

PREFACE

Research in starch biosynthesis is likely to have a great impact on agriculture and industry in coming years. Although the original purpose of research into starch synthesis was not industrial application, it is an example of how science, while trying to answer fundamental questions, may lead to the manipulation of nature for beneficial purposes.

Although the basic studies of starch synthesis were carried out in England during the 1940s, and led to the discovery of phosphorylase and Q-enzyme (branching enzyme), the basis of our modern ideas originated in Argentina from the work of Luis F. Leloir and Carlos E. Cardini. They founded in 1947 the Institute for Biochemical Research and during the late 1950s established that nucleoside diphosphate glucoses were involved in the biosynthesis of both glycogen and starch. These pioneers, “refugees” from a university system decimated by a dictatorial government, achieved great scientific advancement under difficult and very modest conditions. They were supported by private citizens at a time when the government would only employ members of the ruling party. Leloir and Cardini’s group discovered the starch synthase reaction, first with uridine diphosphate glucose (UDPGlc) as a glucose donor (de Fekete *et al.*, 1960, 1961) and then with adenine diphosphate glucose (ADPGlc, Recondo and Leloir, 1961). This group isolated ADPGlc from corn grains and discovered the enzyme ADPGlc pyrophosphorylase (Espada, 1962). For some recollections of those romantic but dangerous times, please see Paladini (1996).

Our aim in writing this book has been to provide an up-to-date account of the biochemistry and molecular biology of starch. The chemistry of the starch granule and the biochemistry, molecular biology, plant physiology, and genetics of plant starch synthesis are discussed, and the recent findings regarding the properties of the starch biosynthetic enzymes and the studies describing their localization in the plant cell are emphasized. The implications of these studies for the seed, biotechnology, and modified starch industries are also discussed. We concentrate mainly on developments published since 1992, discussed against an historical background. For many of

the more important discoveries, the authors' names and the dates are included so that the reader is introduced to most of the important workers in the field. For the subjects treated more succinctly, such as starch structure and degradation, reviews and books are cited as further reading. At the end of the book we include numerous references to the original literature but have not tried to be comprehensive.

Most starch is used as food, but about one-third of the total production is employed in a variety of industrial purposes that take advantage of its unique properties. We include a chapter in which the commercial uses of starch and its chemical and physical processing are summarily discussed. Clearly, how the raw material is used is important for the scientist who works in the basic sciences. Much can be gained by increasing the starch content in some plants and/or by manipulating its quality (e.g., by modifying the ratio of amylose to amylopectin). Starch content has already been increased in tomato fruit and potato tubers by using recombinant DNA and molecular biology techniques, and in the not too distant future it should be possible to alter its composition.

This book has been written with a broad readership in mind: starch has always been an important product, but now the capacity to modify its structure and increase the starch content of crops is attracting the attention of the seed companies, the chemical industry, and the research agencies. Because global warming is likely to affect the starch content in some plant species—a change that would, in turn, affect photosynthesis—this subject is of interest to physiologists, ecologists, and environmental agencies. All of this new attention has increased the flow of research papers in the field. In the next few years many of the basic questions posed here will be answered, leading, we hope, to advances in biotechnology and benefits for all.

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