| | |
|---|---|
| Manganese | 16.86 % |
| Iron | 0.91 |
| Tungsten | 0.20 |
| Arsenic | 0.19 |
| Zinc | 0.18 |
| Lead | 0.04 |
| Nickel and Cobalt | 0.05 |
| Bismuth | Trace. |
| Antimony | Trace. |
| Phosphorus | Trace. |

## IX.—Examination of the Minnesota Early Amber Cane.

By Prof. C. A. GOESSMANN.

*Received February 28, 1879.*

The recent recommendation of the cultivation of the Minnesota early amber cane, an acclimated variety of the Chinese Sorghum, for the production of syrup and sugar for general home consumption, caused the investigation which I propose to describe shortly within the few subsequent pages. The entire management of the experiment, as far as the agricultural and industrial questions involved were concerned, was confined to the application of such modes of operation as any intelligent farmer could carry on with moderate means. The same apparatus were employed for the crushing and pressing of the cane, and the general treatment of the juice, which are quite extensively used for that purpose in Minnesota and other western states, *i. e.*, a Victor mill and a Cook's evaporator, with an additional sheet-iron pan for defecation.

Somewhat more than twenty acres, located on at least as many farms, in the vicinity of Amherst, were planted with genuine seed; upon the college grounds one acre was cultivated, which furnished mainly the material for my tests. As a correct appreciation of the circumstances which control the character of the final practical results, required a definite knowledge regarding the most favorable stage of the canes for sugar manufacture, a series of examinations were instituted with a view to ascertain that particular point. My thanks are due to Mr. E. B. Bragg for kind assistance in the earlier stage of the investigation.

The examination of the cane was carried out in the following manner: On the date specified, the stalks were cut off six inches above the ground, and two feet in length of the tops and the entire leaf

mass removed; the remaining part of the cane was subsequently crushed and pressed to secure its juice. The latter, after being tested for its specific gravity by Brix's saccharometer, and for its relative amount of free acid at boiling heat, by means of a solution of carbonate of soda, containing one grm. of sodium carbonate anhydride in 100 cc of dist. water, was treated without delay, with a solution of basic acetate of lead, in the same manner as in the case of the juice of the sugar-beet-root, to secure a good defecation for similar purposes. The filtered juice was subsequently divided in every instance into two portions; one part was treated directly in the usual manner, with Fehling's solution for grape sugar, and the other part, after being treated in the customary way with hydrochloric acid, at a moderate heat, to convert the cane sugar present into glucose, was treated like the former liquid for the total amount of sugar. The difference noticed between both tests was calculated according to well known rules as cane sugar. It has been the aim, during the entire investigation, to secure in all cases, not otherwise specified, a comparative value to the various analytical statements.

1.

1878.

Aug. 15.—Juice obtained from plants *five* feet high; no flower stalks in sight:

Specific gravity 4.2° Brix, at 27° C. temp.
Grape sugar present ..... 2.48 per cent.
Cane sugar " ..... .... none
Soda solution required..... 6.8 cc.

The microscope revealed the presence of many granules of starch:
Cane lost at 100° C. 92.07 per cent. of moisture.
Cane left at 100° C. 7.93 " of solid matter.

2.

Aug. 16.—Juice obtained from plants *ten* feet high; no flower stalks in sight:

Spec. gravity 5.8° Brix, at 24° C. temp.
Grape sugar present..... ... 4.06 per cent.
Cane sugar " ..... none
Soda solution required..... 9. cc.
Cane lost at 100° C. 88.90 per cent. of moisture.
Cane left at 100° C. 11.10 " of solid matter.

3.

Aug. 20.—Juice obtained from plants with the lower leaves of the canes turned reddish; flower stalks well developed; flowers, however, not yet open:

Spec. gravity 7.0° Brix, at 24° C. temp.
Grape sugar present..... 3.47 per cent.
Cane " " ..... 2.15 "
Soda solution required..... 7. cc.
Cane lost at 100° C. 87.00 per cent. of moisture.
Cane left at 100° C. 13.00 " " solid matter.

4.

