EVALUATION OF QUALITY OF GRANULATED SUGAR

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In general, the method of evaluating sugar quality or the grading of sugar as employed by various companies is essentially the same, but may vary in some of the analytical features. This discussion will deal with the general scheme employed by the Utah-Idaho Sugar Company.

The first item of consideration in evaluating sugar and the most important one is its general appearance in crystalline form. This grading is generally done by visual comparisons with arbitrarily selected sugars usually under artificial daylight illumination. This is done at our factories on each strike, and a small sample of each strike is sent to the general laboratory for visual observation. In addition, a twenty-four hour composite amounting to about three pounds of sugar is sent from each factory to the general laboratory for a detailed analysis to be made each day and the results reported as soon as possible to all factories.

These samples are placed in cellophane bags and carefully wrapped to avoid contamination in transit. The general appearance at the general laboratory is evaluated by means of a photometer; that is, a photoelectric apparatus which measures the amount of light reflected by a smooth surface of sugar using directional illumination. This instrument was designed by B. A. Brice, Physicist, Food and Drug Administration, U. S. Dept. of Agriculture and the writer. A detailed description was given in the Analytical Edition of "Industrial and Engineering Chemistry," for June 15, 1938.

The working standard of reflectance is an opaque white glass plate with a finely ground surface on which reflectance has been determined, relative to freshly prepared magnesium oxide. Thus all reflectance figures on sugars are reported in their relationship to magnesium oxide, so that if a sugar has a reflectance of 92.0% it reflects 92% as much light as MGO Surface. This system of measuring appearance assumes that which makes the sugar look good to you in the sugar bowl is the amount of light it reflects, and this is a safe assumption from the standpoint of the consumer since reflectance may be lowered by slight yellowness or grayness, or large or uneven grain size.

This objective method does away with the question of personal judgment, and gives a numerical evaluation of appearance which is a permanent record. It also furnishes a comparison not only between sugars this year, but for each succeeding year. One difficulty with an arbitrary standard is the lack of uniformity, so that when it is said that a certain factory made all A-plus sugar, this value is some what indefinite unless we know what their A-type sugar happened to be.

The percentage of ash in the sugar is determined electrometrically by means of a conductivity apparatus. While the percentage of ash may not effect the appearance, it is an important factor of quality.

The apparent color and turbidity of the solution of the sugar is determined in the same photoelectric apparatus used for reflectance measurements by means of measuring the transmittancy of the sugar solution with green and red light.

It is believed that the photoelectric method for determining the apparent color and turbidity in sugar solutions without recourse to filtration offers a simple, rapid evaluation of quality for the purpose of industrial control. The determination of apparent color in the unfiltered solutions is based on the fact that with increasing amounts of yellowish coloring matter, the ratio of green to red transmittancy, T_g/T_r, should decrease. If the suspended matter in the solution were to scatter light non-selectively, this ratio would be independent of turbidity. In sugar solutions for which a varying proportion of the scattered light is selective, however, this ratio is not entirely independent of the suspended matter, and the ratio T_g/T_r may be taken to indicate only the apparent color. The results obtained on sugars, together with the simplification gained by elimination of filtering, appear to justify its use in evaluating color quality for practical purposes. The form adopted for the apparent color index is $I_c = 100\ (1-T_g/T_r)$, since in this form $I_c = 0$ for a hypothetical sugar free from coloring matter and turbidity. and increases with increasing amounts of coloring matter. This color value could be expressed by the difference between the specific absorptive indexes for green and red light, but since the instrument scale indicates transmittancy, and since only a practical quality index for solution of constant depth and concentration is desired, it is believed there would be no advantage in using the more usual logarithmic form of expression.

The turbidity index adopted is $I_t = 100\ (1-T_r)$, which is the percent absorbency of the unfiltered sugar solution for red light. This index is practically independent of the coloring matter in solutions of white sugar, because there is virtually no light absorption in the red part of the spectrum by the small amount of coloring matter present. In this form $I_t = 0$ for a hypothetical sugar solution free from suspended matter and having a relatively small quantity of coloring matter and would increase with increasing turbidity. The importance of having the sugar low in color and turbidity is well appreciated.

The degree to which a sugar foams while being dissolved with heat is another quality consideration, and a standard method in general use is applied to each sugar for this determination.

The presence of appreciable amounts of sulphites in sugar is objectionable to certain users, so the amount present in parts per million is determined in each sample. These determinations are made daily and the results reported.

In addition to the foregoing analysis, a portion of the sugar from each factory goes to make up a weekly composite on which the following determinations are made: barley candy, bacteriological examination and screening test.

The barley candy test is one in use for many years, and consists essentially of heating sugar and water under standardized conditions to 350°F and determining the amount of color in the resulting hard candy. The color of the barley candies were determined on the photometer, using a lower concentration and less depth of solution because of the greater amount of coloring matter.

For the bacteriological examination of the sugars, the methods of the National Canners Association were used. In order to conform to the bacteriological standards set by them, the sugars must meet the following specifications:

Total Aerobic Thermophilic Spores

"For the five samples examined, there shall be a maximum of not more than 150 spores and an average of not more than 125 spores per 10 grams of sugar."

Aerobic Flat Sour Spores

"For the five samples examined, there shall be a maximum of not more than 75 spores and an average of not more than 50 spores per 10 grams of sugar."

Anaerobic Sulfide Spoilage Spores

"These shall be present in not more than two (40 percent) of the five samples and in any one sample to the extent of not more than five spores per 10 grams."

Anaerobic Thermophilic Hard Swell Spores

"These shall be present in not more than three (60 percent) of the five samples and in any one sample to the extent of not more than four (65 percent) tubes (method for testing.)

The screening test made on the weekly composite merely supplements those made on each shift at the factory and includes some additional sieves, all sieves of the control set being of U. S. Bureau of standard specification.

CERCOSPORA CONTROL BY SPRAY AND DUST

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The sugar beet growing area of Eastern Canada centers in the most southerly point of Canada, between Lakes Erie, St. Clair and Huron.

Cercospora infection has been severe in the factory areas in 4 years out of the past 8 years, and fairly general in 1932, 1935 and 1937. Our beets lost most of their normal leafage in August and grew an extended crown and new tufts of leaves before harvest. The sugar contents in the years of severe infection were:

1931 - Local beets 14.4%;	outside areas 15.4%;	general average 14.76%
1932 - " " 14.5%;	" " 15.4%;	" " 14.87%
1935 - " " 14.9%;	" " 15.8%;	" " 15.28%
1937 - " " (14.9%)	" " (16.0)	" " (15.35)

Among the recommendations for mitigation of Cercospora infection are the following and our experience with them:

1. Depp Fall Plowing. It has had little to do with Leaf Spot occurrence since 85% of our beet fields are fall plowed regularly and only 2% is unplowed. This 2% is in rotation and plowed for other crops.