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Ultrasound Technologies for Food and Bioprocessing

 Springer

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Preface

The use of acoustic energy in food or bioprocessing operations is a relatively new endeavor if compared with other sources of energy, such as mechanical or thermal, which have been utilized for centuries in various applications. There are two important factors that make the current ultrasound-assisted processes possible. One is related with the development in ultrasound generation technology and the other one is the better understanding of interactions between acoustic energy and liquid media, enabling the development of important guidelines for ultrasound-based processes.

In addition to existing applications, there is an increasing list of potential uses of ultrasound in a wide range of industries. For food and bioprocessing purposes, it includes, for example, homogenization, cutting, extraction, inactivation of microorganisms, inactivation/activation of enzymes, drying enhancement, surface cleaning, depolymerization, crystallization, sieving, bio-component separation, peeling, nanoparticle production, particle size reduction, improvement of interface heat and mass transfer, and so on. It is, therefore, the strong belief of the editors that a comprehensive compilation summarizing the fundamentals of ultrasound technology, current developments, new research findings, and more importantly examples of industrial applications is very much needed to further the uses of ultrasound technology.

This book was designed to be an aid to a broad range of scientists and engineers in several fields, including food processing, food safety, chemistry, physics, chemical engineering, material science, agriculture, and bioprocessing-related disciplines. The 25 chapters in the book are organized into three sections. Section I ([Chapters 1 to 4](#)) covers fundamental aspects of ultrasound as well as high-intensity ultrasound applications. The basic concepts in acoustics, the theory of acoustic cavitation, and the physical and chemical effects of cavitation on biomaterials are detailed in three chapters. There is also a chapter dealing with the thermodynamic and kinetic aspects of ultrasound. Section II ([Chapters 5 to 8](#)) focuses on recent developments in the power ultrasound domain, where the four chapters elucidate important topics, such as how to use variable frequency strategies to enhance an ultrasound treatment and how to avoid the pitting problem in probe-type sonoreactors. This section also

includes non-traditional approaches to generate cavitation, which are very promising. The 17 chapters in Section III ([Chapters 9 to 25](#)) are dedicated to current and potential applications of power ultrasound mainly in the food processing and bioprocessing industries. Topics covered in these chapters include ultrasound-assisted unit operations, such as cutting, cleaning, homogenization, extraction, freezing, crystallization, drying, and membrane separation. In addition, the inactivation of microorganisms and enzymes are covered in detail in three chapters. The use of acoustic energy to change the functionality of food components and ingredients is also extensively covered in the two following chapters, and later on, specific applications, such as the utilization of power ultrasound in the dairy industry, are included. At the end, there is a chapter dealing with the sonochemistry of power ultrasound as applied to the production of nanomaterials.

We hope this book will not only prove to be useful in research and development efforts but will also facilitate the industrial adoption of power ultrasound. Finally, we would like to thank all of the authors for their efforts to contribute very stimulating chapters. Many of these authors also participated in reviewing the manuscripts, for which we are grateful. It was indeed a great pleasure to work with such a fine group of professionals.

Urbana, Illinois
Pullman, Washington
Stuttgart, Germany

Hao Feng
Gustavo V. Barbosa-Cánovas
Jochen Weiss

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