# An On-Farm Demonstration of Calcium Hydroxide Treatment of Corn Silage with Subsequent Observations in the Cooperating Dairy Herd

## A.S. Leaflet R2839

Garland Dahlke, ISU Extension and Outreach Program Specialist, Iowa Beef Center

**Summary and Implications**

Calcium hydroxide is best used when treating over mature fibrous forage to improve dry matter digestibility and energy availability to the recipient animal. There does not seem to be a strong impact on treating high quality feeds such as good quality corn silage. The treated feed tends to ferment slower, but cattle accept it well and production does not seem to be adversely affected and may, in fact tend to reduce some day to day production variation.

### Introduction

Three areas of interest prompted this on farm trial; the use of alkali (calcium hydroxide) treatment for potentially improving the digestibility of high quality corn silage further, the effect of long term storage prior to feeding this alkali treated feed, and the overall effect of this feed treatment on livestock in a production setting. The opportunity to investigate these three areas was presented in two well controlled dairy operations owned and operated by two brothers each providing their own labor and management for their respective operations prior to and during the implementation of the trial.

### Materials & Methods

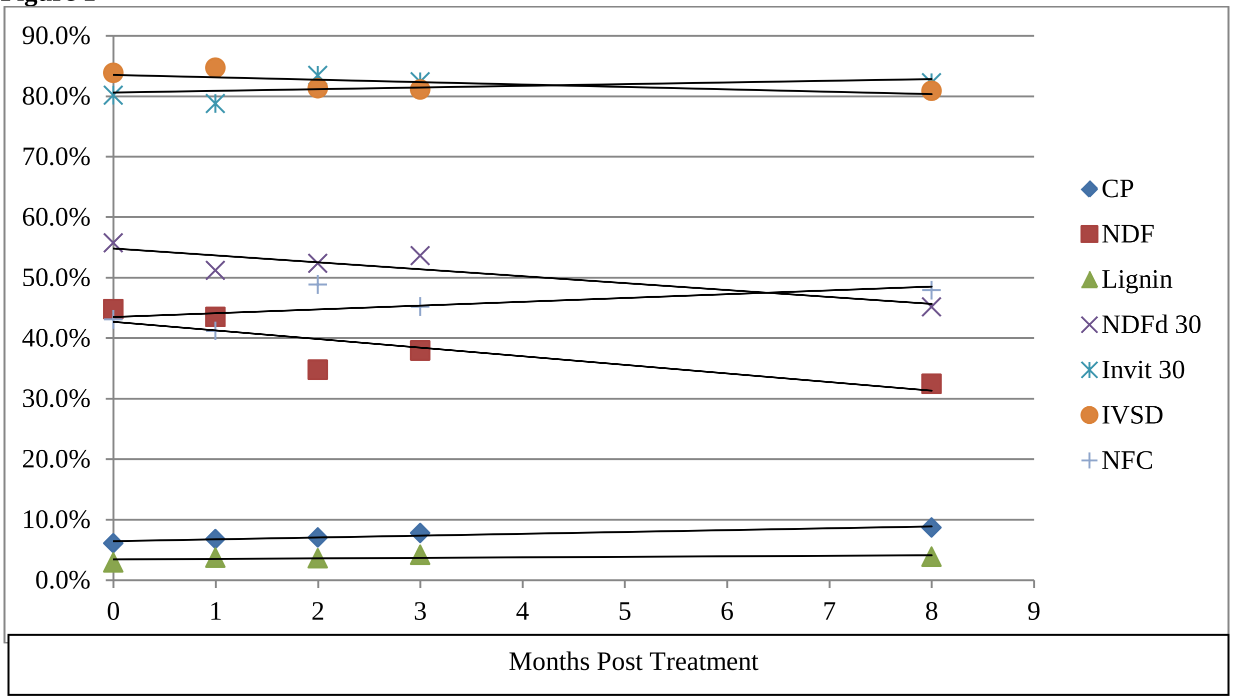
Two dairy herds located across the road from each other, owned and managed by two brothers were involved. Crops were harvested for the herds in cooperation between the two operations and each dairy fed a ration of approximately 2/5 corn silage, 2/5 haylage and 1/5 baled hay as forage dry matter. Since cows were allowed to graze from mid-May through Oct. and housed the herds in stanchion barns through the winter the trial was set to use production measures during the time cattle were confined and fed only stored feeds ( October through May) in order to maintain a more consistent ration. Corn silage on one of the farms was harvested and treated at seven percent of the dry matter with calcium hydroxide at ensiling. The corn plant was about 35% dry matter at harvest and kernels were 2/3 milk line at harvest. The feed was stored in an upright 18 x 60 foot stave silo. This feed was then provided to the herd. The other farm also filled an 18 x 60 foot silo with corn silage but did not treat the silage and therefore did not feed treated corn silage. Both herds were involved in order to compare and help possibly detect deviations from normal trends. Feed samples were taken at day 0 (prior to treatment), one, two, three and eight months post treatment. The samples were evaluated at Dairyland Laboratory, Arcadia, WI. A 30 hour in vitro digestion analysis was used since dairy cows were the recipients of the feed. Rations were balanced based on the results of the feed analysis. Production numbers were obtained throughout the time of the trial from both herds along with the numbers from the previous three years.

