

COMPOSITION OF CANE JUICE AND CANE FINAL MOLASSES

By

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BIOGRAPHICAL NOTE

Dr. Wendell W. Binkley received his B.A. from Ohio Northern University at Ada, Ohio, in 1935 and his M.S. and Ph.D. degrees in 1936 from Purdue University where he studied with Professor E. F. Degering. He was a research chemist for the National Starch Products of New York, New York during 1939-42. He then went to The Ohio State University Research Foundation where he has carried out research in the protein and carbohydrate fields.

Dr. Melville L. Wolfrom received his B.A. degree from The Ohio State University in 1924. During and preceding his undergraduate training, he worked as a control and analytical chemist in various industrial laboratories in Cleveland, Ohio, and served as a developmental chemist with the National Carbon Company in Fremont, Ohio, and the United States Gypsum Company at Gypsum, Ohio, and Chicago, Illinois. He received his Ph.D. degree in organic chemistry from Northwestern University in 1927 under W. Lee Lewis.

Dr. Wolfrom then served for two years as a National Research Council Fellow in Chemistry and studied at The Ohio State University with W. L. Evans, at the Rockefeller Institute for Medical Research with P. A. Levene, and at the National Bureau of Standards with C. S. Hudson. During 1939 he held a Guggenheim Memorial Foundation Fellowship and studied with P. Karrer at the University of Zurich in Switzerland.

He was appointed instructor in chemistry at The Ohio State University in 1929 and has been professor there since 1940. His principal research interests have been in the chemistry of carbohydrates and other natural products.

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Foreword

The title of this monograph is very broad, yet the report does not undertake to mention all recorded literature on molasses or to compile all the claims that have been made and conclusions that have been drawn by previous workers. The material here has been selected by special tests. The purpose of the authors has been to record all the components of cane juice and molasses *that have been positively and unequivocally identified according to the exact criteria of modern organic chemistry*. Many inferential conclusions from inadequate and indirect data have therefore been omitted.

The authors have endeavored to screen the entire literature of chemistry for information meeting these standards. In addition, they include conclusions from their own work under Project No. 4 of Sugar Research Foundation which was carried out between 1944 and 1951 at The Ohio State University. The present report, therefore, will serve as a final account of the project as well as a critical survey of the literature.

The U. S. Department of Agriculture contributed to the work in 1950-1951 and has been the principal sponsor since July 1, 1951, when Foundation support ceased.

The main purposes in studying molasses composition have been two in number. First, a knowledge of molasses components should help explain why we have molasses, that is, just what kinds of substance forming or accumulating in the liquors are responsible for eventually inhibiting sugar crystallization. Second, a knowledge of non-sugar molasses constituents, including those beneficial or helpful to microorganisms, should assist the efficient use of this product for making alcohol yeast, citric acid, or other products of microbiology as well as chemical transformations. A third purpose, that is, to discover ingredients worth recovering for immediate sale, is a relatively minor one.

About 53 organic compounds so far have been identified in cane juice and about 44 in molasses. The greatest remaining problem is to discover

just how the high molecular weight ingredients of molasses ("sugar polymers") are formed from cane juice constituents, to elucidate their structures and to learn how to minimize their formation or eliminate them. The work already carried out should form a basis for discovering the differences between juices that are readily clarified and those that are "refractory," or those which differ otherwise in practical handling in the mill. Such information should eventually guide the breeder in producing more satisfactory new varieties.

Both cane juice and molasses are very complex mixtures and difficult to resolve. The newly-developed methods of chromatographic separation have contributed a great deal to current progress. The authors of this report did extensive original work in the early stages to adapt chromatography to sugar separations.

The goal of complete knowledge of cane juice and molasses composition is more nearly in sight now than ever before, though much still remains to be done.

HENRY B. HASS
President

ROBERT C. HOCKETT
Former Scientific Director

COMPOSITION OF CANE JUICE AND CANE FINAL MOLASSES

BY W. W. BINKLEY AND M. L. WOLFROM

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I. INTRODUCTION

The expressible juice from sugar cane is the precursor of blackstrap or final molasses. Components of the juice constitute the major part of this by-product. However, a significant portion of the final molasses consists of the altered reaction products formed under factory conditions from the juice constituents. A summary of the composition of cane juice is presented as a necessary background for any discussion of cane final molasses. Cane juice is an aqueous solution circulating in the living plant and carrying materials required for growth and metabolism. It is therefore extremely complex. It distinguishes itself from other plant juices or saps by its characteristically high content of sucrose. The

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