Rapid Determination of Moisture in Pressed Sugar Beet Pulp

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A large proportion of the sugar beet pulp produced in the U.S. is pressed and dried for use as a feed, and it is necessary to determine the moisture content of pressed pulp rather frequently as a control on pressing operations. The usual method of oven drying involves a lag of several hours between sample collection and results. The purpose of this report is to present results on a chemical method for solids determination (1, 2, 3, 4)[2] which may be used as an alternative to oven drying to the rapid method of Cotton et. al. (5).

Since the solids in plant materials are largely organic, it should be possible to determine total solids by measuring the dichromate necessary for complete oxidation and to calculate moisture difference. A rapid reproducible method, easily adaptable to beet pulp, has been developed by Launer and Tomimatsu 1, 2, 3, 4)[2] for the determination of moisture in rice, prunes, corn, potatoes, peas, and pineapple-rice pudding.

Details of the procedure are to be found in published reports 1, 2). An outline of the procedure is as follows: 25.00 ml. of 1.835N potassium dichromate is added to a weighed sample of material, calculated to reduce not more than 80 percent of the dichromate. About 30 ml. of concentrated sulfuric acid is carefully added while the mixture is stirred with a magnetic stirrer. It is important that the first 10 ml. be added slowly and that foaming caused by the rapid initial oxidation be allowed to subside before the remainder of the acid is added. The heat of dilution of the acid raises the temperature of the mixture sufficiently to oxidize the organic material within 4 minutes. The reaction mixture is then diluted with 150 ml. of water and the excess dichromate titrated electrometrically with ferrous ammonium sulfate. A pH meter with platinum-calomel electrodes can be used, or a simple system can be arranged with about 10 dollars worth of equipment (1) to detect the end point. The entire procedure can be completed within 10 minutes after the sample has been weighed. Use of magnetic stirring and avoidance of external heating are essential for reproducible oxidation (3). Care must be taken when adding the sulfuric acid that the

[1] Western Regional Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture, Albany 10, California. Prsented at 10th Meeting of American Society of Sugar Beet Technologists, Detroit, Mich., Feb. 4-6, 1958.

[2] Numbers in parentheses refer to literature cited.

foam produced during the initial oxidation does not deposit some of the solid sample on the side of the beaker above the final level of the oxidizing solution.

In order to calculate solids in a sample, it is necessary to know the dichromate consumed in oxidizing a given amount of the dry material in the sample. Moisture can then be calculated from the formula:

$$\text{Moisture } \% = 100\ (1 - F \times D)$$

where D is ml. dichromate per gm. of wet sample and F is gm. dry material per ml. dichromate. The factor F can be determined from the formula by comparison with a reference method of moisture determination.

A major point of interest in consideration of this method is the accuracy and precision of the factor F. Listed in Table 1 are the F values for various materials, taken from published reports of Launer and Tomimatsu (1, 2, 3, 4) and for beet pulp, determined here on one sample of beet pulp dried in the oven for comparison. The uniformity of the factor is striking, showing a range of only 11% for the plant materials listed. This can be attributed to the fact that the solids of each of these materials are largely carbohydrate.

Table 1.—*F* Values[1]

Material	*F*	Material	*F*
Rice	0.01247	Glucose	0.01385
Prunes	0.01382	Sucrose	0.01319
Corn	0.01268	Polyhexose	0.01248
Potatoes	0.01338	Peas	0.01361
Pineapple-rice pudding	0.01333	Sugar beet pulp	0.01302
		S.D.	0.00004

[1] Gm. of solids equivalent to 1 ml. of 1.835 N dichromate.

The sugar beet factor given in Table 1 was determined on one sample of dried and ground pulp. The pulp was from beets which had been stored for several months prior to diffusion. The F factor for beet pulp can be more accurately established by using several different batches of pulp. A serious source of error in any procedure (the dichromate as well as oven drying) lies in sampling techniques. Table 2 shows the variations in moisture levels found by different sampling methods. Oven moisture was determined at 60° C., 18 mm. Hg. for 16 hours, and dichromate moisture by use of F = .01302, sample chosen to contain 200 to 250 mg. solids. Four to 6 replicates were run to determine standard deviations.

Table 2.—Variation in Moisture Level With Sampling Method.

Sampling Method	Oven Moisture	S.D.	Dichromate Moisture	S.D.
5-Gm. grab samples	93.4	0.17	.....	.....
Pulp chopped with knife, 4-gm. samples	93.69%	0.13	93.60%	0.16%
Blended with 2 vol. water, 10-gm. samples	93.82%	0.06	93.60%	0.03%

We would like to call attention to the fact that in a pulp of 90 percent moisture, an error of 1 percent in solids determination results in only 0.1 percent error in moisture content, so that when determinations are made with the dichromate method, the higher the water content of the sample, the more accurate is the moisture determination.

Although only a limited number of trials have been made on sugar beet pulp, it appears that the solids in samples of sugar beet pulp can be determined by the dichromate heat-of-dilution method as precisely as by vacuum oven desiccation. The method requires only about 10 minutes after the sample is weighed, and only 4 minutes per sample for a series of samples. No expensive equipment is required.

Literature Cited

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