# A Convenient Method for Preserving Sugar Beet Pulp for Analysis

CHARLES PRICE AND JAMES M. FIFE[1]

## Introduction

In sugar beet improvement work breeding for resistance to specific diseases is important. It is necessary to conduct the tests in the areas in which the diseases occur. Agronomic tests, therefore, frequently are made at considerable distances from the sugar factory or from the research laboratory, and usually facilities are not available for setting up a temporary laboratory for the immediate analysis of the samples of sugar beet pulp to determine percentage sucrose and apparent purity coefficients. Furthermore, air temperatures may be unfavorable for obtaining accurate results in the absence of facilities for controlling temperature.

These conditions emphasized the need for a dependable method of preserving pulp from sugar beets grown on experimental plots until the samples could be transported to a well equipped laboratory for analysis at some later period. On the basis of exploratory tests in 1937 the method of storing pulp described in this paper has been used at the U. S. Sugar Plant Field laboratory at Riverside, California, whenever it has not been feasible to analyze the pulp at once. Other sugar beet research workers familiar with our results report that they have found the method of storing sugar beet pulp suitable for their purposes.

## Methods and Results

In 1937 preliminary experiments were conducted to determine changes occurring in the sucrose percentage and coefficient of apparent purity of sugar beet pulp frozen immediately after sampling the beets. Strong evidence was obtained from sucrose analysis that little or no change occurred during storage of the pulp but in this test changes in reducing sugars were not determined.

In 1948 more extensive tests were conducted in which sugar beets grown at Rrawley and Riverside, California, were used. The purpose of using beets from two sources was to determine whether or not the pulp from beets of high sucrose content grown in the Imperial valley would respond differently under storage conditions than pulp from beets of relatively low sucrose content grown at Riverside, California. In the respective comparisons of fresh with stored pulp from beets grown at the two locations it was found that there were no differences in responses in the two lots. Time was not available for making complete analyses of pulp from both lots; therefore, only the beets grown at Riverside were used for critical tests over a prolonged period of storage.

The plan of experiment followed was to select 20 beets free from disease and of uniform size from variety U.S. 56 grown in the experimental

[1] Agronomist and Biochemist, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

plot at Riverside. The beets selected were washed free of soil particles and the tops removed at the lowest leaf scar. The entire beet was then passed through a multiple rasp such as is used by the beet sugar industry. The mass of finely divided pulp was mixed thoroughly by an electrically operated

Table 1.—Changes in Sucrose, Reducing Sugars, Dry Matter, and Apparent Purity Coefficient of Sugar Beet Pulp Stored below 8° F.

| Date analyzed | Period stored | Sucrose (fresh basis) | Reducing sugars (fresh basis) | Dry matter | Apparent purity coefficient |
|---|---|---|---|---|---|
| | Days | Percent | Percent | Percent | |
| 9-15-48 | 0 | 15.7[1] | | | 87.9[1] |
| 9-16-48 | 1 | | 0.12 | 21.62 | |
| | | | 0.12 | 21.02 | |
| 9-24-48 | 9 | 15.7 | 0.15 | 21.00 | |
| | | 15.7 | 0.17 | 21.02 | |
| 9-28-48 | 13 | 15.7 | | | |
| | | 15.7 | | | |
| 9-29-48 | 14 | | 0.16 | 21.26 | |
| | | | 0.13 | 21.21 | |
| 10- 1-48 | 16 | 15.7 | 0.12 | 21.46 | |
| | | 15.6 | 0.13 | 21.20 | |
| 10- 7-48 | 22 | 15.6 | 0.15 | 21.10 | |
| | | 15.7 | 0.14 | 21.19 | |
| 10-15-48 | 30 | | 0.14 | 21.35 | |
| | | | 0.14 | 21.45 | |
| 10-18-48 | 33 | 15.7 | | | |
| | | 15.7 | | | |
| 11-10-48 | 56 | 15.7 | 0.13 | 21.10 | 87.9 |
| | | 15.7 | 0.14 | 21.15 | 87.9 |
| 12-10-48 | 86 | 15.7 | 0.12 | 21.10 | |
| | | 15.7 | 0.12 | 21.15 | |
| 1-14-49 | 121 | 15.7 | 0.16 | 21.25 | |
| | | 15.7 | 0.16 | 21.25 | |
| 12- 6-49 | 443 | 15.6 | 0.20 | 21.30 | |
| | | 15.7 | 0.21 | 21.30 | |

[1] Mean of 10 determinations.

mixer which introduced a considerable amount of air into the pulp during the mixing process. A number of small sample bottles with tight fitting lids were filled with pulp. These sample bottles held approximately 80 grams of mixed pulp. As a check on the uniformity of the pulp and for an accurate determination of the percentage sucrose in the pulp at the beginning of the storage period, the pulp in each of 10 bottles was sampled

separately for sucrose and purity. Sucrose percentages and total solids by refraction were determined by the one-solution method as devised by Bachler[1]. Extraction of sucrose was by the cold water digestion method of Krueger as modified by Sachs Le Docte.

To determine the reducing sugars, twenty grams of pulp were washed into a 200-ml. Kohlrausch flask with distilled water. One drop of caprylic alcohol was added to break the froth which formed when vacuum was applied to remove the air worked into the pulp during mixing with an electrically-driven mixer. Sufficient neutral lead acetate was added to clear the extract before the volume was adjusted. The extract was filtered clear, then deleaded with sodium oxalate and again filtered. The cuprous oxide was precipitated using an official method[2] and titrated with potassium permanganate using ferrous phenanthroline as indicator. Hammond's revised table was used when calculating the amount of invert sugar percent.

The bottles of pulp were stored in a cold storage unit in which the temperature was maintained at approximately —5° F. for the first 130 days. For the remainder of the period the samples were stored the temperature was maintained below 8° F.

Two or three bottles were taken at random from the cold storage unit on each of the sampling dates shown in Table 1. The pulp was allowed to thaw and the entire contents of the bottles were removed and mixed thoroughly before duplicate samples were weighed out for analysis. The uniformity of the dry matter determinations indicates that the thorough mixing and the introduction of air into the pulp during the process avoided serious separation of juice from the pulp while it was being prepared for storage or while samples were being weighed out. The sucrose remained unchanged in the pulp for a period of 443 days, and reducing sugars remained nominal in amount. The coefficient of apparent purity was determined on samples after 56 days of storage and there was no change.

## Summary

**Critical tests were conducted in 1948 to determine the effect of storing sugar beet pulp in a frozen condition for analysis later. In these tests, twenty beets were selected and prepared for sampling. The beets were passed through a multiple rasp such as is used by the beet sugar industry. A portion of the pulp was analyzed immediately and the remainder was stored at a temperature below 8° F.**

**These tests showed that no loss in sucrose and no significant increase in reducing sugars occurred in the samples stored for 443 days. The coefficient of apparent purity was determined on the samples after 56 days of storage and there was no change. It was found to be highly important to remove all of the thawed pulp from the container and to mix it thoroughly before samples were removed for analysis. If sufficient air is incorporated into the pulp during the process of mixing, the separation of the juice from the pulp apparently is avoided.**

[1] Bachler, F. R. Facts About Sugar, 28: 420-423. 1933.
[2] Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists, 6th Ed. 1945.