

# Characterizing the Ensiling Properties of Sugarbeets with Dry Feedstuffs

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## Abstract

A study was conducted to evaluate the ensiling characteristics of chopped sugarbeets with dry feedstuffs. Precalculated amounts of each feedstuff were weighed individually to achieve desired proportions of each silage product and thoroughly mixed for five minutes. After mixing, the silages were distributed evenly into three 5-gallon buckets and sealed to provide an anaerobic environment. The treatments for this study were arranged in a 4 x 4 + 1 factorial design to determine the effects of DM level and source of dry feedstuff on the ensiling properties following a 42-day fermentation period. Treatments were ensiled sugarbeets alone (25 percent DM) or based on 1) formulated silage DM concentrations of 27.5 percent, 35 percent, 42.5 percent and 50 percent and 2) the inclusion of dry feedstuffs (alfalfa hay, dry-rolled corn, wheat middlings and wheat straw). Fermentation and nutritive characteristics of ensiled feedstuffs were influenced by the addition of dry ingredients. A linear increase ( $P < 0.001$ ) in silage pH was observed with the addition of alfalfa, dry-rolled corn, wheat middlings and wheat straw to ensiled sugarbeets. Lactic acid increased ( $P < 0.001$ ) with the addition of wheat middlings. Alfalfa addition to sugarbeet silage affected ( $P = 0.05$ ) lactate concentration in cubic fashion. Percentage of lactate decreased ( $P = 0.01$ ) when corn was added, while wheat straw did not influence ( $P = 0.37$ ) lactate. Ensiling characteristics of sugarbeets alone (25 percent DM) were compared with sugarbeets and dry ingredients mixtures formulated to have 35 percent DM. Results indicated fermentative characteristics were altered; pH increased ( $P < 0.001$ ) when dry ingredients were included, while lactate was lower ( $P = 0.003$ ) for the sugarbeets ensiled with dry-rolled corn, compared with sugarbeets ensiled alone. Alfalfa, wheat straw and wheat middlings decreased in vitro DM digestion ( $P < 0.001$ ), while dry-rolled corn did not affect ( $P = 0.54$ ) in vitro DM digestion. These results indicate the inclusion of dry feedstuffs with sugarbeets altered fermentation and, with the exception of corn, decreased in vitro DM digestion (IVDMD).

## Introduction

Preservation of high-moisture forages is a practice known as ensiling and is a process in which a crop is stored under anaerobic conditions until it is used. Maintaining the nutritional value (energy, DM and crop quality) of silages during the storage period is essential to successful ensiling programs (Muck, 1988; Oude Elferink et al., 2000). In this study, we investigated ensiling sugarbeets. We hypothesized that incorporating locally available dry feedstuffs with sugarbeets would enhance the ensiling process or nutritive value of the silage.

## Materials and Methods

A research experiment was conducted to evaluate the effects of the addition of dry feedstuffs to sugar beets during a 42-day fermentation period; treatments were arranged in a 4 x 4 + 1 experimental design. The premise was to characterize the effects of 1) silage DM and 2) the source of dry ingredients on sugarbeet-based silages. Formulated silage dry matters of 27.5 percent, 35 percent, 42.5 percent and 50 percent were achieved through mixing of dry ingredients with sugarbeets. Four different dry substrates were evaluated in the ensiling process with sugarbeets. They were: 1) alfalfa (ALF), 2) dry-rolled corn (DRC), 3) wheat middlings (WM) and 4) wheat straw (STR). A control treatment of sugarbeets only also was included. Following mixing, each mixture was transferred into three 5-gallon plastic pails lined with two 30- by 36-inch plastic bags, which were sealed and covered to ensure an anaerobic

environment. Upon completion of the 42-day fermentation period, silage containers were opened and a sample was acquired from each pail. Each 0.176 oz. sample was combined with 3.38 fl. oz. of water and refrigerated (39.2° F) for 12 hours. The pH of the liquid was measured using a combination electrode and percentage of lactate was measured. Data were analyzed using the Mixed procedures of SAS (SAS Institute Inc., Cary, N.C.). The model included dry feedstuff as the fixed effect. There was a dry substrate x DM interaction; therefore, within each dry feedstuff, regression equations were developed (see Figures 1 through 3).

