

Sampling of Sugar Beets for the Processing Laboratory

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The variation of sugar concentration in different parts of the sugar beet root has been reported by several workers. Further study has been made of this variation because of the necessity of having reliable sugar analyses on beets used for experimental purposes.

Data obtained by Urban (1)² and Floderer and Herke (2) indicate that the sugar concentration in the beet is at its maximum at the region of maximum diameter, then decreases slowly with the taper of the root. Data found by Ludecke (3) indicate that this tendency is not followed by some beets but that the sugar concentration is at a maximum in the region below the largest diameter zone. Fort and Stout (4) have found that there is relatively low sucrose concentration in the core portion of the beet with sucrose increasing to its highest value in the outside two-thirds portion of the beet but then dropping to a low value in the outer one-eighth inch. Fort and Stout point out that this variation in composition may have a decided effect on analytical results.

Experimental

Since the reported analyses did not show very large differences, it seemed that there would be some manner of sampling individual beets that would avoid the variations.

Plugs were taken from a single beet diagonally down from the zone of largest diameter towards the tip. By this procedure it was hoped that the samples would be from the zone of highest concentration and thus would avoid the large variations. But the analyses from one beet were as follows: 9.9%, 10.1%, 11.0%, 9.9%, 10.4%, 9.0%, 11.0%, 11.0%. These results led to a more detailed study of how large the variations are in individual beets grown in this area.

Our initial studies were made by discarding the crown and cutting the beet root into three thick disks. Each of these disks was cut into concentric rings. Two samples for analyses from these rings were taken from diametrically opposite positions. Figure 1 illustrates how these zones were numbered. Table I is an example of the analyses obtained from 1600- to 2600-gram beets from Manteca and Woodland, Calif., which were stored from four to six weeks.

Table I.—Analyses of Sectioned Beets.

	1	2	3
I	14.0%	13.2%	10.7%
	16.6	13.3	10.6
II	16.6	13.6	12.6
	16.5	13.6	12.1
III	16.9	14.3	13.2
	17.5	16.0	13.2

These data are in accord with those obtained by Ludecke (3), but such large differences have not been reported.

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²Numbers in parentheses refer to literature cited.

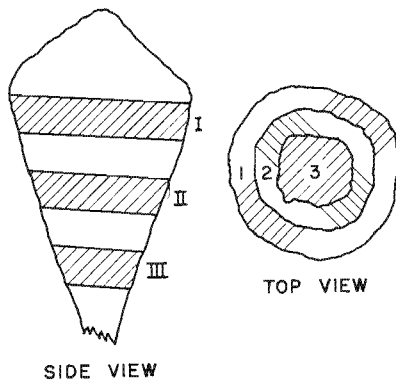


Figure 1.—Sectioning of Sugar beet root.

A more detailed study was made by paring 26-gram samples consecutively from the skin towards the core of cross-sectional disks about three centimeters thick. Care was taken to note which sample was composed mainly of parenchymous or of conductive tissues. As shown in Figure 2, a surprisingly large difference in sugar concentration was found in the two types of tissue of fresh beets, with the conductive tissues having more sugar. This observation was verified with beets from Brawley and Swingle,

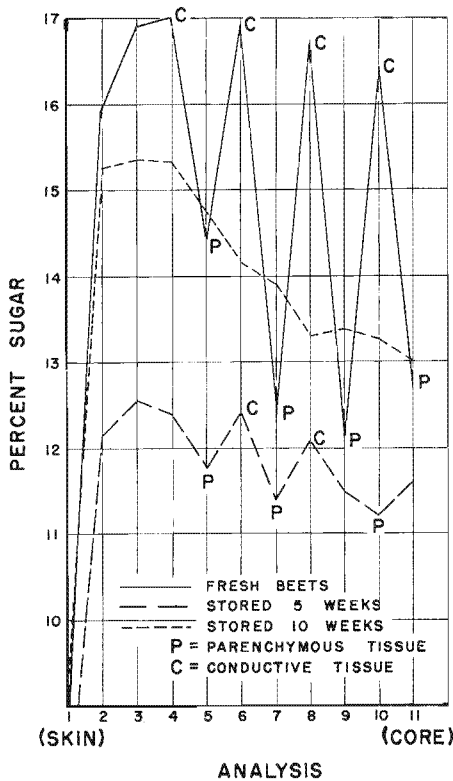


Figure 2.—Sugar concentrations of cross section of sugar beet root.

