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A METHOD FOR ESTIMATING SOLUBLE SOLIDS IN DRIED CITRUS PULP

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Introduction

Inquiries and requests on the part of processors of dried citrus pulps and citrus molasses indicate a need for a method whereby the soluble solids present in commercial, dried citrus pulps might be estimated.

Processors are adding molasses at varying rates to pressed pulps prior to drying. Few, if any, operators use proportioning equipment to control the process and very little is known concerning the storage life or keeping qualities of the products as related to the molasses content. The problem facing the industry is therefore twofold: (1) Development of a method for evaluating the molasses, or soluble solids, content of the finished products; and (2) studying the hygroscopic characteristics as related to storage life of dried citrus pulps containing varying amounts of citrus molasses. This latter problem will be the subject of a later report.

The method for estimating the soluble solids content of dried citrus pulps should be simple and reasonably accurate, such that it would have practical application in the processing plants, for the purpose of differentiating sweetened and unsweetened feeds as well as establishing the relative molasses content in terms of soluble solids. Official methods of analysis (2) are tedious and time-consuming, and require use of equipment not generally available in citrus pulp plants. Processors feel that such methods attain a degree of accuracy not warranted and are so expensive and time-consuming as to be economically impracticable.

A simple and rapid method has been developed which is satisfactory for estimating the soluble solids. It consists primarily of dissolving the soluble solids in dried pulp samples by suspension in water, the liquid phase being removed by filtration and the Brix value of the solution determined. Experimental results presented in this paper indicate that this method should prove valuable to the industry in evaluating the soluble solids content of dried citrus pulps.

Preparation of Authentic Samples

Two series of samples ("A" and "B") were prepared to contain pulp and molasses solids as follows: (1) All pulp solids (no molasses added), (2) 90% pulp solids and 10% molasses solids, (3) 80% pulp solids and 20% molasses solids, (4) 70% pulp solids and 30% molasses solids, (5) 60% pulp solids and 40% molasses solids, and (6) 50% pulp solids and 50% molasses solids.

The "A" series was prepared from grapefruit pulps at 28.45% solids and molasses at 73.7% solids; while the "B" series represents mixed grapefruit and orange pulps of 25.9% solids and molasses at 72.0% solids.

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The materials used in preparing the above two sets of samples were obtained from commercial plants; the pulps being taken immediately following the presses. The pressed pulps were held in frozen storage and the molasses under refrigeration while being used as source materials in preparing the experimental samples.

The pulp and molasses required for a given sample were weighed together in the bowl of a dough-type mixer[1] and mixed for a minimum of 15 minutes. The materials were allowed a contact period of one hour before being placed in a circulating air oven adjusted to 80° C. Samples were removed when judged to contain not over 8% moisture.

Dried citrus pulps are composed of both large and small particles of the various components. In order to minimize errors due to sampling, 400-gram samples were ground in a hammer mill[1] to pass a 1/16-inch mesh screen. After thorough mixing, small subsamples of such preparations yield reproducible analytical values. Consequently, both the laboratory preparations of pulp and the commercial pulps used in this study were prepared for analysis in this manner.

Method of Analysis

The soluble solids in a sample of citrus pulp were dissolved in water and the Brix value of the liquid determined. By simple calculation the soluble solids content of the sample was established.

To a 25-gram portion of the prepared sample 200 grams of hot water (about 70° C.) were added followed by continual moderate stirring on a hot plate, adjusted to maintain 70° to 80° C. for 20 minutes. The sample was then cooled in a water bath to room temperature and water added based on the tare weight as required to replace that lost through evaporation during the heating period. The sample was again stirred for 2 minutes before filtering through a dry "filter aid" pad in a Buchner funnel using vacuum.

Total soluble solids of the filtrate were determined by both refractometer and hydrometer. Iranzo and Veldhuis (1) have reported close agreement of both refractometer and hydrometer Brix values with that of total solids in citrus molasses. Therefore, the Brix values of the filtrates obtained in this study represent a soluble solids concentration of one-ninth that of the original sample. The percent soluble solids was then obtained by multiplying Brix values by the factor of 9.

