DETECTION OF ANHYDROUS GLUCOSE, MIXED WITH REFINED CANE SUGAR.

BY P. CASAMAJOR.

I lately received from Chicago a sample of sugar, suspected of being adulterated. The appearance of this sugar, and the sensation to the touch, were decidedly in favor of the supposition that starch sugar had been mixed with it. The sensation to the touch is very characteristic of such mixtures. The person who sent the sugar described this sensation by saying that "it felt like ground cocoa-nut."

Upon applying to the suspected sugar several tests, which had been found efficacious in detecting common hydrated starch glucose, the following results were obtained.

A test which was described before this Society at its meeting of March, 1880,[*] consists in stirring a suspected sugar with a small quantity of water. If any ordinary commercial starch glucose is present, this will appear as chalky white specks, which are distinctly seen in the translucent mass of wet sugar. This test is worthless with crystallized anhydrous glucose, as the crystals of this substance have, when mixed with water into a paste, the same translucency as crystals of cane sugar.

I also applied to the suspected sugar, the test which consists in treating a sample of sugar with a saturated solution of starch glucose in methylic alcohol of density equal to 50° of Gay Lussac's alcohometer. In the present instance, the saturated glucose solution which I used was made from anhydrous dextrose. By washing the suspected sugar with this solution, a small crystalline residue was obtained, which could not represent the total glucose present, as there was only 5 p. c., a quantity too small to pay for the trouble of mixing it with refined sugar.

The crystalline residue, placed under a microscope, showed the elongated square prisms, characteristic of anhydrous glucose, a form which cannot be mistaken for crystals of cane sugar, and still less for the thin plates of hydrated glucose.

Before proceeding with accounts of further tests, I must here withdraw a suggestion made by me before this Society in November, 1880,[‡] to the effect that starch glucose, mixed with refined

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[*] "Journal of the American Chemical Society," Vol. II., p. 111.

[†] *Ibid*, p. 428.

[‡] *Ibid*, p. 429.

cane sugar, could very likely be determined quantitatively by washing the suspected sugar with a saturated solution of starch glucose in methylic alcohol, and then weighing the residue. I suggested this process as one that might succeed, but one which I had not had occasion to try. The results which I have since obtained with this process show that the residue is much less than the quantity of starch sugar originally present. This is undoubtedly owing to this, that after dissolving cane sugar, the methylic solution acquires the property of dissolving additional quantities of starch sugar.

The sample of suspected sugar was also tested by the optical saccharometer. The direct test was 93.7 p. c. The solution was inverted, giving as a result 74.5 p. c. of pure sugar. This result clearly showed adulteration by a dextro-rotary substance. It does not, however, represent the actual quantity of cane sugar present, as I will show, by examining the influence of anhydrous glucose in a case of this kind.

To study this influence, I took 26.048 grammes of anhydrous glucose, which were dissolved in sufficient water to give 100 cc. of solution. A portion of this being placed immediately in the tube of the saccharometer, gave a deviation of 115.4 to the right. After standing in the tube for twenty minutes, the deviation fell to 95.7; after two hours, the deviation was 82.5. It was then allowed to stay over night in the tube, and, fourteen hours after, the deviation had fallen to 78.8, which did not vary afterwards on standing for several hours. The solution was then heated to 68° C. with 10 per cent. of its volume of hydro-chloric acid, the operation taking about fifteen minutes. This, after being neutralized with carbonate of soda gave a deviation to the right still equal to 78.8. There had then been no change by treating with hydro-chloric acid, which shows that the presence of dextrose is no bar to obtaining correct results by inversion, provided both observations, before and after inversion, are made after the deviating power of dextrose has reached a state of rest.

Returning to the test of the suspected sugar by the optical saccharometer, we have seen that the deviation to the right was at first 93.7 per cent. After standing in the tube fifteen minutes, the deviation fell to 90.2. We have seen that the result obtained by inverting, after the first reading, was 74.5. This result is evidently too high as the dextro rotary power of the dextrose present had diminished in the interval between the two observations.

