NaOH Wheat Silage and Alfalfa Haylage for Growing Steers and Heifers

Keith Bolsen, Harvey Ilg, Mopoi Nuwanyakpa, and Jim Hoover

Summary

Wheat silage, with and without sodium hydroxide (NaOH), was fed, with or without alfalfa haylage, in an 80-day growing trial. Calves fed NaOH-silage consumed 18% more feed and gained 16% faster than those fed control silage, but feed efficiencies were similar. When 50% of the wheat silage was replaced with alfalfa haylage (DM basis), gains decreased 3.1 and 3.7%, feed intake increased 12.3 and 9.7%, and feed efficiency decreased 23.7 and 14.4% for calves fed control and NaOH silages, respectively. NaOH increased ensiling temperatures by 9 to 12° C during the first 6 weeks. Dry matter recovery from the concrete stave silos was similar for both silages (82.1% for control and 83.9% for NaOH); recoveries from buried bags were 92.3 and 89.5%. NaOH wheat silage was more stable in air than was either control wheat silage or alfalfa haylage.

Introduction

In several previous trials, we showed that wheat silage can be used effectively in cattle growing rations (Bulletin 613, Kansas Agriculture Expt. Station). However, compared with corn silage, wheat silage is less digestible, has a lower intake, and deteriorates faster in air.

This trial was our second one in which we evaluated the potential of sodium hydroxide and alfalfa haylage to improve the quality of wheat silage rations.

Experimental Procedure

Two whole-plant wheat silages (late dough, 57% moisture) were made in 10 ft x 50 ft concrete stave silos on June 9 and 10, 1980, without (control) or with NaOH applied at 3.8% of the crop dry matter. NaOH was applied as dry prills, metered with a hydraulic applicator attached to the silage blower. Silage was direct-cut using a Field Queen forage harvestor with a 2-inch recutter screen.

Silos were opened after 7 months. Each silage was fed to 30 Hereford and Simmental steer and heifer calves (six pens of five calves) during an 80-day growing trial (January 5 to March 26, 1981). For three pens receiving each wheat silage, alfalfa haylage replaced half the silage (dry matter basis). Wheat silages and haylage were full-fed along with supplement fed at 2.0 lb of supplement per calf daily (air-dry basis). Supplements were formulated to bring the total rations (dry basis) to 12.0% crude protein (all natural), .45% calcium, .35% phosphorus and to provide 30,000 I.U. of vitamin A and 70 mg of aureomycin per calf daily. The two NaOH wheat silage rations contained 1.4% potassium, supplied by either potassium chloride or alfalfa haylage. Rations were fed twice daily, with forage and supplement mixed in the bunks.

The haylage (ensiled at 40 to 44% moisture in a 14 ft x 40 ft Harvestore) was from 4th-cut alfalfa harvested in September, 1979.

All calves were weighed individually, after 16 hr without feed or water, at the start and at the end of the trial. Intermediate weights were taken before the a.m. feeding on days 28 and 56.

Dry matter losses during fermentation, storage, and feedout were measured for both wheat silages by weighing and sampling all loads of fresh crop ensiled and, later, weighing and sampling all silage removed. About 125 lb of fresh crop was removed from each silo twice during filling, packed into three nylon bags (30 lb/bag), and buried in each silo. As silage was fed, bags were removed from the silos, weighed, mixed, and sampled for chemical analysis, and dry matter loss was determined. Ensiling temperatures during the first 6 weeks were monitored with four thermocouples evenly spaced in each silo.

Aerobic stability (bunk life) of the wheat silages and haylage was determined as described on page 7 of this Progress Report.

Results

Chemical analyses of the two silages and haylage are shown in Table 7.l. Control silage fermented normally, as evidenced by low pH, predominance of lactic acid, and little butyric acid. However, NaOH silage underwent a clostridial fermentation, characterized by high pH, excessive butyric acid, and little lactic acid.

Ensiling temperatures (Figure 7.l) averaged 9° to 12° C warmer for NaOH silage than the control throughout the 6 weeks.

Cattle performances are shown in Table 7.2. Calves fed NaOH silage alone gained faster ($P<.05$) and consumed more feed ($P<.05$) than those fed control silage alone. Adding alfalfa haylage to either wheat silage increased feed intake by about 11%, but decreased rate and efficiency of gains. Our previous trial (Progress Report 394) also showed that NaOH increased intake but not use of wheat silage and that haylage had less net energy than wheat silage. In both trials, the high sodium content of the NaOH silage rations caused high water intake, excessive urination, and extremely wet pen conditions.

Dry matter losses in the stave silos (Table 7.3) were similar for control and NaOH wheat silages and 2 to 6 percentage units higher than those generally obtained with corn or sorghum silages. Dry matter loss from the buried bags represented slightly less than the minimal loss obtainable in a farm-scale silo.

Aerobic stability results in Table 7.4 show that NaOH silage was highly stable in air (heating on the 10th day), control silage moderately stable (heating on the 4th and 5th days), and haylage unstable (heating on the 2nd day).

Table 7.1. Chemical analyses of control and NaOH wheat silages and alfalfa haylage.