Vacuum oven moisture values were determined on all samples and all analyses were based on a calculated moisture-free basis. Vacuum oven equipment is not generally available in commercial citrus pulp plants but practically all of them use the Dietert Moisture Teller.[2] It was felt that conditions for operation of the Dietert which would give results in reasonable agreement with values obtained by the vacuum oven method would be of some value. It was found that 15 minutes' treatment at 230° F. of a 25-gram sample of ground pulp prepared as previously outlined would give satisfactory values. It should be noted that variation in particle size of sample materials would induce variable results with the "Dietert" unit and therefore the conditions here recommended should be closely followed.

Discussion

In establishing the sample size and ratio of sample to water, it was found that the pulp would absorb 4 to 5 times its weight of water, thus making it necessary to use a ratio greater than

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[1] Any other type of equipment having the same capabilities would serve the purpose.

[2] The mention of certain trade products does not imply that they are endorsed by the Department of Agriculture over similar products not mentioned.

5 to 1. The use of a 25-gram sample and an 8 to 1 ratio of water to sample yields 70 ml. or more of filtrate, depending on the ratio of soluble and insoluble solids present. At least 70 ml. of solution is necessary to float a standard Brix hydrometer (graduated 0° to 10° in 0.1° units) when used with a 100-ml. graduate which has been found suitable. The use of a ratio greater than 8 to 1 would have no advantage but would only further decrease an already low concentration of soluble solids in the solution.

The averaged total soluble solids by both hydrometer and refractometer for all samples used in this study are given in Table I. The average deviation between duplicates of hydrometer values in the "A" and "B" series samples was 0.062° Brix or about 1 percent, while that of the refractometer values was 0.17° Brix or about 3 percent. Total soluble solids obtained by the refractometer were usually higher than those of the hydrometer, the average difference being about 0.1° Brix. In this table the percent molasses added values were computed in the terms used by the industry, i.e., pounds of molasses added per hundred pounds of product obtained. Computations here are based on 72° Brix molasses and a dried product at 8% moisture. Total sugars, also given in Table I, were determined on all samples used in this study by the official Munson-Walker gravimetric method (2). A correlation can be established between Brix values and total sugar values, but it

TABLE 1
AVERAGE TOTAL SOLUBLE SOLIDS AND TOTAL SUGAR VALUES OF FILTRATES

Sample	Molasses Added %	Total Soluble Solids Hydrometer ° Brix	Total Soluble Solids Refractometer ° Brix	Total Sugars %
A-31	0	4.63	4.70	3.29
A-32	12.9	5.27	5.30	3.68
A-33	25.8	5.97	6.09	4.28
A-34	39.4	6.72	7.06	4.41
A-35	51.5	7.25	7.39	4.60
A-36	64.2	7.87	8.09	4.89
B-37	0	3.90	3.77	1.73
B-38	13.0	4.77	4.80	2.56
B-39	25.7	5.49	5.68	3.47
B-40	38.7	6.40	6.38	4.24
B-41	51.3	7.00	7.07	4.45
B-42	64.4	8.10	8.14	5.39
C-1	35.8	6.16	6.34	3.84
C-2	5.0	4.42	4.45	2.19
C-3	20-25	4.82	4.96	2.58
D-1	0	4.68	4.86	2.35
D-2	8.0	4.72	4.79	2.69
E-1	35.8	6.22	6.48	3.87
F-1	15.0	5.47	5.65	3.41
G-1	16.0	5.05	5.22	3.47
G-2	20.0	4.90	5.00	3.52
H-1	3.0	4.92	5.00	3.19
H-2	10.0	5.30	5.36	3.68

is not sufficiently clear cut to merit further elaboration here.

