Calcium Oxide and Calcium Hydroxide Treatment at Various Moisture Levels of Cornstalks and Fescue Hay

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Summary and Implications

Calcium Oxide (CaO) and Calcium Hydroxide ($Ca(OH)_2$) treatment of forage when a fresh alkali product is used can improve the digestibility of some forage, but not all forages stand to benefit. In these trials the treatments at lower moisture did not combust and there was evidence that the treatment was effective in increasing digestibility at moistures less than 50%. Less water or possible no water addition might allow for easier treatment of forages. Larger scale treatments should be evaluated. It would be interesting to see if the alkali treatment has different effect on different particle sizes of forage.

Introduction

Improving low quality forage digestibility through an alkali treatment of the forage is becoming a more common practice especially with higher priced feedstuffs. Currently it is suggested that the forage be moistened resulting in a product that is 50% dry matter upon treatment, the CaO then added at 5% or the $Ca(OH)_2$ added at 7% of the forage dry matter. When CaO is used this seems to be especially wise to add this moisture to reduce heat since there have been reports of combustion. The use of $Ca(OH)_2$ however may make this requirement unnecessary since this product does not seem to generate the heat that the CaO does after treating. Two questions remain though, one being relative effectiveness of the Ca(OH)2 when compared to the CaO treatment, the other being the effect of the added moisture.

Material and Methods

Coarse ground corn stalks and fescue grass hay, as one might choose for feeding to cattle as a roughage source, were obtained from the Iowa State University Beef Nutrition Research Farm. The forage sources were moistened to 25%, 37.5% and 50% moisture and then treated with either CaO at 5% of the forage dry matter or $Ca(OH)_2$ at 7% of the forage dry matter. The mixes were then packed into 55 gallon barrels and sealed by placing a water filled bag on top to simulate an enclosed silo or forage bunker. Samples were then removed from the structure about one week later and evaluated for total neutral detergent fiber (NDF), NDF digestibility and total dry matter digestibility by a commercial in-vitro method performed by Dairyland Laboratory in Wisconsin. At the time of treatment a pH reading was taken on each barrel sample and a HOBO automatic temperature logger was placed in the barrel. One month later the same procedure was repeated with the corn stalks only and using only the 25% moisture as a reference check on the repeatability of the procedure. The forage used was baled up as dry feed from the previous year's harvest, about 10 months earlier. The initial NDF level in the stalks was about 86% while the fescue hay was about 66%. In addition a representative sample of the cornstalks was hand sorted into coarse, intermediate and fine particle size samples and each sample was analyzed for total neutral detergent fiber (NDF), NDF digestibility and total dry matter digestibility by a commercial in-vitro method performed by Dairyland Laboratory in Wisconsin.

Results

Table 1 provides a summary of the effect of the treatment on the first round. The alkali treatment showed to be very effective in reducing NDF and improving digestibility of both NDF and total dry matter in the corn stalks regardless of the moisture level while the effect on the fescue indicated no definite advantage to treatment. Temperature measurements were higher for the 25% and 37.5% moisture treatments as compared to the 50% moisture treatment with the exception of the 37.5% moisture cornstalk treatment. There was no indication of combustion at treatment or during the storage period.

When the process was repeated a month later using the same source of $Ca(OH)_2$ and a fresh source of CaO on the corn stalks at 25% moisture, the effect was similar with the CaO treatment but the $Ca(OH)_2$ treatment was less effective (see table 2). The lack of treatment effect in the repeated trial may be due to that the same Ca(OH)2 source had been exposed to air for approximately 50 days and potentially the humidity might allowed conversion of some of the $Ca(OH)_2$ back to calcium carbonate. The pH measurement and temperature readings on the repeated trial mixtures were not as high indicating less of a reaction. Looking at the initial pH reading from the first round and the second round of the trial on the cornstalks, it appears that this pH reading will provide a good forecast on how well the treatment will work for a given feedstuff.

The sorted cornstalk samples analyzed did not show a large difference in digestibility although the coarse sample was lower in digestibility than the intermediated and fine samples. It is interesting to note that none of the sorted samples were as high in digestibility as the mixed control sample. This could be due to sampling error or that some of the very fine particles in the control sample were not represented in the sorted samples.

Table 1.

Treatment			% DM	% NDF	%NDFd	% in vitro d	% Ca	pH	Temp ^oF
control	hay		90.9	66.0	61.2	74.4	0.6	6.0	83
Ca(OH)2	hay	25	73.7	62.0	56.6	73.1	3.5	11.6	110
Ca(OH)2	hay	37.5	71.9	65.2	58.8	73.1	3.0	11.4	114
Ca(OH)2	hay	50	54.0	64.0	52.4	69.6	2.8	11.2	101
CaO	hay	25	78.9	60.6	53.4	72.0	3.6	10.7	111
CaO	hay	37.5	70.2	62.9	55.2	71.9	3.5	10.1	110
CaO	hay	50	50.0	64.5	51.4	68.7	2.5	10.0	96
control	cornstalk		83.8	86.8	44.9	52.2	0.4	6.0	83
Ca(OH)2	cornstalk	25	74.7	72.7	55.2	67.4	3.3	11.8	116
Ca(OH)2	cornstalk	37.5	64.2	72.4	57.2	69.0	2.9	11.7	114
Ca(OH)2	cornstalk	50	44.2	69.3	51.5	66.4	3.3	11.6	98
CaO	cornstalk	25	77.4	79.6	44.7	56.0	2.7	11.1	120
CaO	cornstalk	37.5	60.7	81.7	53.3	61.8	2.5	10.8	98
CaO	cornstalk	50	47.6	75.7	39.9	54.5	2.5	10.8	101

*Recorded pH and temperature were taken approximately 90 minutes after treatment.

Table 2.

Treatment			% DM	% NDF	%NDFd	% in vitro d	% Ca	pH	Temp ^oF
control	coarse cornstalk		91.0	86.6	40.1	48.1	0.4	6.0	83
control	intermediate cornstalk		89.4	88.0	48.1	54.4	0.4	6.0	83
control	fine cornstalk		88.3	88.6	46.4	52.5	0.4	6.0	83
control	cornstalk		84.5	87.4	50.4	56.7	0.4	6.0	83
Ca(OH)2	cornstalk	25	75.9	82.3	50.4	59.5	2.2	10.8	93.5
CaO	cornstalk	25	74.6	77.8	56.6	61.4	2.6	10.4	108.5

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