and oat silages, depending possibly upon the type of silo, the moisture content of the forage, type of forage, stage of maturity, year-to-year effects, and areas in the silos that are sampled. The greater the exposure to air, the greater are the undesirable changes that occur in silages upon storage.

ACKNOWLEDGMENT

The analyses by Biochemistry and research assistance by Dairy Department are appreciated.