Sucrose in the Stalks of Maize Inbreds

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A Connecticut field corn inbred, C103, has been discovered to have sucrose in the juice of the stalks in an amount approaching that of sugar cane. A sample of juice extracted on October 18, 1947, contained 8.65% sucrose and 2.60% invert sugar, or a total of 11.25% sugar. The juice of normal cornstalks varies in sucrose content from 1 to 4%.

The stalk of C103 has appreciably more vascular bundles than the normal corn, with very little pith and a rather large proportion of juice. A similarity was noticed between this stalk and that of sugar cane observed growing in Cuba more than a score of years ago. The recollection led to tasting the C103 stalk, and, surprisingly, it seemed almost as sweet as cane. Chemical analyses of the cornstalks confirmed the sweetness and demonstrated that the sugar present was largely sucrose.

TABLE 1

Sample No.	Inbred or hybrid	Invert sugar (%)	Sucrose (%)	Total
499	C103	1.80	5.72	7.52
500	2477 Tr (Ldg)	2.62	3.52	6.14
503	1948 Tr (Ldg)	3.48	2.70	6.18
504	1951 L317	1.68	2.91	4.59
498	C102*	2.32	3.45	5.77
501	2478 C102 × C103	1.68	1.37	3.05
502	2488 L317 × C103	0.74	1.27	2.01

* Ears were harvested from this sample about 10 days before sample was taken. Consequently, this figure is probably too high in comparison with the others.

TABLE 2

Sample No.	Inbred or hybrid	Invert sugar (%)	Sucrose (%)	Total
679	C103–2	2.60	8.65	11.25
678	C103	3.57	6.20	9.77
681	Tr (Ldg)	5.83	2.11	7.94
680	C103 × Oh 40B*	1.93	9.27	11.20
682	Syrup C103	20.32	35.99	56.31

* Stalks had no ears. Consequently, this figure is higher than for an average of this hybrid, which seemed to vary considerably in sweetness when the stalks were tasted.

After finding the stalk of C103 sweet, several other inbreds were tasted. Tr (Ldg) was fairly sweet to the taste, but there was no difficulty in differentiating the C103 line when it was unknown to the tester. Other inbreds tasted were not notable in sugar content.

The occurrence of sucrose in cornstalks has long been known. Before the Spanish Conquest of Mexico, the Aztecs made sugar from the stalks of Indian corn, *Zea Mays* L. (*3*). Also, various attempts, some almost 100 years ago, were made by the U. S. Department of Agriculture (then a division of the Patent Office) to secure sugar commercially from cornstalks (*2*). A patent was taken out by F. L. Stewart in 1906 for a method of increasing the sugar content of cornstalks. This method consisted in removing the ears before maturity, thus doubling the amount of sugar in the stalks. A report of experiments along this line is given by Clark (*1*). After a rather thorough investigation it was concluded that it was not economically feasible to use cornstalks as a source of sugar even though sugar could be obtained.

This conclusion was undoubtedly correct for open pollinated corn, where one has only limited control over the heredity. But with the pure-line method it is quite a different story. Pure lines can be maintained, and undoubtedly the sugar content can be increased by breeding for this specific character. The stalks which were analyzed had, for the most part, produced good ears. Thus, it should be possible to incorporate the high sugar content into the commercial field corn hybrids, harvest the ears, and have the sugar crop as a by-product.

Tables 1 and 2 show, respectively, the amount of sugar found in the stalks and the juice.

Since the sweetness of C103 was not discovered until October 1, few analyses were made in 1947. Although the leaves were killed by frost in late September, a sample of C103 taken on October 18 showed as high a percentage of sucrose as was found previously. Thus, there would be some time for processing stalks after harvesting the ears.

Two hybrids, L317 × C103 and C102 × C103, showed a very low percentage of sugar, although both had a stalk similar to C103. Thus, it seems that the sugar content is not a function of the same gene or genes causing the stiffer stalk. The stiff stalk behaves as a dominant and the sugar content as a recessive. The hybrid C103 × Oh 40B had a high sugar content, but this was probably partially caused by having produced no ears. The stalks on which ears were produced did not have a high juice content and were not sweet to the taste. Neither was the Ohio inbred Oh 40B sweet to the taste.

While the high sucrose content of the cornstalks may make sugar production from corn feasible, it may also render cornstalks higher in feeding value for farm animals. This should be true not only for silage but when the stalks are fed green. The higher sugar content might also cause the stalks to be more palatable.

The high sucrose of cornstalks at present is confined to one inbred line, C103. Manufacture of sugar on a commercial scale, or utilization of the higher sugar content for feeding animals, must await the development of a hybrid with stalk juice high in sugar. To produce such a hybrid, one or more inbreds similar to C103 in genetic constitution will be needed. If these cannot be discovered among existing ones, it will be necessary to develop them by breeding—a feasible project but one requiring time.

References

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3. WINTON, A. L., and WINTON, K. B. *The structure and composition of foods.* (Vol. 4.) New York: John Wiley, 1939.