California. The largest difference observed was 12.5 percent in the parenchymous tissue with 17.0 percent in the adjacent conductive tissue, shown in Figure 2. This finding of difference of sugar concentration in the two types of tissues is in accord with that of Schneider and Hoffman-Walbeck (5), but they do not report as large a difference as we have found. Perhaps this smaller difference can be explained by the fact that they used beets that weighed 400 to 600 grams, whereas ours weighed from 1500 to 2000 grams. Also, it was observed that the concentration differences lessened after several weeks of storage. It was found that the sugar concentration in the center of the beet decreases with time to give a very good verification of the trend previously reported (4).

The very large differences in the different parts of the beet make it very difficult to obtain uniform samples from a beet. This is especially true of unsymmetrical beets because there is bunching of the tissues in certain sections. The most satisfactory method of obtaining uniform samples is to cut the beet into cosettes and to mix the cosettes thoroughly. This technique was used for samples used in finding conditions for the cold digestion Sachs-Le Docte method of analysis and for finding the percentage of sugar in beets used in experiments.

In the analyses reported here, the Sachs-Le Docte method of analysis for sucrose was used. The sugar beet, with the crown and tip removed, was cut into cosettes $\frac{1}{8} \times \frac{1}{8} \times \frac{3}{4}$ inches with an Urschell dicer, and then these cosettes were thoroughly mixed by hand in a stainless steel pan. Samples of 26 grams of these cosettes in 179.1 ml. of 5° Brix lead acetate were ground in electrical blenders. Conditions for the cold digestion technique were found by grinding for 1- and 5-minute periods, with extraction periods of 1/6, 1/2, and 3-hour periods. These data, given in Table 2, indicate that a 5-minute grinding period and 10-minute extraction period are satisfactory.

Table 2.—Analyses Used in Determining Conditions.

Grinding periods	Extraction periods			
	1/6 hr.	1.2 hr.	1 hr.	3 hrs.
1 min.	16.4%	16.6%	16.7%	17.3%
5 min.	17.7%	17.6%	17.5%	17.6%

It was noted in some of the analyses, especially those of the skin and of the pulp, that the filtrate colored upon standing enough so that it interfered with the reading. This coloration was greatly diminished by filtering in a nitrogen atmosphere. This filtration was accomplished by filtering into a suction flask with a slow stream of nitrogen coming in the side arm.

One hundred and fifty to 200 pounds of beets used in experiments are cut into cosettes and are mixed thoroughly in a cement mixer. Analyses of such cosettes result in sugar percentages as the following: 15.4, 15.2, 15.2, 15.2, 14.8, 15.3, 15.3, 15.6, 15.5, 15.2, 15.3, 15.0. The larger variation is probably due to poorer sampling from the longer cosettes and from larger differences because of the presence of the crowns and the tips. Analyses of cosettes which were cold, 2°-5° C., over a long period of time to see if there would be an appreciable sugar loss are shown in Table 3.

Table 3.—Analyses Showing Sucrose Retention in Storage.

	Initial	6 hr.	24 hr.	48 hr.	72 hr.
Sugar percentage	14.7%	14.6%	14.7%	14.7%	14.6%

*These values are average of 5 to 6 analyses.

From these data it was concluded that cold cassettes could be cut and mixed and kept for 6 to 8 hours to give a uniform source for experimental purposes.

Summary

It is very difficult to plug beets to give a representative sample of the sugar concentration because of the variation in different parts of the beet.

The conductive tissues of the fresh beet root have a much higher sugar concentration than the parenchymous tissues. In a stored beet, the core has a lower concentration than the zone near the skin.

It was found that cassettes could be cut, mixed, and kept for 6- to 8-hour periods, if kept cool, to give a uniform source for experimental purposes.

References

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