Aug. 24.—Juice obtained from plants bearing flower stalks with fully developed open blossoms:

Spec. gravity 8.7° Brix, at 23° C. temp.
Grape sugar present..... 3.7 per cent.
Cane " " ..... 3.0 "
Soda solution required ..... 4.0 cc.
Cane lost at 100° C. 85.93 per cent. of moisture.
Cane left at 100° C. 14.07 " " solid matter.

5.

Aug. 27.—Juice obtained from canes of plants in full blossom:

Spec. gravity at 10° Brix, at 25° C. temp.
Grape sugar present..... 3.65 per cent.
Cane " " ..... 4.13 "
Soda solution required ..... 10. cc.
Cane lost at 100° C. 84.52 per cent. of moisture.
Cane left at 100° C. 15.48 " " solid matter.

6.

Aug. 30.—Juice obtained from canes of plants with the formation of the seed fairly begun:

Spec. gravity 9.5° Brix, at 30° C. temp.
Grape sugar present..... 4.00 per cent.
Cane " " ..... 3.81 "
Soda solution required..... 9.5 cc.
Cane lost at 100° C. 83.86 per cent. of moisture.
Cane left at 100° C. 16.14 " " solid matter.

7.

Sept. 2.—Juice from canes of plants with seeds in the milk, *i. e.*, seeds of full size, yet still soft:

Spec. gravity 10.70° Brix, at 27° C. temp.
Grape sugar present..... 3.85 per cent.
Cane " " ..... 4.47 "
Soda solution required ..... 9.5 cc.
Cane lost at 100° C. 84.15 per cent. of moisture.
Cane left at 100° C. 15.85 " " solid matter.

8.

Sept. 9.—Juice obtained from canes of plants with seeds still soft:

Spec. gravity 12.10° Brix, at 22° C. temp.
Grape sugar present..... 3.21 per cent.
Cane " " ..... 6.86 "
Soda solution required ..... 9.5 cc.
Cane lost at 100° C. 73.87 per cent. of moisture.
Cane left at 100° C. 26.13 " " solid matter.

9.

Sept. 9.—Juice obtained from canes of plants, from which, on the 2d of Sept., the leaves and the tops had been removed, without disturbing them otherwise:

Spec. gravity 12.8° Brix, at 22° C. temp.
Grape sugar present..... 3.77 per cent.
Cane " " ..... 6.81 "
Soda solution required..... 9.5 cc.
Cane lost at 100° C. 73.25 per cent. of moisture.
Cane left at 100° C. 26.75 " " solid matter.

10.

Sept. 18.—Juice obtained from canes of plants left upon the field without any alteration regarding leaves or tops:

Spec. gravity 13.20° Brix, at 22° C. temp.
Grape sugar present ..... 3.57 per cent.
Cane " " ..... 7.65 "

11.

Sept. 18.—Juice obtained from canes of plants, from which only the tops had been removed, leaving the remaining portion of it undisturbed in the soil:

Spec. gravity 13.8° Brix, at 22° C. temp.
Grape sugar present..... 3.16 per cent.
Cane " " ..... 8.49 "

12.

Sept. 18.—Juice obtained from canes of plants, from which the tops and all the leaves had been removed on the 9th of Sept., whilst the remaining portion of it was not disturbed in the soil until cut on the 18th of Sept.:

Spec. gravity 11.5° Brix, at 22° C. temp.

| | | |
|---|---|---|
| Grape sugar present..... | 3.16 | per cent. |
| Cane " " ..... | 5.85 | " |

13.

Sept. 18.—Juice obtained from canes of plants which were cut off on the 9th of Sept., had their tops removed as usual, yet their leaves left on, and, consequently been left upon the field for *nine* days before the sample tested was secured by pressing:

Spec. gravity 12.8° Brix, at 22° C. temp.

| | | |
|---|---|---|
| Grape sugar present..... | 10.00 | per cent. |
| Cane " " ..... | 0.60 | " |

14.

Sept. 21.—The juice secured from the cane of No. 13 on the 21st of Sept., showed 13° Brix, at 21° C. temp., and when taken still two days later its specific gravity was equal to 15° Brix, at 18° C. temp.

From the previously stated observations, we may safely deduce the following conclusions, regarding the question above specified, at least as far as our climatical and terrestrial conditions bear on the growth and development of the Minnesota early amber cane, as a sugar-producing plant:

1. The grape sugar appears in the cane at an early stage of its growth (Nos. 1–2), and increases slowly to from 3 to 4 per cent. before cane sugar is formed.

