The selenium is separated from the tellurium by boiling the precipitate in concentrated potassium cyanide solution, filtering, and adding hydrochloric acid, when the selenium comes down as a brick-red precipitate, which is weighed as before, after drying at 100°.

The tellurium is determined by difference or the small amount dissolved by the cyanide solution may be precipitated, after removal of selenium, by saturating with sulphur dioxide, collecting the precipitate with the original residue, and weighing after drying at 100°.

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THE USE OF SULPHUROUS ACID ($HNaSO_3$) IN MANUFACTURE OF GLUCOSE SYRUP AND GRAPE-SUGAR.

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UP to the year 1893 a large quantity of the glucose syrup and grape-sugar offered in home markets was manufactured by a carefully worked-out process, in which sulphurous acid had but little if any place.

While a fine grade of glucose can be manufactured without the use of sulphurous acid, its irrational use has taken full possession of some manufacturers.

That sulphurous acid has a legitimate place in a rational process of manufacture few who have studied the subject will deny, but a great deal of careful work is yet necessary to define the use of this reagent.

I have studied the action of sodium bisulphite on glucose syrup and grape-sugar in several directions, and with interesting results. The bisulphite used was manufactured by Gelian and Co., of New York, who have an excellent article of 38°–40° Bé. density.

Preserving Color of Glucose Syrups.—Numerous experiments have convinced me that sulphurous acid is of great value in preserving the color of glucose syrups. I will present here one

experiment, from the many made, to demonstrate this action of the acid.

On June 21st, fifteen batches (ca. fifty barrels each) glucose syrup were manufactured. Batches 2–9 received one gallon 38° Bé. sodium bisulphite and eight fluidounces of muriatic acid; batches 10–15 received two gallons bisulphite and sixteen fluidounces of muriatic acid.

On July 7th, batches 2–9 had lost color and brilliancy. Batches 10–15 of good color and brilliant.

In September batches 2–9 had a *decided* brown color and had lost brilliancy through separation of gypsum (?). Batches 10–15 good color but not brilliant.

In January, batches 2–9 had a *dirty brown* color. Batches 10–15 a *light* straw coloration.

The bisulphite may be added all to the finished product in the cooler, or a part to the liquor in the 39° Bé. vacuum pan, and the remainder to the finished product in the cooler.

The effect of its addition to the 39° Bé. liquor is immediately perceptible in the bleaching of the light straw-colored liquor.

Giving Brilliancy to Candy.—The candy test is for brilliancy and color, and while in some hands gives meaningless results, in skilled hands is a valuable criterion.

This test is carried out as follows: The glucose is weighed into a shallow copper dish along with cane-sugar ("Havemeyer and Elder S. R. Co. 'A' Sugar"), and 150 cc. water added. The proportions of glucose and cane-sugar are the following: For

42° Bé. syrup, 8 oz. glucose and 1 lb. 9 oz. cane-sugar;
43° " " 8 " " " 1 " 10 " "
44° " " 8 " " " 1 " 11 " "
45° " " 8 " " " 1 " 12 " "

The dish is placed over the direct flame of an eight-inch Fletcher burner and when the mixture begins to boil, five drops of olive-oil are added to prevent trouble from bubbles. Continue boiling for six minutes, watching carefully the rise of temperature with an accurate thermometer, and when 308° F. is reached, which usually requires nine minutes, pour the hot mass on an

oiled marble slab, when it spreads over the surface, making an irregular circular mass of about fourteen inches diameter.

When the mass has cooled sufficiently *to cut*, divide into halves. Mold one-half into a slab one inch thick, five to six inches long, three inches wide, and wrap in an oiled paper.

The other half is to be cut into strips one to one and a half inches wide, and *without any manipulating*, folded over four times, forming a coil.

From the slab and coil the brilliancy and color are judged. Using a confectioner's glucose made by oxalic acid and run over a dull specially prepared bone-black, a standard candy was prepared having the necessary brilliancy and color.

A large number of glucose samples from sharp bone-black, dull bone-black, specially prepared phosphate bone-black with bisulphite and without bisulphite were made into candy, and in every instance the addition of bisulphite added brilliancy and color.

In connection with candy I must speak of the bugbear sticky candy; there is a great hue and cry attributing sticky candy to the use of bisulphite. I am unable to trace the origin of this assertion to any person, but all are confident of its truth. It may have originated in the practice of preparing syrup for gum-drop manufacturers by adding two and a half buckets of bisulphite and one and a half quarts of muriatic acid to a batch of forty-four barrels 42° Bé. glucose, thus producing an acidity of 0.05–0.055 gram hydrochloric acid in 100 grams syrup. The reasoning may be. If sticky, moist gum-drops are produced by syrup receiving a large quantity of bisulphite, then stickiness and moistness in *all* candy must be due to the use of bisulphite!

I have studied this subject carefully and have been unable to trace sticky candy to the use of bisulphite.

Six samples of candy were boiled using 43° Bé., confectioners' glucose containing two gallons of bisulphite to fifty barrels; six samples of candy using glucose containing eight gallons of bisulphite to fifty barrels.

Three of the candies made from glucose containing two gallons, and three from that containing eight gallons, were exposed

on the laboratory table. Six samples were placed in a closely covered desiccator over sulphuric acid.

It was observed that the samples exposed on the laboratory table grew equally sticky; the samples in desiccator showed no sign of stickiness. This pointed to a certain degree of humidity of the air influencing the stickiness of candy. With this in mind a long series of careful observations were made with reference to the relative humidity of the air, and with the result that stickiness cannot be attributed to the use of bisulphite.

It is interesting to note here, that one candy manufacturer will complain of glucose giving sticky candy, while another manufacturer using glucose from the same batch makes no complaint.

