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Food Physics

Physical Properties –
Measurement and Applications

With 131 Figures and 208 Tables

 Springer

Foreword

This new book, *Food Physics: Physical Properties – Measurement and Applications*, is an expanded version of the text in German, *Lebensmittelphysik* (Springer, 2004), by the first author, Ludger Figura. It is the result of collaboration between Ludger Figura and Art Teixeira who have been teaching food physics and physical properties of foods at the Bremerhaven Hochschule (Germany) and the University of Florida (USA), respectively. The book is a timely addition that will serve as a useful resource on the physics and physical properties of foods. It should be useful worldwide to teach junior- or senior-level undergraduate students. In addition, it should find use in food companies because, as the authors point out: “it is essential that food companies be able to design and control their processing operations to assure maximum product quality and safety and to develop new and improved food products and quality attributes desired by the consuming public.”

There are fourteen chapters, in order: Water Activity, Mass and Density, Geometric Properties: Size and Shape, Rheological Properties, Interfacial Phenomena, Permeability, Thermal Properties, including Heat Transfer in Food, Electrical Properties, Magnetic Properties, Electromagnetic Properties, Optical Properties, Acoustical Properties, Radioactivity, and On-Line Sensing. Each subject was given its due weight. The first seven chapters cover about 62% of the book. In addition, there are several appendices on relevant topics, such as: Units and their Conversion, Distribution Functions, Complex Numbers, Greek Letters, Properties of Water, and Conversion Charts for: Temperature, Sugar Concentration, as well as Relevant Literature references.

I enjoyed reading an early draft of *Food Physics: Physical Properties – Measurement and Applications*. I am sure that students and researchers of Food Physics and Physical Properties will find it to be a useful and worthy text.

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Preface

Why should there be a book about food physics and the physical properties of foods? In order for the food processing industry to increase food safety and to be competitive in an ever expanding global market place, it is essential that food companies be able to design and control their processing operations to assure maximum product quality and safety and to develop new and improved food products with quality attributes desired by the consuming public. The food scientists and engineers entrusted with the responsibility for developing the means by which these results can be achieved will have to have mastered a fundamental knowledge base in the physical properties of food materials, and the science of food physics, which provides the scientific principles upon which these properties can be understood and applied. This book was conceived with this purpose in mind.

The book is intended for both food scientists and food engineers, as reflected in the chosen title and subtitle for the book. The title *Food Physics* is directed to food scientists who recognize the importance of food physics as a core part of a food science curriculum, along side food chemistry and food microbiology, for understanding the physical behavior of food materials. The subtitle *Physical Properties – Measurement and Applications* is directed to food engineers who are always in need of physical properties for process design and control applications, and recognize that such physical properties can only come from the study of food physics. In fact, it has been the relatively recent introduction of food engineering into the food process industries over the past few decades that called attention to the need for physical properties and the study of food physics in the combined fields of food science and engineering.

Food physics offers considerable breadth in the range of topics covered, as well as depth of coverage in each topic. The book contains fourteen chapters with each chapter related to a different field of physics in which physical properties of foods are important. Nearly all areas of physics are covered, beginning with water activity and the role of moisture content in foods, followed by basic properties of mass and density and size and shape, and then continuing through mechanical, rheological, thermal, and electromagnetic radiation properties and their applications, including electrical, magnetic, optical, acoustical, and ionizing radiation properties. The final chapter of the book introduces the reader to the exciting new world of in-line sensors for the on-line measurement of physical phenomena that can be used as indirect indicators of food

properties or quality attributes that must be controlled in closed-loop feed back control systems for on-line process control in food process automation.

The material in each chapter is presented at several levels of depth so that the book can serve as an instructional text for students at one level, a source book on theory and scientific principles for researchers at another level, and a handy reference book for practicing professionals in the field on a third level. The presentation of material in each chapter has been crafted with the undergraduate college student in mind first. Basic scientific principles and theory are explained in simple clear language, drawing on examples of every day life experiences to help students understand the concepts. The derivation of mathematical expressions is carried out in a step-by-step sequence of logic so that students can fully appreciate the subsequent use of these expressions in making the necessary calculations, and most chapters include examples for the students to gain exercise in the calculations. Each chapter also contains further discussion of scientific principles and theory with suggestions and examples of possible new applications with the research graduate student and scientist in mind. Also included in each chapter are cited references to which the reader may go for more detailed information on specific applications of the related physical properties.

The authors have combined their experience of more than thirty years teaching food properties to undergraduate food science and engineering students to make this book possible. The book, itself, is primarily an English translation of the recent German text *Lebensmittelphysik* by Figura, published by Springer in 2004. At the time that first book was published, Figura and Teixeira had already teamed up to begin collaboration on an English language version of the book through a series of exchange visits. This new book, *Food Physics: Physical Properties – Measurement and Applications* is the result of that collaboration.

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Ludger Figura
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