2. The cane sugar is first noticeable at the time when the flower stalks become visible above the leaves, and its amount increases steadily until the seeds are of full size, yet still soft (Nos. 3–8).

3. The relative proportion of grape sugar to cane sugar did not exceed, at any time before the hardening of the seeds, 3.1 of the former to 8.4 of the latter; in the majority of cases it was about three to seven.

4. The cane loses a considerable amount of its moisture during the period of development of the seeds—from 10 to 12 per cent.; see Nos. 7–8; aiding thereby in increasing the density of the juice; the better quality of the latter during later periods in the life of the plant has, for this reason, to be ascribed largely to that cause, and not to the continued formation of sugar. The quality of the juice is improved at that stage largely, therefore, if not entirely, at the expense of its quantity.

5. The increase in the density of the juice of the cane, after the seeds are full sized, may be somewhat retarded by taking off the leaves, without disturbing the remaining plant in the soil (No. 12).

6. The cane sugar of the plants changes gradually, yet steadily, into grape sugar, after they are once cut off; the degree of that change varies widely, and depends largely on the exposure they suffer subsequently from weather and from temperature, being more serious during moist and warm, than in dry and cool weather.

7. The safest way to secure the full benefit of the early amber cane crop for syrup and sugar manufacture is to begin cutting the cane when the seed is full grown, yet still soft; in our case, between the 10th and 15th of September, and to grind them without delay.

The average yield of a syrup of 7.4° Brix, per acre, amounted to from 160 to 170 gallons, and rose in some instances to 240 gallons. To study the effect of the mode of manufacture pursued on the composition of the syrup, the following experiment was instituted. The juice of a healthy, fresh cut cane was tested before it passed into the defecator, and, also subsequently, the syrup obtained from it.

Sept. 29.—Juice 14.7° Brix, at 15° C. temperature.

| | |
|---|---|
| Grape sugar present..... | 3.61 per cent. |
| Cane " " ..... | 8.16 " |

The syrup obtained from the previously stated juice contained:

| | |
|---|---|
| Grape sugar..... | 37.87 per cent. |
| Cane " ..... | 37.48 " |

A glance at these results shows, that the relative proportion of the cane sugar and the grape sugar, as found in the juice of the same, are so seriously altered in the course of its manufacture into syrup, that it must be conceded, that the question, whether the syrup obtained in

the customary way can serve for the economical manufacture of sugar for the general market, can scarcely be entertained any more seriously; the sugar production, from syrup like the above, must remain a mere incidental feature in the amber cane industry, as far as our section of the country is concerned, and so long as the cost of separating the sugar does not offer more substantial advantages.

*Amherst. Mass., Feb'y 26, 1879.*

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## X.—Notes Upon Chicle.

By GEO. A. PROCHAZKA, Ph. D., and H. ENDEMANN, Ph. D.

*Received March 19th, 1879.*

The great interest in the search of substitutes for india-rubber and gutta percha, which for some time past has been manifested by technical men, has led us to an examination of a Mexican product, known in the United States for a number of years under the names of *Chicle* or *Sapota*. The latter name would imply that the product were derived from one of the many species of Sapotaceae, one of which is pointed out as the tree furnishing Balata. With the latter product it shares in fact many qualities; the general description given of Balata seeming to apply directly to the product under examination.

Balata is the concrete juice of a tree variously called by botantists *Mimusops Balata* Gaertn., *Achras balata*, *Achras Dissecta* and *Sapota Muelleri*, a Sapotacea which grows in British Guiana, while Chicle is said to be the product of a tree of the same class from Mexico. The difference in the manner of obtaining the material is evident from the chemical composition. While Balata is an almost pure hydro-carbon, with its various products of oxidation, Chicle contains, also, the various impurities of the juice from which it is derived.

The only reference to Chicle that could be found was by J. R. Jackson [Ph. J. Tr. (3) 7.409]. He gives a general description of the material, stating that it resembles gutta percha in appearance, being, however, more friable and brittle. He further mentions that it is probably derived from *Chrysophyllum glycyplacum* of the family Sapotaceae, and that it is also known under the names of *Mexican gum* and *rubber juice*.