### Results

*Duration of Treatment Time*

The first point of interest dealt with the duration the feed was exposed to the alkali treatment before feeding. As more time is given for the alkali reaction to work, the greater the response. Figure 1 below provides a summary of what was observed. It is suggested that alkali treated feed be held three to seven days prior to feeding in order to allow the reaction to take place. A longer holding time does allow a continued reaction to occur although the rate becomes slower. It also appears that the pH changes that occurred with alkali ensiled forages eventually drop into an acidic range although not as quickly or to the same magnitude that normally fermented corn silage would. Normal fermentation in well-made corn silage results in a pH of less than "4" within a couple weeks post ensiling. In this case the pH of the corn silage after treating was "11.4" and dropped to "4.8" after 1 month post ensiling. This pH value stayed near this "4.8" value throughout the remaining time of the trial. This modified fermentation pattern was also reflected in the organic acid production. The slower fermentation lead to an acetic acid level higher than normal thus the ratio of lactic acid to acetic acid was <1:1 rather than the normal 3+:1 ratio. It is notable and a very consistent outcome based on previous experiments, that the crude protein and non-fiber carbohydrate (NFC) values increase (24% and 15% increases respectively) after calcium hydroxide treatment while the NDF fraction decreases (17% decrease). These values continued to increase and decrease respectively throughout the time the trial was conducted. The digestibility values did not change much however. Starch digestibility (IVSD) and total dry matter digestibility (Invit 30) remained quite consistent throughout. NDF digestibility (NDFd 30), which is the digestibility of the remaining silage NDF after treating, tended to decrease as the trial continued.

**Figure 1**




*Feed Analysis and Value*

The purpose of the alkali treatment is to improve digestibility of the feedstuff and allow better utilization of the energy contained in the feed by the animal receiving the feedstuff. This would allow a portion of the normal grain allocation to be replaced. With high fiber, low digestible feedstuffs this treatment seems to work quite well, however with high quality feedstuffs this treatment did not seem to be as effective. Table 1 below provides energy estimates of the feedstuff samples taken throughout the year based on the University of Wisconsin Milk2006 methodology and were reported on the laboratory reports obtained from Dairyland Lab. Based on this alone, the estimated available energy content of this feed did not seem to be greatly influenced by the treatment and therefore did not allow any grain to be replaced in the ration. One value that is not one Table 2 but does require mention is that these farming operations did not use a kernel processor on their forage harvester. The kernels of grain therefore were intact for the most part at harvest and the use of the alkali did soften the kernels to a point that the silage fed and seemed to digest as if it were processed. The energy values reported therefore in Table 1 were the values used for processed corn silage since the alkali treatment does have the same effect as a corn processor on the harvester in softening the kernel. The value of processing has the effect of feeding extra grain or four to six percent more energy per unit silage dry matter. In this case, a conservative equivalent of 80 extra pounds of corn grain per ton of corn silage dry matter was considered to be established. The increase in crude protein concentration did allow 20 pounds of crude protein supplementation to be replaced per ton of treated corn silage fed. The additional calcium in the treated corn silage provided 48 pounds of additional calcium per ton of corn silage dry matter. Table 2 provides a summary of the value from the treatment.

