Food Extrusion Science and Technology

edited by
Jozef L. Kokini
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Preface

Extrusion processing of food materials has become increasingly important. Very diverse applications ranging from candy (licorice) processing to caseinate production, from solid fat manufacturing to development of flavors, have been introduced in the last decade. While the technology is becoming increasingly available, the science base has become increasingly difficult to generate because the applications are becoming more and more complex.

For example, it is becoming apparent that the mechanical energy introduced during extrusion serves as a catalyst for many of the intriguing reactions. Therefore, understanding of the distributon of strain, strain rate, and extent of mixing during extrusion is critical to many of these chemical reactions. While much of this information has been dealt with in an elementary form in several textbooks, the recent advances have not been dealt with in a systematic fashion. This book attempts to meld recent advances in the simulation of transport phenomena during single- and twin-screw extrusion with chemistry pertaining to food material transformation during extrusion. This interaction between engineering principles and food chemistry at a mechanistic level is what makes this book unique.

The book is divided into five sections. Part I focuses on transport phenomena during extrusion and covers both single- and twin-screw extrusion, with special emphasis on the metering section where reaction kinetics and transport phenomena are integrated. Kneading elements, which play a key role during twin-screw extrusion, are particularly emphasized. Part II covers rheological properties of cereals during extrusion. The coverage of this topic is particularly important because rheological properties become the bridge between transport phenomena and chemical changes during extrusion. Part III is involved with chemical and physicochemical transformations during extrusion. Starch and protein conversions are discussed mechanistically, and binary interactions between starch and protein, as well as

ternary interactions between protein, starch, and lipids, are also introduced. An exploration of the effects of these transformations on functionality of extrudates is one of the unique aspects of this book.

Part IV focuses on scale-up and control of extruders. This topic is of utmost importance to food technologists who need to convert their laboratory-based expertise to plant level production. The principles involved in scale-up of extruders, the effect of wear, instabilities, process dynamics, and the improvement of product quality through twin-screw extrusion and closed-loop quality control are all addressed in this section.

The last section in the book attempts to bridge functionality with physical properties, chemistry, and technology. For example, a mechanism for the expansion of extrudates is proposed and the effect of process parameters on the expansion of extruded materials is discussed. Application of extrusion to oriental foods constitutes a unique topic. The effect of extrusion operating variables on functionality is discussed in great detail.

We are indebted to the contributing authors for their creativity, promptness, and cooperation in the development of this book. We are also thankful to the Center for Advanced Food Technology for creating the environment to bring together such an impressive group of extrusion scientists. We also sincerely appreciate the patience and understanding given to us by our wives, Jenny Kokini, Mary Ho, and Vatsala Karwe. Without their support, this piece of work would not have materialized.

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