3) monensin supplementation? Secondly, what would the relative economics of thiopeptin versus roughage feeding show? Third, might addition of thiopeptin to preconditioning and sale barn rations help prevent stress and shipping fever of cattle? Fourth, is feeding of all concentrate rations feasible with thiopeptin? Potential benefits would be expected since roughages normally depress intestinal starch digestion and reduce efficiency use. Finally, health of newly received cattle deserves further attention to determine why ruminal or intestinal damage reduces later performance. If the magnitude of carryover effects is quantitated, livestockmen may pay more attention to this critical period.

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Corn Silage Ammoniation Time and Protein Solubility

F. N. Owens, W. M. Sharp and George Davis[1]

Story in Brief

Chopped corn plants (27 to 34 percent dry matter) were ensiled with addition of ammonia at various times following chopping. Insoluble crude protein content was increased by ammonia addition. Delaying ammonia treatment for up to 4 hours after chopping did not greatly reduce the effect of ammoniation on protein solubility. Addition of urea had effects on protein solubility similar to ammonia addition with higher recovery of added protein.

Introduction

In freshly chopped corn plant material, only a small proportion of the protein is in a soluble form. In silage, 40 to 80 percent of the protein (nitrogen) is soluble. The chance for ruminal bypass of soluble protein is small, and protein bypass for ruminants is generally desirable. In research conducted at Michigan State, protein solubilization has been attributed primarily to continued action of plant enzymes the first few hours after harvest. Therefore, if plant enzymes can be inhibited, the protein value of corn silage for cattle should be improved. Since ammonia will inhibit plant enzymes rapidly, ammonia treatment of corn silage, besides providing an economical source of nitrogen, may improve the protein value of corn silage. If rapid inhibition of plant enzymes is desired, it may be necessary to treat silage immediately after chopping. The objectives of these two laboratory trials were to test the effects of 1) ammonia treatment at various times after chopping and 2) various nitrogen sources and levels and energy addition on protein solubility of corn silage.

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Materials and Methods

In the first trial, whole plant corn material (34 percent dry matter) was chopped at Garden City, Kansas, and ensiled immediately or held for 30, 60 or 240 minutes prior to ensiling in plastic bags. Ammonium hydroxide (1 percent of dry matter) was applied to half of the samples prior to ensiling. In the second trial, corn silage (27 percent dry matter) delivered to a feedlot in Garden City, Kansas, was ensiled in plastic bags without additives or with added urea (.5, 1.0, 1.5 percent of wet matter), ammonium hydroxide (.2, .4, .6 or .8 percent of wet matter) or glucose (1, 2, 4 or 8 percent of wet matter). Samples were analyzed for dry matter, total nitrogen and nitrogen which was soluble in .15 M NaCl.

Results and Discussion

Results of the first trial are presented in Table 1. The pH declined with fermentation but remained higher with ammoniation. Solubility of protein of the corn material was doubled by fermentation. The amount of insoluble, potential bypass protein was decreased 24 percent by fermentation. Addition of ammoniated water increased total and soluble protein content, but the insoluble protein was increased as well. The amount of insoluble protein remaining after fermentation decreased only slightly when ammoniation was delayed up to 4 hours. This suggests that ammonia addition 4 hours

Table 1. Protein fractions following ammonia treatment (trial 1)

Sample	Time (min)	pH	Crude protein fractions, % Total	Soluble	Insoluble	*In vitro* digestibility, %
Fresh frozen	—	5.51	6.79	1.71	5.09	62.7
Untreated	—	4.26	7.31	3.49	3.82	63.5
Ammoniated	0	4.35	10.32	5.24	5.08	67.9
Ammoniated	30	4.19	10.92	5.72	5.20	71.2
Ammoniated	60	4.70	10.74	5.77	4.97	65.2
Ammoniated	240	4.37	10.37	5.48	4.90	64.6

Table 2. Protein fractions following ammonia treatment (trial 2)

Item	% of wet	% of dry	*Crude protein*, % of DM Total	Calculated	Soluble	Insoluble
Untreated	0	0	8.84		3.34	5.50
ammonia	.21	.78	12.06	(13.7)[a]	5.31	6.75
	.36	1.33	14.19	(17.2)	7.02	7.17
	.57	2.11	17.41	(22.0)	10.22	7.19
	.72	2.66	19.75	(25.5)	12.12	7.62
Urea	.5	1.85	14.25	(14.0)	7.62	6.62
	1.0	3.70	19.19	(19.3)	11.69	7.49
	1.5	5.56	25.75	(24.5)	17.17	8.58
	2.0	7.40	27.97	(29.7)	20.28	7.69
Glucose	1	3.7	9.50		3.25	6.25
	2	7.4	8.87		3.29	5.58
	4	14.8	8.25		2.50	5.75
	8	29.6	7.93		2.91	5.03

[a]Calculated from added nitrogen.

after harvest had almost as much effect on protein as ammoniation during chopping. *In vitro* digestibility tended to be greater with ammoniation.

In the second trial, very high levels of ammonia, urea or glucose were added. Levels of insoluble protein were much higher in this trial than the other. This reflects the high variability of corn silage. Recovery of nitrogen added as ammonia averaged 82 percent while all of the nitrogen added as urea was recovered. The amounts of insoluble crude protein present increased similarly with addition of both urea and ammonia. Addition of soluble carbohydrate (glucose) had no effect on insoluble protein content. Results suggest that NPN addition to corn silage may increase the content of insoluble, potential bypass protein. Whether this increased insoluble protein does escape ruminal digestion remains to be proven. A number of feeding studies from Michigan with ammoniated corn silage suggest that ammoniated corn silage is used more efficiently by cattle. If increased protein bypass is responsible, ammoniation should prove most useful for starting cattle fed low protein rations.

Roughage Levels in Feedlot Rations

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Story in Brief

Five levels of roughage (8 to 24 percent of ration dry matter) were fed with three corn types (high-moisture, steam-flaked and a mixture of the two) to 240 steers (747 pounds initially) for 121 days. Roughage was one-third ground alfalfa hay and two-thirds corn silage. Feed intake was about 7 percent less and metabolizable energy about 8.7 percent greater with steam-flaked than with high-moisture corn in the ration. Gains and efficiencies of feed use were greatest for steers fed 8-percent roughage with steam-flaked grain, 12-percent roughage with the corn mixture and 16-percent roughage with high-moisture corn grain. Although addition of roughage to the 8-percent roughage ration increased feed intake and replaced corn energy for steers fed high-moisture corn, it actually increased the amount of steam-flaked grain required per pound of gain. The greatest advantage for steam-flaked grain was with the lowest roughage level. Rumination tended to increase with added roughage, but ruminating steers gained weight at a slower rate (3.30 vs. 3.38 pounds daily) than non-ruminating penmates. The optimal level of roughage in a feedlot ration appears to depend on grain processsing.

Introduction

Roughages are included in high-concentrate rations for several reasons. First, dilution of the ration or the rumen contents with roughage helps avoid acidosis and founder. Second, added roughage increases rumination, which may increase digestion in the rumen both by reducing particle size and by increasing saliva flow and ruminal pH. Roughage may also aid ruminal mixing to avoid abnormal or slimy types of fermentation. Certain roughages also contribute protein, minerals and vitamins to the ration.