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Beef Cattle Feeding: Treating Corn Silage with Limestone and Urea
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TREATING CORN SILAGE WITH LIMESTONE AND UREA

COOPERATIVE EXTENSION SERVICE

MICHIGAN STATE UNIVERSITY

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Corn silage is one of the principle feeds for fattening beef cattle in Michigan. On good farm land more pounds of beef per acre can be produced from good corn silage than from any other crop.

Recent research has shown that the addition of limestone or urea at ensiling time can improve the feeding value of corn silage. This bulletin briefly summarizes the results of the research and points out the possibilities which these additives in silage offer to the cattle feeder.

Changes In Silage Composition

Fermentation in normal corn silage, without any additives, produces certain organic acids and a feed which is acid in reaction. Limestone or urea added to either whole plant silage or ear corn silage cause changes in the pattern of acid production as well as other changes.

Changes in acid production: The most important change is an increase in the lactic acid content (see Table 1.) This organic acid can be used by cattle for energy and thus any increase should be beneficial. One might assume that an increase in organic acids would bring about a higher total acidity of the silage (lower pH), but this apparently does not occur due to the neutralizing effect of the limestone and urea (table 1.)

TABLE 1. Effect of limestone and urea on acid production in earcorn silage (Ohio experiments 1961).

Treatment	pH	Acetic Acid %	Lactic Acid %
Control	3.75	.52	2.88
½% limestone	3.95	.44	4.64
1% limestone	4.00	.53	4.63
½% limestone, ½% urea	4.05	.43	4.88

Effect on carotene (pro-vitamin A). Experimental results vary regarding the effects of treating silage on the carotene content. Some experiment stations have reported an increase in carotene content from limestone additions, while others have shown a decrease. An Indiana trial showed a 3½ fold increase in carotene from adding limestone.

Color and general appearance. Treated silage usually shows a greener color. Several stations have observed increased palatability from limestone and urea and one station indicated a better keeping quality after removal from the silo. Odor has been observed to be more mild or less acetic than untreated silage.

Protein content: Adding urea to the silages increases the nitrogen content which the cattle can convert to protein. Experimental results have not been analysed sufficiently at this time for an estimate of the degree of protein increase from a given level of urea addition.

Calcium content. Regular corn silage is low in calcium and requires a mineral supplement. Adding limestone to silage increases the calcium content, but more experiments are needed for a valid comparison. Researchers have observed, however, that cattle consuming the treated silage consume less minerals when offered on a free-choice basis. More research is necessary regarding the effect these treatments have on the calcium level as well as other minerals in the silage.

Feed-lot Performance

In the final analysis, cattle performance will show whether adding limestone or urea to silage is a good practice. Acceptance by the cattle and the mere changes in silage composition could indicate an improvement in feeding value from adding either limestone or urea, or both. Feeding tests have shown variable feed-lot response from one station to another, (see table 2). The average of the various tests look encouraging.

Whole plant corn silage. Results from three experiment stations show that gains and feed efficiency were not consistently improved with the addition of either limestone or urea alone. Adding the combination of limestone and urea increased gains about 8% and feed efficiency 5% to 7%. Observations from cattle feeders who have added limestone alone are generally favorable.

Ear corn silage. Results appear to be more consistent with ear corn silage than with regular silage. Limestone alone, or limestone and urea, increased gains and feed efficiency from 6 to 10%.

TABLE 2. Summary of results of adding limestone and urea to whole-plant and ear-corn silage for fattening cattle.

Station	Level limestone added %	Level urea added %	Feed-lot response		
			Daily Gains		Feed per cwt. of gain % change due to treated silage
			Control	Treated	
Whole Plant Corn Silage					
Ohio, 1959	1.0	---	2.35	2.32	8% less
Minnesota, 1962	0.5	---	1.76	1.71	2% more
Minnesota, 1962	0.5	---	1.48	1.48	none
Indiana, 1962	0.5	---	1.83	1.97	4% less
			Av. 1.86	1.87	
Minnesota, 1962	---	0.5	1.76	1.59	10% more
Minnesota, 1963	---	0.5	1.48	1.45	4% more
			Av. 1.62	1.52 (6% dec.)	
Ohio, 1959	0.5	0.5	1.70	1.89	7% less
Ohio, 1961	0.5	0.5	1.65	1.76	5% less
			Av. 1.68	1.82 (8% inc.)	
Ear Corn Silage					
Ohio, 1959	1.0	---	2.17	2.16	none
Ohio, 1960	1.0	---	1.81	2.07	10% less
			Av. 1.99	2.11 (6% inc.)	
Ohio, 1961	0.5	0.5	2.02	2.13 (7% inc.)	7% less

Recommended Levels

From research completed so far, the choice of levels of limestone or urea to add to silage rests within quite narrow limits. Limestone or a mixture of limestone and urea appear to be of equal value in stimulating organic acid production in the silage. Thus there would be little choice between them for this purpose, but if an increase in protein is desired, urea is necessary. Urea is considerably more expensive than limestone.

Suggested levels to add to silages are presented in Table 3. Over 0.5% urea is not recommended since limited research has shown that 1.0% urea in silage decreased appetite in dairy cows.

Type of limestone. High-calcium or feed grade limestone, containing about 39% calcium and less than 1% magnesium is recommended. Dolomitic limestone, which contains about 21% calcium and 12% magnesium, has given more variable results in terms of organic acid production and growth response. The level of calcium in the resulting silage is less when dolomitic limestone is used.

Mineral intake pattern. Cattle consuming limestone-treated corn silage showed a change but variable mineral intake. Minerals offered on a free-choice basis may be down in some cases, and up in others. As noted previously, the calcium content of the silage is increased and there may be other factors which bring about a change in appetite for minerals. More research is necessary before specific recommendations can be made but it is suggested that high-phosphorus carriers such as dicalcium phosphate or bone meal should be available as well as trace mineral salt.

TABLE 3. Levels of limestone and urea to add to corn silages¹.

	Limestone	Urea	Limestone + urea
Whole plant silage	.5-1.0%	.5%	.5% each
Ear corn silage	1.0%	.5%	.5% each

¹0.5% is equivalent to 10 lb. per ton and 1.6% to 20 lb. per ton of silage.

Method of treatment. Several methods of adding limestone or urea to the silage have been found satisfactory. One commonly used way is to spread the materials as uniformly as possible over the top of each load of silage, just before blowing into the silo. Thus as the silage falls into the unloading auger the additives and silage are mixed. So that the proper proportion of limestone or urea to silage is added, a good estimate of the weight of the silage is necessary. If scales are not available, this can be done by weighing an average load of silage at a public scale and marking the wagon.