Forage	Dry matter	pH	Ash	Crude protein	Crude fiber	Lactic acid	Acetic acid	Propionic acid	Butyric acid	NH_3-N*
	%		% of the DM							
Control	41.95	4.24	7.17	11.11	24.40	4.29	1.40	.19	.17	6.76
NaOH	41.75	7.16	10.37	9.67	25.46	.82	1.23	.95	5.82	9.67
Alfalfa haylage	60.43	5.61	11.23	23.71	24.78	1.24	.86	.16	.03	4.20

*NH_3-N expressed as a % of total N.

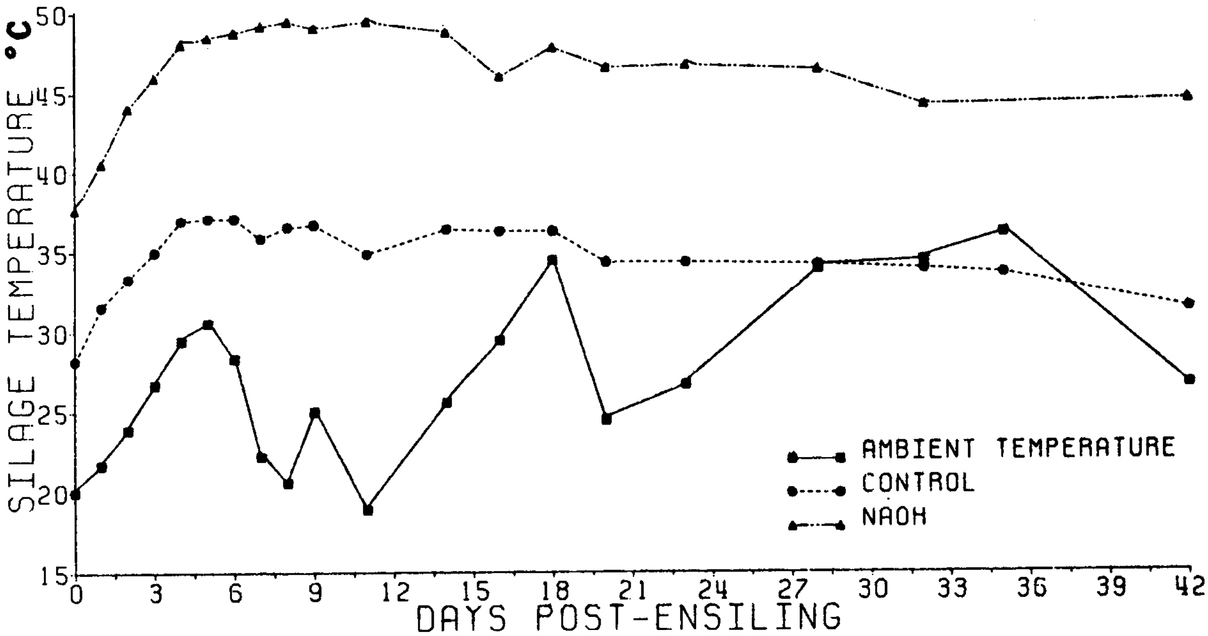

Figure 7.1. Ensiling temperatures for control and NaOH wheat silages.

Table 7.2. Performance by steers and heifers fed the four wheat silage and alfalfa haylage rations.

	Control wheat silage		NaOH wheat silage	
	alone	+ haylage	alone	+ haylage
No. of calves	15	15	15	15
Initial wt., lbs.	479	481	482	474
Final wt., lbs.	608	607	632	619
Avg. daily gain, lbs.	1.62[c]	1.57[d]	1.88[a]	1.81[b]
Avg. daily feed intake, lbs.[2]				
wheat silage	10.23	6.36	12.47	6.89
haylage	---	6.35	---	6.96
supplement	1.80	1.80	1.80	1.80
total	12.03[c]	14.51[b]	14.27[b]	15.65[a]
Feed/lb. of gain, lbs.[2]	7.51[a]	9.29[b]	7.58[a]	8.67[a,b]

[1] 80-day trial: January 5 to March 26, 1981.

[2] 100% dry matter basis.

[a,b,c,d] Values with different superscripts differ significantly ($P<.05$).

Table 7.3. Wheat silage fermentation, storage, spoilage, and feedout losses

Silo and silage treatment	DM recovered: Feedable	DM recovered: Non-feedable (spoilage)*	DM lost during fermentation, storage and feedout
Concrete staves	% of the DM put into the silo		
Control	82.06	6.00	11.94
NaOH	83.86	5.00	11.14
Buried bags			
Control	92.26	--	7.74
NaOH	89.48	--	10.52

* Removed from the silage surface when the silos were opened January 4, 1981.

Table 7.4. Changes in temperature and losses of dry matter by the two wheat silages and alfalfa haylage during air exposure

Silage	Day of initial rise above ambient temp.*	Maximum temp.	Accumulated temp. above ambient, C: day 3	day 6	day 10	Loss of DM (% of DM exposed to air): day 3	day 6	day 10
		C						
Control	4.9	53.9	**	27.4	121.1	<1.0	1.1	9.8
NaOH	10.0	29.4	**	**	6.5	<1.0	<1.0	1.7
Alfalfa haylage	2.0	40.0	28.0	52.4	76.4	2.1	5.4	17.9

*1.5 C rise above ambient (18.3 C).

**No rise in temperature.