In Table II the calculated total soluble solids (that present in the pressed pulp plus that added in molasses form) may be compared with values obtained by the method (° Brix x 9), as found in the "A" and "B" experimental samples. The soluble solids found in the respective nonmolasses added samples formed the

TABLE 2
COMPARISON OF THE CALCULATED PERCENT SOLUBLE SOLIDS PRESENT WITH VALUES INDICATED BY THE METHOD FOR SERIES "A" AND "B" SAMPLES

Sample	Soluble Solids, Calculated %	Soluble Solids, Found %
A-31		41.7
A-32	47.5	47.4
A-33	53.3	53.7
A-34	59.1	60.4
A-35	64.9	65.2
A-36	70.8	70.7
B-37		35.1
B-38	41.6	42.8
B-39	48.1	49.4
B-40	54.6	57.6
B-41	61.1	63.0
B-42	67.5	72.8

basis for computing the total soluble solids values. Agreement in the "A" series is considered good while the cause of the variance observed in the "B" series is not immediately apparent. The data indicate that, when applied to properly prepared dried citrus pulp samples, the method will give representative soluble solids values.

The relationship of percent soluble solids to percent molasses added for the "A" and "B" series samples is represented graphically in Figure 1. Here again the term "percent molasses added" is used to indicate the pounds of molasses used per hundred pounds of dried feed produced. The data for the samples were calculated to 8 percent moisture basis before plotting in Figure 1. The 8 percent moisture level was chosen because that is the value which has been given by the feed producers as optimum.

The two curves are quite similar and indicate a regular, progressive increase in soluble solids content with increasing molasses. However, it should be remembered that the "A" samples represent a grapefruit pulp and the "B" samples represent mixed orange and grapefruit pulps. The soluble solids values of the two unsweetened experimental samples are quite different and this difference is reflected throughout the two graphs. Other samples might show even wider deviations. It is suggested, therefore, that each processor prepare his own set of reference curves rather than use those presented in this paper. Thus, by knowing the nature of the pulp being processed the operator might judge how much molasses to add in order to produce a dried product of the desired soluble solids content or vice versa.

The commercial samples have also been plotted on Figure 1 and it will be noted that the values do not fall in a narrow band; however, the general trend follows that of the experimental samples. Inasmuch as the varieties of pulps, their moisture, and the exact amount of molasses added is not known for these samples, further observations are not warranted.

The samples represent different types of dryer operation. Samples C, D, E, and H were produced in fire dryers; F in a steam tube dryer and G in a 2-stage fire and steam-tube dryer, thus representing a cross section of commercial operation. It is quite possible that the method of drying, as well as the inherent differences in the raw product, might influence the soluble solids characteristics of the product—another reason why each processor might wish to prepare his own set of reference curves.