## Results

The study indicates there was a dry ingredient x DM interaction ( $P < 0.001$ ) for the following variables: crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and in-vitro dry matter and organic matter digestion (IVDMD and IVOMD, respectively). A dry ingredient x DM interaction ( $P < 0.001$ ) for fermentative measurements (pH and lactate) also was observed among ensiled treatments. Therefore, results are presented as regression analysis within dry ingredient.

By the nature of the experimental design, as the percentage of dry ingredient increased, there was a linear increase ( $P < 0.001$ ) in silage DM for all treatments, while actual DM concentrations were consistently higher than formulated levels, even though sugarbeets were slightly wetter than we originally assumed (Table 1). Crude protein concentration increased linearly ( $P \leq 0.006$ ) via the addition of DRC and WM as the dry ingredient. Silage CP was increased ( $P = 0.01$ ) in a quadratic manner when adding ALF to the silage mixture. Sugarbeet silage CP decreased ( $P = 0.02$ ) in a quadratic fashion with the addition of STR as the dry ingredient. When comparing sugarbeet silage alone (24 percent DM) with silages containing dry ingredients (35 percent DM), CP concentration increased ( $P < 0.001$ ) for ALF, DRC and WM, while a decrease ( $P = 0.006$ ) in CP concentration was observed with the addition of STR to sugarbeet silage (Table 1).

**Table 1. Analyzed fermentation characteristics of sugarbeets ensiled for 42 days with and without the inclusion of dry feedstuffs to achieve a 35% DM concentration.**

Item	DM, %	pH	Lactate, %	CP, %	IVDMD, %
Sugarbeets <sup>a</sup>	24.00	3.69	4.30	4.90	92.12
Alfalfa hay	37.9***	4.08***	4.42	13.1***	72.31***
Dry-rolled corn	35.8***	3.89***	2.70***	8.3***	91.67
Wheat middlings	38.2***	4.01***	4.83	14.3***	81.08***
Wheat straw	39.0***	3.96***	3.90	4.3**	62.28***
SEM <sup>b</sup>	0.90	0.02	0.31	0.20	0.58
P-Value	<0.001	<0.001	0.00	<0.001	<0.001

\*\* , \*\*\* Means differ from control (sugarbeets only)  $P \leq 0.01$  and  $0.001$ , respectively.

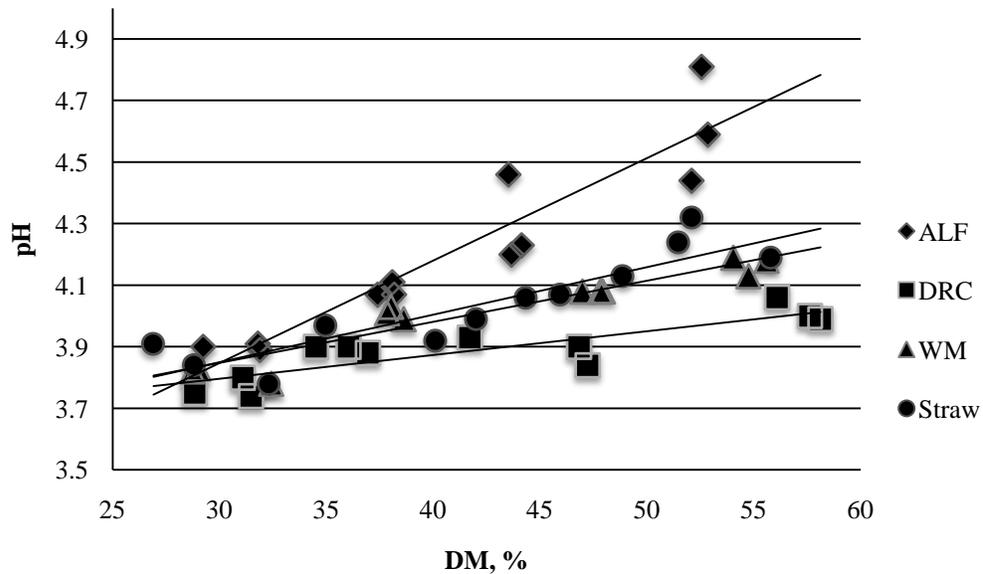
<sup>a</sup>Sugarbeets without the addition of dry feedstuffs was used to produce a 25 % DM silage.

