Encapsulation and Controlled Release Technologies in Food Systems

Edited by Jamileh M. Lakkis

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Jamileh M. Lakkis, Ph.D., has 14 years experience in the food, dietary supplements, and consumer products industries. She served as Senior Project Manager at Pfizer/Cadbury-Schweppes, Morris Plains, NJ, focusing on designing confectionery products as delivery systems for oral care benefits. As a Senior Encapsulation Specialist for General Mills, Inc., Minneapolis, MN, Dr. Lakkis designed several microencapsulation processes for stabilizing and masking the taste/aroma of a variety of functional and nutraceutical actives for their applications in breakfast cereals, dairy, confections, and shelf-stable bakery products. Her professional experience also includes engagements as Senior Research Scientist at Land O'Lakes, Inc., Arden Hills, MN. Dr. Lakkis co-organized the first IFT symposium on microencapsulation and controlled release applications in food systems. She is an active member of the Controlled Release Society and serves on the society's newsletter editorial board representing the Consumer and Diversified Products Division.

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I dedicate this book to LEBANON
Which had not been my country, I'd have chosen it to be

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Preface

Encapsulation and controlled release technologies have enjoyed their fastest growth in the last two decades. These advances, pioneered by pharmaceutical companies, were a result of: (1) the rapid change in drug development strategies to target specific organs or even cells, (2) physicians' growing concern about patient non-compliance, and (3) pharmaceutical companies desire to extend their market monopoly on new drugs for a certain period of time as provided by the US and international patent laws.

Despite this progress, encapsulation and controlled release technologies have only been recently adopted by the food industry. Food researchers and technologists have often been confronted with the dilemma of how to translate all these advances from the drug arena into practical applications in food systems. By searching the literature, one can find volumes of books and specialized publications on encapsulation and controlled release technologies. Unfortunately, most of these publications have dealt with theoretical aspects of these technologies with little emphasis on real applications in consumer and food products.

This book attempts to illustrate various aspects of encapsulation and controlled release applications in food systems using practical examples. These examples will give the reader an appreciation for the delicate art of designing encapsulated ingredients and the enormous challenges in incorporating them into food formulations. Most of the practical examples in this book were borrowed from the patent literature. This approach might be questioned based on the fact that patents applications are never peer reviewed, but seems justifiable considering the frantic effort by both industry and academia to protect their discoveries and to gain limited-time monopoly on their innovations, thus limiting the availability of such information in peer-reviewed articles.

This publication has several potential uses. It is a reference book for scientists in the food, nutraceuticals and consumer products industries who are looking to introduce microencapsulated ingredients into new or existing formulations. It is also a post-graduate text designed to give students some comprehension of various aspects of encapsulation and controlled release in food systems.

This book is organized in such a way that each chapter treats one major application of encapsulation and controlled release technologies in foods.

Chapter 1 introduces the readers to various encapsulation and controlled release technologies, as well as release mechanisms, suitable for applications in foods, nutraceuticals and consumer products.

Chapter 2 by Professor Nissim Garti and his collaborators discusses a novel approach to encapsulation and controlled release via reverse microemulsion technique referred to as nanosized self-assembled liquids (NSSL). Such systems are shown to provide exceptional thermodynamic stability in a wide pH range. In addition to enhancing bioavailability of functional active ingredients, NSSL systems, by virtue of their unique transparent appearance, are excellent candidates for beverage applications.

Chapter 3, by Dr. Klaas-Jan Zuidam and co-workers, presents an elaborate approach to understanding emulsions and their benefits as delivery systems in food applications. This chapter discusses various mechanisms of emulsion stabilization and destabilization and

how they can best be designed for targeted delivery of flavors and functional ingredients in the human gastrointestinal system.

Chapter 4 on encapsulation and controlled release of probiotics by Drs. Chen and Chen reports on approaches for encapsulating probiotic bacteria in dairy products as well as in the human gastrointestinal tract. This chapter also discusses novel optimization techniques for stabilizing these beneficial bacteria and enhancing their survival rates.

Chapter 5, written by the editor of this book, highlights current approaches to encapsulation and controlled release technologies for bakery products applications. Current encapsulation practices such as hot-melt particle coating and spray chilling are discussed. Examples of the performance of encapsulated leavening agents as well as sweeteners and flavors are presented in shelf-stable bakery applications.

Chapter 6 on nanoencapsulation technology by Dr. Huang and his collaborators deals with novel approaches to encapsulate enzymes and nutraceuticals. Specific examples are presented on stabilization of phytochemicals and their enhanced bioavailability via incorporation into nanoemulsions and bioconjugation systems.

Chapter 7 on flavor encapsulation via complex coacervation is written by Dr. Curt Thies. Discussion is focused on the basic principle of complex coacervation technique as a liquid–liquid polymer phase separation phenomenon. Guidance on polymer selection and subsequent implications on the physicochemical properties of capsules as well as their release behavior is provided.

Chapter 8, written by the editor of this book, details techniques used for delivering therapeutic as well as functional actives and flavors via confectionery products. Technologies and subsequent applications discussed in this chapter have wide applications in the food, nutraceuticals, as well as pharmaceutical arenas. Mechanisms and challenges specific to targeted release in upper gastrointestinal tract, especially the mouth and throat areas will be described in great detail.

Chapter 9 discusses encapsulation and controlled release of actives in packaging applications by Dr. Ozdemir and collaborator. In this contribution, the authors provide examples on embedding fragrances, pigments as well as antimicrobial and insect repellent agents into food packaging films.

Chapter 10, authored by Ms. Kathy Brownlie, provides a marketing perspective of microencapsulation technologies and their potential impact on the food industry. Ms. Brownlie offers an in-depth assessment of market drivers as well as constraints that are still hindering wider implementation of these technologies in food manufacturing.

This book has definitely surpassed my vision and expectations thanks to the contributors that I am grateful to all of them for their expertise, commitment, and dedication. It is my hope that this book will prove itself a useful source on encapsulation and controlled release in a wide range of food and consumer product applications.

Many thanks to the editorial staff at Blackwell Publishing Co., especially to Mark Barrett and Susan Engelken for their valuable help and advice throughout this project.

Last but not least, I would like to thank my parents who taught me the importance of working hard, having clear goals, and standing for what I believe is right. It is a lesson that guides me in everything I do.

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