PREFACE

This volume of the projected series of the book on food gums and hydrocolloids continues in the same vein as Volume I, i.e., a pragmatic book written to assist the scientist and technologist who need a practical, current reference book on the state-of-the-art in this field. Volume I covered the general background and comparative properties of hydrocolloids and the very important area of fermentation or biosynthetic gums.

Volume II continues with coverage of three important categories of gums — the natural plant exudates, the seaweed extracts and the family of cellulose gums.

Volume III will cover the plant seed gums, gelatin, pectin, starch, and other pertinent materials.

Again I would like to thank each of the contributing authors for their efforts and assistance in this undertaking and I’d like to thank my many friends and associates in the food industry and at General Foods Corporation for their advice, counsel, and encouragement. Thanks to Ms. Elly Cohen for her assistance in proofreading and correcting the rough manuscript and special thanks for Mrs. Margaret Paino and Ms. Kathy Kastendieck for the typing assistance that made this book possible.

Valley Cottage, New York
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Martin Glicksman is a Principal Scientist in the Central Research Department of General Foods Corporation, Tarrytown, New York. For the past 27 years he has been actively involved in applied research and in the development of many new food products. Before joining General Foods he worked for seven years in the pharmaceutical and fine chemical industry as an organic chemist.

Mr. Glicksman has acquired an international reputation in the field of hydrocolloid technology, has published many papers, and holds 19 patents in the field. His best known publication is the book *Gum Technology in the Food Industry*, which is a basic reference book on hydrocolloids in the food processing industry.

Mr. Glickman holds a B.S. degree from City College of New York and M.S. and M.A. degrees from New York University. He is a Fellow of the Institute of Food Technologists and is currently a Counselor of the New York Section of the I.F.T. which has a membership of about 1100 food industry members. He is also editor of the newsletter of the Carbohydrate Division of the national I.F.T.
CONTRIBUTORS

Alan H. King
Senior Technical Representative
KELCO
Division of Merck & Co., Inc.
Clark, New Jersey

Martin Glicksman
Research Scientist
General Foods Corporation
Tarrytown, New York
Dedicated
to my grandchildren,
Scott Loren and Eric Warren
FOOD HYDROCOLLOIDS

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INTRODUCTION

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I. GENESIS OF GUMS

Historically, the earliest known gums or hydrocolloids were the natural exudates or secretions from trees and bushes. Knowledge of these materials has surfaced in many of the surviving records dating from the ancient Egyptian dynasties through the biblical era and up to modern times. Today several of these natural gums are still common articles of commerce.

A great many plants exude viscous, gummy liquids, which when exposed to air and allowed to dry, form hard, glassy masses. The shapes of these masses vary from spherical, tear-drop balls typical of gum arabic-producing Acacia trees to curved, ribbon-like strands of tragacanth from Astragalus bushes. The colors of these exudates also vary widely from almost clear white to dark brown, depending on the species, climate, soil, and adsorbed impurities.

The basis and reason for the formation and exudation of gums by plants is still not understood, and many theories have been formulated to explain these phenomena. One hypothesis suggesting that gum formation is a protective mechanism resulting from a pathological condition is supported by evidence concerning the production of gum arabic. Healthy Acacia trees, grown under favorable conditions of soil and climate, produce little or no gum, while trees grown under adverse conditions of high elevation, excessive heat, and scarcity of moisture produce sizeable quantities of gum arabic. In addition, the yield of gum can be further increased by deliberately injuring the tree by stripping away the bark.

Other investigators believe that gum formation is part of the normal physiological metabolism of the plant as in the case of the gums in sugar beets and yeasts. Still others consider gums to be synthesized as a result of an infected section of the plant to prevent further invasion of the tissue. This can be considered similar to the formation of a scab on a human wound. The formation of gum has also been attributed to fungi attacking the plant and releasing enzymes that penetrate the tissues and transform the constituent cellulose materials of the cell wall into gum. This has been suggested to be the mechanism of formation of the gum found in the gummosis disease of various deciduous trees. Yet another theory, particularly with respect to Acacia species, claims the formation of gums to be caused by bacterial action and suggests that specific bacteria are capable of producing different kinds of gum. However, the current theory of gum formation is that it is not a pathological occurrence, but is a result of normal enzymatic behavior of the plant. Recent morphological studies have shown the presence of gum arabic in various cells throughout the Acacia plant as part of the plant's normal growth and development.

II. PHYSICAL PROPERTIES

The physical appearance and properties of the natural gums are of utmost importance in determining their commercial value and their end use. These vary considerably with gums of different botanical sources, and there are even substantial differences in gum from the same species when collected from plants growing under different climatic conditions or even collected from the same plant at different seasons of the year. The physical properties may also be affected by the age of the exudate, treatment of the gum after collection, such as washing, drying, sun-bleaching, and storage temperatures.

Natural gums are exuded in a variety of shapes and forms, the best known being the tear-drop or globular shape of various grades of gum arabic. Other characteristic shapes are flakes or thread-like ribbons as with gum tragacanth. Still others resemble stalactites, and after collection and fracturing yield irregular rod-shaped fragments.

The surface of most gums is perfectly smooth when fresh but may become rough or covered with small cracks or striations upon weathering, resulting in an opaque appearance.
These fissures or striations are often restricted to the surface, but may be deep in some gums, causing the "tear-drops" to break up into smaller fragments during handling and shipping.

The color of gums in their natural exudate shape varies from almost water-white (colorless) through shades of yellow, amber, and orange to dark brown. The best grades of gum arabic are almost colorless with slight traces of yellow. Some gums possess pink, red, or green lines; and some black or brownish gums are also found.

Many gums when first secreted appear to be colorless, and it is believed that color is due mainly to the presence of various types of impurities. Color often appears as the gums age upon the tree and may be due to extraneous substances that are washed onto the gum. Bush or grass fires can cause discoloration by scorching. Tannins from the sap or tissues of the parent tree are frequently the cause of discoloration and are believed to account for some of the very dark gums yielded by certain trees.

The water-soluble plant gums are usually odorless and in this respect differ markedly from the oil-soluble resinous exudates which have distinctive smells. The gums are usually tasteless and bland, except for some species which have a sweet, carbohydrate taste and some types that have been contaminated. Gums contaminated with tannins usually have a harsh, bitter flavor that is a serious detriment in food applications.

Gums vary in hardness, but since this is usually dependent upon the amount of moisture present (12 to 16%), it cannot be used as a means of classification as with minerals. Density is also variable and depends upon the amount of air entrapped when the gum was formed.

There are many plant gum exudates known all over the world, but only four are of real importance to the food industry. These are arabic, ghatti, karaya, and tragacanth. Many of the other gums are known and used in local areas where they are available, but only to a very limited extent. These gums have similar properties and can be used for similar applications where necessary. Some of the more common ones are damson, plum, cherry, peach, prune, lemon, almond, cashew, brea, chagual, mesquite, shiraz, cactus, neem, sapote, cholla, khaya, jeol, and others too numerous to mention. For detailed information on these less important gums, the reader is referred to the publications of Whistler, Smith and Montgomery, Whistler and Smart, and Howes. In this section only the four important commercial gums will be discussed — arabic, ghatti, karaya, and tragacanth.

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