<sup>b</sup>Standard error of the mean:  $n = 5$ .

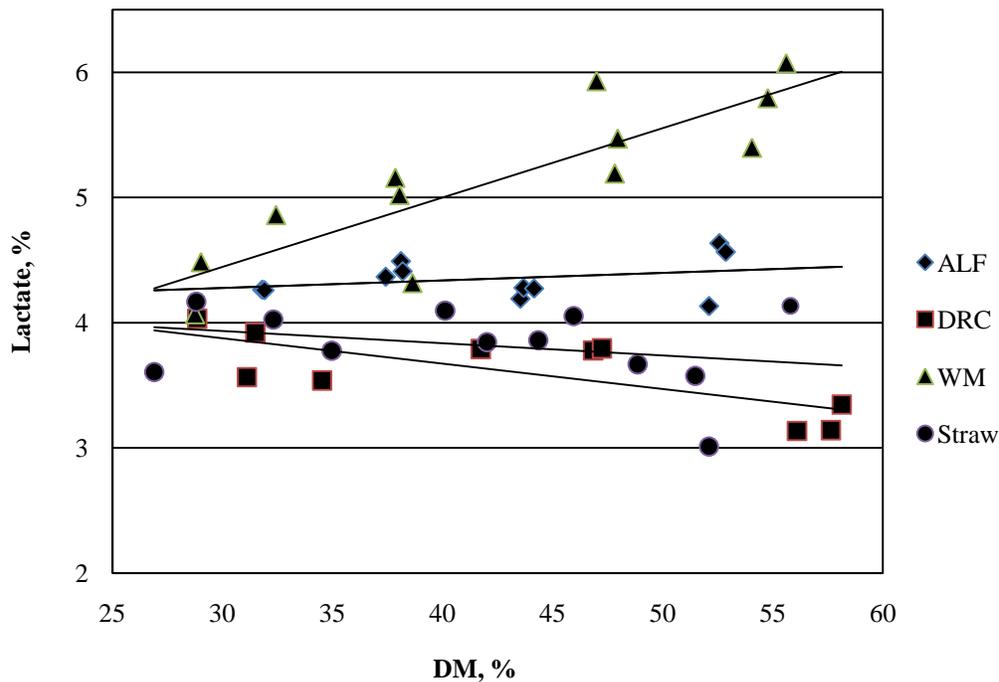
Fermentation characteristics measured were pH and lactate. Silage pH increased linearly ( $P < 0.001$ ) with the addition of ALF, DRC, WM and STR as silage DM increased (Figure 1). Average pH for all silages with formulated dry matter of 35 percent was 3.99 vs. 3.69 for sugarbeets ensiled alone (Table 1). Lactate concentration for ensiled sugar beets was not different ( $P \geq 0.37$ ) with the addition of ALF and STR (Figure 2). Ensilage lactic acid percentage

increased linearly ( $P < 0.001$ ) with the addition of WM, while addition of DRC decreased ( $P < 0.01$ ) lactate concentration quadratically in the silage. In comparing lactate concentrations between sugarbeets and the formulated 35 percent DM dry substrate treatments, lactate concentration decreased ( $P = 0.003$ ) with the addition of DRC (Table 1). We observed no difference ( $P \geq 0.19$ ) in lactic acid percentage for ALF, WM and STR, compared with sugarbeets ensiled alone.