**Table 1. MILK 2006 Energy Calculations – Using Processed Corn silage Estimates.**

| Post Treatment | TDN % | NE m Mcal/lb | NE g Mcal/lb | NE l Mcal/lb |
|---|---|---|---|---|
| Initial | 69.5 | .72 | .44 | .70 |
| 1 month | 65.1 | .68 | .41 | .66 |
| 2 months | 66.8 | .71 | .44 | .70 |
| 3 months | 65.9 | .68 | .41 | .68 |
| 8 months | 65.6 | .70 | .43 | .69 |

**Table 2. Value of Treatment.**

Energy Yield = 80 Mcal NE m gain per ton of treated corn silage dry matter
Cr. Protein Yield = 20 extra pounds more crude protein per ton treated corn silage dry matter
Calcium Yield = 48 extra pounds more calcium per ton treated corn silage dry matter

*Animal Performance*

The treated silage was accepted well by the cattle that received it (cows and replacement heifers). The higher pH in the treated silage may reduce bunk life during warmer weather, but did not seem to impact this trial. The previous years of production data and the herd which did not receive the treated silage were used as a rough gauge to detect any response. The year this trial ran showed a trend of better milk production and lower somatic cell counts than observed in previous years. The treated silage did not seem to cause any departure from the trend however two notable items should be mentioned. The first is the improved production consistency and the second being a marked improvement in pregnancy conception rates that occurred with the herd feeding of the treated feed.

Month to month milk production, milk fat, milk protein and milk somatic cell counts were compared within and between herds. Average and standard deviations of these monthly values were computed and then compared to the treatment year. Table 3 provides a summary. The herds, as alluded to in the Materials and Methods section of this paper were owned and managed solely by the same two individuals throughout the four years data was recorded. The consistency of day to day (or month to month production in this case) was measured by the standard deviation with a lower value indicating a more consistent output. An improvement from measurement to measurement in treated herd was notable with a 70% decrease in milk output variability alone. This may also contribute to the improvement in AI conception rates observed with both the cows and heifers in the treatment herd. Cow conception rates improved from 45% to 53 percent in the treatment herd while heifer conception rates improved from 70% to 78%. The effect of the alkali softening the corn kernel upon contact and some buffering properties of the treated feed in the rumen may be the reason for this outcome.

**Table 3. Monthly Production and Consistency.**

| | Treatment Herd | | | | Control Herd | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Avg | Std | % Change in StD | Time | Avg | Std | % Change in StD |
| Milk lbs | Trt Year | 69.1 | 1.3 | -70.9 | Trt Year | 75.2 | 3.7 | 4.7 |
| | Pr 3 Yrs | 68.1 | 4.5 | | Pr 3 Yrs | 73.4 | 3.6 | |
| Fat % | Trt Year | 3.61 | 0.17 | -2.9 | Trt Year | 3.89 | 0.22 | 44.3 |
| | Pr 3 Yrs | 3.71 | 0.18 | | Pr 3 Yrs | 3.62 | 0.15 | |
| Protein% | Trt Year | 2.69 | 0.34 | -19.2 | Trt Year | 2.92 | 0.16 | 35.4 |
| | Pr 3 Yrs | 2.58 | 0.42 | | Pr 3 Yrs | 2.81 | 0.12 | |
| SCC | Trt Year | 144.0 | 20.9 | -68.5 | Trt Year | 107.8 | 30.5 | -74.7 |
| | Pr 3 Yrs | 159.8 | 66.3 | | Pr 3 Yrs | 194.5 | 120.7 | |

**Acknowledgement**

This trial was made possible by Mississippi Lime of St. Louis, MO, Schaefer Farms of Marshfield WI, and the Iowa Beef Center.