Another sample of adulterated sugar was placed in the saccharometer as quickly as was practicable, after dissolving it in water. The indication was 100.4 per cent. As this sugar had all the appearance of a low sugar, this indication was sufficient to show that it was adulterated. This solution was kept in the tube for further examination. Fifteen minutes afterwards, the deviation had fallen to 94.3 per cent. Half an hour from the first observation, the reading was 91.6 ; one hour after, 90.2 ; two hours after, 89.9 ; three hours after, 89.7 ; five hours after, 89.3. After this there was no further variation. After inversion the indication was 72.7 per cent., which was considered as the correct percentage of pure sugar.

The optical saccharometer may then be considered as sufficient to determine if starch glucose is present in a sugar, by observing the deviation immediately after getting the solution ready for the saccharometer, and repeating the observation at sufficiently wide intervals of time. If dextrose is present in notable quantities, the deviation will decrease in a marked manner. Although the proof obtained in this way is satisfactory, it can only be applied by the very few persons who have saccharometers. To combat adulteration the best processes are those which can be easily applied by dealers and consumers, who are unprovided with scientific appliances.

The following process can be applied by using such means as are at the command of everybody. It is applicable to the detection of adulteration with either anhydrous or hydrated glucose :

Take two beaker glasses or two tea-cups. In one put a quantity of the suspected sugar, and in the other put about the same quantity of a sugar known to be refined sugar, free from adulteration.

Add, cautiously and gradually, a quantity of water to each sugar sufficient to make each equally and decidedly moist, and stir the sugar to mix it well and get it uniformly wet. Then place both cups in hot water. Any temperature between 50° and 100° C. will do. In about ten minutes the pure sugar will appear more moist than when cold, while the other sugar, if it contains a sufficient amount of starch glucose, will have sunk into a pasty, sticky mass, analogous to the *fill mass* of sugar refiners.

The application of heat is not indispensable, as a difference may be obtained by allowing the two sugars to stand several hours after being moistened, but, with heat, the effect is immediate, and is much more marked.

If the two samples of sugar are allowed to stand in the cups after they have cooled down, the pure sugar will look dryer on becoming cold, while the adulterated sugar will continue in the state of a pasty, sticky mass.

This test is founded on the property possessed by cane sugar to form viscous, uncrystallizable compounds when mixed with many organic or inorganic substances, among which are anhydrous and hydrated dextrose. An example of compounds of this kind is *molasses*, obtained as as a residuum in sugar manufacture.

As long as a mixture of cane sugar and starch glucose is sufficiently dry, it may look fair enough, as the elements which form molasses are kept from combining by want of water. The sugar adulterator is well aware of this, and he is careful to dry his sugar before mixing with glucose. Indeed, one characteristic of adulterated sugars is that they are always dryer than refined sugars of the same grade, which are known as *coffee sugars*, and are always sold moist.

As soon as sufficient water is added to an adulterated sugar, and moderate heat is applied, enough viscous syrup is formed to make the sugar sink into a paste, which remains permanently soft.

Useful indications may be obtained as to adulteration by starch glucose, by means of Fehling's solution. An ordinary refined coffee sugar will rarely show more than 5 percent. of glucose, while a sugar adulterated with the usual dose of starch glucose, will show about 20 per cent. of glucose.

ANALYSIS OF SOAP.

By Dr. Albert R. Leeds.

In the analysis of soap it is necessary to determine :—

(1) Water.

(2) Uncombined fat.

(3) Soap consisting of (3a.) combined Fatty Acids, estimated as Fatty Anhydrides, and (3b.) Combined Alkali, usually Soda (Na_2O).

(4) Uncombined Alkali.

(5) Glycerine.

(6) Resin.

(7) Sodic Carbonate.

(8) Sodic Chloride.

(9) Sodic Sulphate.