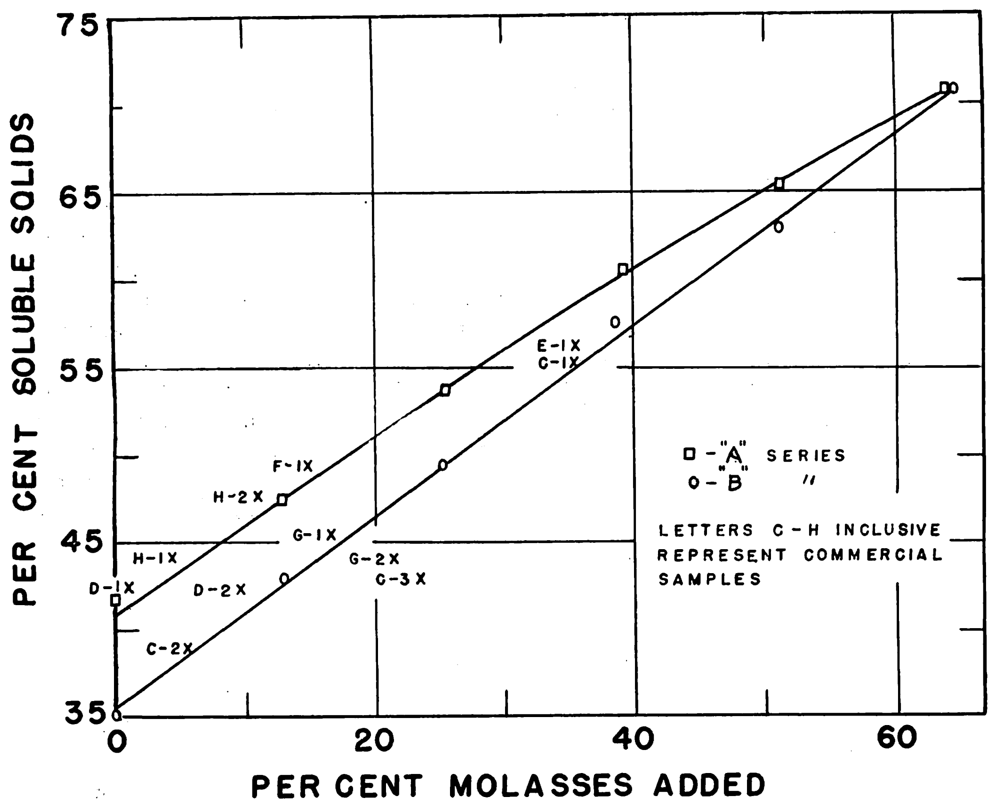

FIGURE I
SOLUBLE SOLIDS FOUND IN THE SAMPLES ARE PLOTTED AGAINST THE "MOLASSES ADDED" AS DEFINED IN THE REPORT
"A" Series (Grapefruit Pulp);-"B" Series (Mixed Orange and Grapefruit Pulps)

In most plants the molasses is added with manual control and is not strictly proportioned. The molasses content is really indicated by the amount of molasses used and the quantity of feed produced during a shift or similar period. This may account for some of the variation in the commercial samples. Strict proportioning should result in greater uniformity of the product.

If all the molasses produced in a plant handling citrus pulp were added back, it is estimated that the dried product would contain about 36% molasses. Thus, the data presented cover the ranges that would be expected in normal factory operation.

It is felt that the simple method described here will prove of practical value to processors of dried citrus pulps containing added molasses. The method may be used in control of plant operations to establish the approximate molasses content.

Summary

A simple and rapid method has been developed for the estimation of the soluble solids content of dried citrus pulps. It is based on the use of a small portion of a large sample which is finely ground and thoroughly mixed. It is suitable for routine operation in establishing the range of molasses content of citrus pulps. In experimental samples, increasing additions of molasses resulted in the regular

increase in the soluble solids values. The conditions for operation of the "Dietert Moisture Teller" which will approximate moisture values obtained by the vacuum oven method are also given.

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ORNAMENTAL SECTION

THE GENUS ALLAMANDA IN FLORIDA

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One of the most versatile of our Tropical American shrubs is the colorful Allamanda. Depending on its training, the Allamanda may be a shrub or a vine and is therefore logically called "Half vine-Half shrub." Under good cultural conditions the Allamanda should have flowers in every month of the year.

While this is a tropical plant and will not withstand freezing temperatures it does sprout readily from the roots and in a few short weeks following a freeze it will be a nice plant and full of bloom.

Flowers are funnel-shaped, yellow or purplish in color, with the essential organs deep in the tube. The fruit is a large prickly cap. Fruit and seed are not borne on conservatory specimens and in Florida only *Allamanda neriifolia* or Bush Allamanda has the unusual seed pod with any regularity.

With the exception of *Allamanda neriifolia* which is grown from seed, the other species of Allamanda are easily grown from old and new wood cuttings. With reasonable care a good grower should have a 90 percent live on cuttings.

The Genus Allamanda is a popular one with the Landscape Architects and Gardeners because of its many uses. *Allamanda cathartica,* variety Hendersonii may be used as a spreading plant almost like a ground cover—two feet high and any desired spread from four feet up. This same variety may be trained as a vine although it must be tied as it has no devise for either holding on or attaching itself. The Williamsii variety may also be used this same way, but it is not as popular because of its smaller sized flower. The use of the Allamanda as a spreading type plant has come into more popular use recently with the more modern type of low home. Certainly one of the best assets of the Allamanda is its insusceptibility to insects and fungi.

The following is a list of the species and varieties in the Genus Allamanda:

ALLAMANDA (APOCYNACEAE—family)

Cathartica—Common yellow Allamanda; Brazil; scandent shrub

Grandiflora—4½ inch yellow flowers.

Hendersonii—leathery, shiny foliage—5 inch yellow flowers.

Nobilis—flowers to 5 inches across—Magnolia-like fragrance.

Schotti—three to four inch flowers, shorter and dark striped throat.