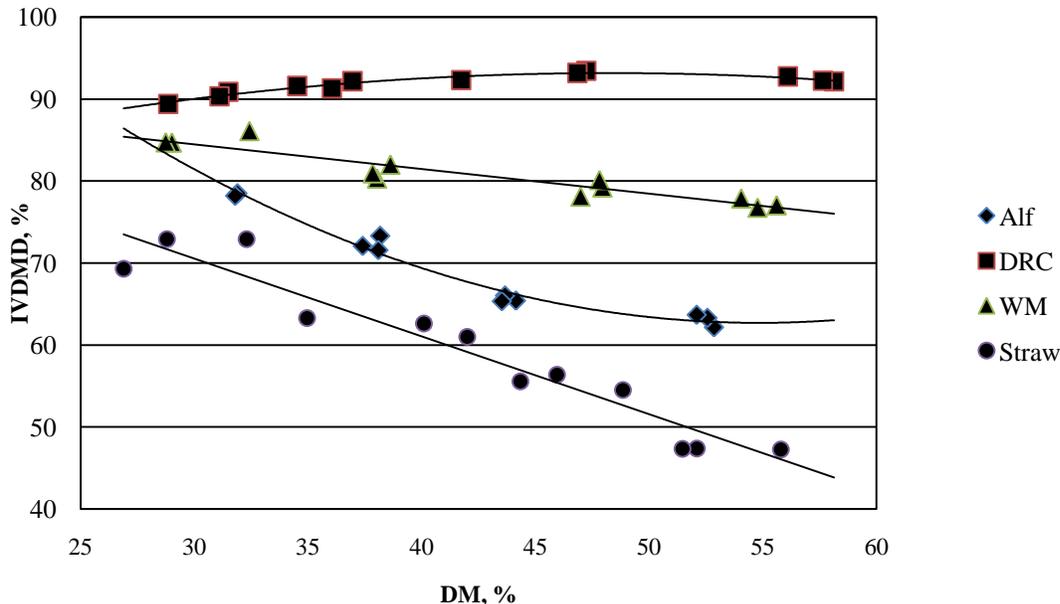
**Figure 1. Effect of the addition of dry feedstuffs on pH of ensiled sugarbeets.**



**Figure 2. Effect of the addition of dry feedstuffs on lactate in ensiled sugarbeets.**



**Figure 3. Effect of the addition of dry feedstuffs on IVDMD of ensiled sugarbeets.**



Digestibility (IVDMD) decreased linearly ( $P < 0.001$ ) with the addition of dry substrates WM and STR (Figure 3). The addition of ALF to ensiled sugarbeets decreased ( $P = 0.003$ ) IVDMD in quadratic fashion. Dry-rolled corn increased ( $P < 0.001$ ) IVDMD quadratically as silage DM increased with the addition of corn. In comparisons between ensiled sugarbeets alone and ensiled sugarbeets with added dry feedstuffs (35 percent DM; Table 1), IVDMD was less ( $P \leq 0.003$ ) for ALF, WM and STR.

### Implications

Fermentative characteristics were altered as DM increased when dry feedstuffs were ensiled with sugarbeets. Results indicate sugarbeets can be ensiled alone and with the addition of the dry feedstuffs used in this study; nutritive values were altered as DM of the silage changed.

### References

- Oude Elferink, S.J.W.H., F. Driehuis, J.C. Gottschal and S.F. Spoilstra. 2000. Silage fermentation processes and their manipulation. FAO Electronic Conference on Tropical Silage pp. 1-28.
- Muck, R.E. 1988. Factors influencing silage quality and their implications for management. J. Dairy Sci. 71: 2992-3002. ◆