Again, for some unknown reason, it is supposed that glucose receiving over three gallons of bisulphite per batch cannot be used by candy manufacturers for sundry *unknown reasons!* To obtain data bearing on this, batches of glucose were prepared containing five, six, seven, and eight gallons of bisulphite and placed in the hands of a skilled candy manufacturer who knew nothing of the content of bisulphite. In every instance, glucose containing eight gallons of bisulphite gave the best results!

Influence of Bisulphite on Boiling-Point of Candy.—The use of a large quantity of bisulphite makes it possible to boil candy to a higher temperature than when no bisulphite or a small quantity is used.

Batches of confectioners' glucose, 43° Bé. density, were prepared from a sharp bone-black and received varying quantities of bisulphite. Candies were boiled and with the following results:

Batch receiving	2	gals.	$HNaSO_3$	boiled	to	308°	F.	Candy	good color.
"	"	2	"	"	"	" 330°	"	"	very bad color.
"	"	6	"	"	"	" 308°	"	"	very good color.
"	"	6	"	"	"	" 330°	"	Color	better, but bad.
"	"	8	"	"	"	" 308°	"	Very	good color.
"	"	8	"	"	"	" 330°	"	Color	improv'g but bad.
"	"	10	"	"	"	" 308°	"	Very	good color.
"	"	10	"	"	"	" 330°	"	Color	still better.
"	"	12	"	"	"	" 308°	"	Very	good color.
"	"	12	"	"	"	" 330°	"	Good	color.

In the manufacture of hydrated grape-sugar having the average composition,

Red substance	70.00	per cent.
Water.....	20.00	"
Ash.....	0.52	"
Rest of dextrine.....	....	"
Nitrogenous bodies, etc.	9.48	"
	100.00	

it will be found that liquor from the second filtration can be treated with sulphurous acid to good advantage; and this accomplished by burning sulphur in a small iron furnace and pumping the fumes into the liquor.

Working with an amount of liquor representing 24,000 pounds finished product, the acidity when

½	lbs.	sulphur	is	burned,	is	0.016	gram	HCl	in	100	grams.
1½	"	"	"	"	"	0.027	"	"	"	"	"
2	"	"	"	"	"	0.034	"	"	"	"	"

The use of bisulphite with glucose syrup made it easy to ask the question, What effect will bisulphite have on grape-sugar solutions? Tradition has it that an acidity of over 0.034 gram hydrochloric acid is not allowable; why, no one knows. Some claim that an acidity over this point interferes with the action of the yeast in brewing.

I have experimented in this direction and with the following result:

To batches of grape-sugar sulphured by burning one and a half to two pounds of sulphur and two gallons of bisulphite were added. Laboratory experiments failed to show a diminished activity of the yeast; and more convincing, the brewers using the sugar made no complaint.

It is reasonable to suppose that the slight acidity of 0.034–0.045 gram hydrochloric acid will be taken care of by the calcium carbonate present in water used for brewing.

The addition of bisulphite to grape-sugar solutions led to the interesting observation that crystallization is thereby accelerated. I have made long series of observations and the records clearly show this fact.

I will present a few observations on the subject :

No. of experiment.	Date of manufacture.	Date of observation.	Condition of sample with $HNaSO_3$.	Condition of sample without $HNaSO_3$.
1.	9.12	9.20	Hardened	Liquor on top
2.	9.11	9.20	"	"
3.	9.19	9.20	Heavy cloud of crystals	No cloud
		9.23	Solid	"
4.	9.23	10.4	"	Little syrup
5.	9.23	10.4	"	Considerable syrup
6.	9.23	10.4	"	Little syrup
7.	9.22	10.4	Little syrup	Great deal of syrup
8.	9.22	10.4	Solid	Little syrup
9.	9.22	10.4	"	Moist
10.	9.22	10.4	"	Very little syrup
11.	9.22	10.4	Plenty syrup	$\frac{2}{3}$ syrup
12.	9.21	10.4	Solid	$\frac{3}{4}$ "
13.	9.21	10.4	"	Mushy
14.	9.21	10.4	"	Little syrup
15.	9.21	10.4	"	$\frac{3}{4}$ syrup
16.	6.21	10.4	$\frac{2}{3}$ syrup	$\frac{3}{4}$ "
17.	9.20	10.4	Very little syrup	$\frac{1}{4}$ "
18.	9.20	10.4	$\frac{1}{7}$ syrup	$\frac{5}{8}$ "
19.	9.20	10.4	Solid	$\frac{3}{4}$ "
20.	9.20	10.4	$\frac{2}{3}$ syrup	$\frac{7}{8}$ "
21.	9.20	10.4	Little syrup	$\frac{1}{5}$ "
22.	9.19	10.4	$\frac{1}{4}$ syrup	$\frac{1}{4}$ "
23.	9.19	10.4	Solid	$\frac{3}{4}$ "
24.	9.19	10.4	Solid and dry	$\frac{2}{3}$ "
25.	9.19	10.4	$\frac{7}{8}$ solid	$\frac{1}{2}$ "
26.	9.19	10.4	$\frac{2}{3}$ solid	$\frac{2}{3}$ "

The bisulphite bleaches grape-sugar solutions readily, and its effect on the sugar at the end of fourteen days and after six months is very marked.

Added to the "washer batch" (the batch first dropped from vacuum pan after boiling out with muriatic acid) the effect is pronounced.

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THE FURFUROL-YIELDING CONSTITUENTS OF PLANTS.

By C. F. CROSS, E. J. BEVAN, AND C. BEADLE.

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THE chemistry of the formation of the permanent tissue of plants may be approached from various points of view. From the incidents of our working connection with the subject